IN SEARCH OF THE MASTER BUILDER:
GOVERNMENT USE OF DESIGN/BUILD CONTRACTS

by

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ABSTRACT

This research examines the use of design/build contracts by government agencies seeking to improve the process of public building development. Under these single responsibility contracts, traditionally separate contracts for design and construction services are consolidated. The study considers design/build in the context of current practice and of previous process innovations by public agencies.

In the process of consolidating contracts, design/build appears to treat building activities as interactive, emphasizing the integration of construction knowledge into design. The prototypical model is found in the integrated design/build firm. This model differs from the system of separate contracts for design and construction services, in which specialized activities necessary to complete a project are compartmentalized and organized in a linear sequence. The institutional structure of the industry and its associated work rules and procedures reflect the linear process and thus pose potential barriers to the use of an integrated process by traditional firms.

A case study is used to explore in detail the kind of interactions that occurred in the implementation of a design/build contract by the state of Massachusetts for the development of a new jail in Boston. Full implementation of an integrated process was hampered by organizational barriers and the persistence of old practices. The design/build, rather than being an integrated firm, was a project based association of multiple organizations, and organizational boundaries reinforced habitual practices and inhibited inter-organizational communication. The design process was difficult to penetrate. The diverse decision making administrative agencies and branches of government pursued conflicting goals. The state's imposition of bureaucratic controls at the beginning of the process compromised the control of factors such as cost. Most importantly, a strict separation between the public and private sectors prevented the communication of critical information between the partners in the building process: the public owner, the private designer, and the private contractor.

Integration of construction knowledge into design occurred at several points in the development, between the architect and the general contractor at the beginning of their partnership, between the owner, the architect and the general contractor after the contract award, and between the consulting engineers and the relevant subcontractors in the design of final building systems. These suggest the conditions under which design/build might be successfully implemented. The integration of construction knowledge into design was accomplished through a process of negotiation between the partners. The negotiating process also had positive effects on the control of quality, cost, and schedule during the later stages of implementation.

This indicates that the successful implementation of design/build contracts for public construction must be accompanied by a recognition that government is a partner in the process of building. Public accountability must be redefined to permit this partnership and the associated process of negotiation within the partnership. In addition, we must seek new processes of design that are open to the input of construction knowledge. We should also look
to different forms of project organization that might improve the integration of firm activities on projects, through more permanent or repetitive partnerships.

The barriers to project based communication in implementation of the new contract form also prevented learning about the process. This, coupled with the way the industry creates new projects organizations for each project, left participants with a limited understanding of the outcome of the experiment, what led to failure, and what led to success. This finding explains in part the long term pattern of process experimentation by public owners, a pattern characterized by repetitive innovation, limited evaluation, and the periodic abandonment of potentially good ideas. This thesis recommends that we devise processes of research and evaluation that become integral components of the process of innovation, to promote learning while experiments are in process.

Thesis Advisor: Dr. Bernard J. Frieden
Title: Professor, Urban Studies and Planning
To my father, William Franklin Baxter, Jr. '34
## CONTENTS

Abstract .................................................................................................................. 2

Contents ................................................................................................................... 5

Illustrations and Tables ......................................................................................... 7

Preface ..................................................................................................................... 8

I Introduction .......................................................................................................... 10

Government Agencies and the Performance Problem ........................................... 10

The Performance Problem in Construction ......................................................... 11

The Design/Build Solution ..................................................................................... 12

The Research ......................................................................................................... 13

Organization of the Thesis ..................................................................................... 16

II: The Building System and the Public Owner ..................................................... 17

A. Overview of the Industry: Product Sectors and Building Systems ................. 17

B. The Rise and Fall of Traditional Practices in Building .................................... 24

C. Two Alternatives for Project Organization ....................................................... 33

D. The Theory of Design/Build and a Model of Practice ..................................... 41

E. This Research .................................................................................................... 51

III. Public Design/Build: Patterns of Experimentation and Practice ................. 54

A. The Pattern of Experimentation ........................................................................ 54

B. Patterns of Current Practice .............................................................................. 62

C. What Do These Patterns Suggest? .................................................................... 71

IV. An Alternative Method of Procurement ......................................................... 74

A. Background: The Massachusetts Contracting System ..................................... 74

B. DCPO Design/Build: The Limitations of Traditional Methods ....................... 81

C. Two Ideas Shape DCPO's Design/Build Method ............................................ 90

D. Design/Build and the Nashua Street Jail ....................................................... 101

E. The Legislature, the Inspector General and the Judge .................................... 105

F. Summary .......................................................................................................... 109
V. Buying A Jail: The Procurement Aspects of Design/Build
   A. How the Study Dictated Outcomes
   B. The Pitfalls of Procurement by Design Competition
   C. DCPO Decides to Use Design/Build for More Projects
   D. Summary

VI. Implementation: The Industry's Perspective
   A. The Architects Carry the Design Competition
   B. Negotiating the Contract
   C. Roles for the Builders
   D. The Participants and Subsequent Projects
   E. Summary

VII. Negotiating Change: Ideas in Conflict
   A. Changing Procurement Rules
   B. Restructuring the Organization
   C. Reforming the Process of Design
   D. Measuring Project Performance
   E. Issues Raised by Case

VIII. Implications of the Research
   The Process of Experimentation and Change
   What Does the Evidence Show? What Worked?
   How Can We Resolve the Embedded Conflicts?
   What are the Implications for Public Owners?
   The Agenda For Future Research

Appendices
   A. Acronyms
   B. Experimental Public Building Projects
   C. Summary of Survey
   D. Characteristics of Corrections Projects

References
   Bibliography
   Survey of Public Projects
   Case Documents and Interviews
ILLUSTRATIONS and TABLES

Figures
1. Construction Market Sectors ................................................................. 19
2. The Business System for Commercial and Institutional Building .................. 23
3. Traditional Project Organization .............................................................. 27
4. Linear Design Process .............................................................................. 30
5. Two Versions of Construction Management ............................................. 36
6. The Austin Company District Office ......................................................... 44
7. Linear Process Versus the Integrated Firm ................................................. 47
8. The Public Projects .................................................................................. 61
10. DCPO Organization in the State Administration ......................................... 80
11. The DCPO Building Process ................................................................... 86
13. Simultaneous Design/Build Competitions .............................................. 125
14. Organization of Hyman-Stubbins, Inc. ...................................................... 150

TABLES
1. DCPO Design/Build Contracts: 1986-1989 ............................................... 14
2. Building Construction in the United States in 1986 ................................... 21
3. Use of Design/Build and Construction Management in 1988 .................. 33
4. Design/Build Fees to The Stubbins Associates ....................................... 158
5. Characteristics of DCPO Design/Build Projects ..................................... 174
6. Spatial Changes in the Nashua Street Jail Program .................................. 198
7. Program Comparison: Bristol and Nashua Street .................................... 200
8. Design Cost Comparison: Nashua Street and Bristol ............................... 201
9. Jail Schedule and CAPICS Milestones .................................................... 202
D-1 Summary Characteristics of Correctional Facilities .................................. 241
This thesis is part of a life-long study of how we as a community create the buildings in which we live and govern. Many people helped me to discover and investigate the multiple aspects of this process. Thus the thesis reflects stories from many sources. I would like to acknowledge some of those here.

My interest in design flowered at Vassar, where I majored in the history of architecture. I also spent hours in Jeh Johnson's studio, learning how to use drawing to describe the form of buildings. I took that interest to the University of Pennsylvania, but I soon became more interested in the problems of cities.

I became a city planner in Worcester, MA, where I worked for the local redevelopment authority, the city planning department, and finally a non-profit neighborhood development corporation. At the Worcester Cooperation Council, Inc., my mentor Michael Tierney challenged me to design new strategies to rebuild the neighborhood in which we worked, he then turned and asked that I implement the strategies I had created. This forced me to confront the knotty problems of implementation.

At MIT, while I concentrated on urban and regional economics in my course work, I also participated in field studies of several commercial development projects. These were part of a larger study by Bernard Frieden and Lynne Sagalyn of the rebuilding of downtowns in the United States. Lynne and Bernie gave me an important close look at the development process for large scale projects. I also learned how one goes about doing case research.

In 1985, I returned to the world of practice, hired by Deborah Poodry to manage studies of government buildings to be developed by the Massachusetts Division of Capital Planning and Operations. Deborah gave me the opportunity to participate in a variety of projects, and what began as a part time job studying recreational facilities became a full time job planning corrections projects and developing new ways for the state to buy design and construction services. At DCPO, I worked with Tunney Lee, who later as a member of my thesis committee reviewed the details of the DCPO case, and Jack Carlson, who championed the design/build process at DCPO. Henry Irwig helped me keep my connection with academia during this period. Several of his students in Civil Engineering at MIT did internships at DCPO, using the work as part of their thesis research. The master's thesis by Stephen Minden describes in detail DCPO's early thinking about design/build.

The ongoing "Louise Dunlop writing group" was both a support system and an intellectual resource. Sarah Kuhn, Andrew Laing, Henk Wagenaar, Kalyn Culler, Caroline
Clarke Guarnizo, Françoise Carré, and Wim Overmeer gave me critical feedback on the ideas that became this document. Françoise and I shared an office, and she provided moral support in addition to her intellectual comments. Leticia Rivera-Torres read early drafts of the case. Most important, Wim Overmeer acted as a sounding board for my most confused as well as my most clear thinking. As I insisted that the thesis was only about design/build, he prodded me to think about the problems of learning, encouraging me to recognize the significance to my story of the process of experimentation in practice. I wove this theme into the final thesis.

Several people were generous enough to read and to give detailed comments on drafts of the document. Reviewers who participated in the DCPO projects included Henry Irwig, John Messervy, Easley Hamner, and Wilson Shook. Ranko Bon at MIT provided new insights about the theory. Gary Hack, a member of my thesis committee, had particularly thoughtful comments about both the substance of the research and the context of practice, pushing me to think about the consequences of new building processes for architects and planners. I want to give special thanks to Bernie Frieden, chairman of my committee, who kept encouraging me to tell one story in the thesis, but who tolerated my persistent efforts to tell several stories at once. He made sure that the research framework was reasonable and solid.

Finally, my family and friends kept me connected to reality during the most isolating parts of the writing process. Mary Britt Tetro, Ann C. Nelson, and Jane Moulton simplified my life when I needed space to write, listening to me, feeding me, and entertaining my son Andrew. My mother, my sister, and my son gave equal support, encouragement and love. Thank-you all.
I. Introduction

Government Agencies and the Performance Problem

Government agencies confront recurrent problems in the development of new public buildings. The contracting process is complicated and lengthy, construction is expensive, and project schedules are unduly long. Sponsors of private building, facing similar problems, have modified the way they organize projects; many use construction management and design/build to solve problems associated with traditional project organization. When public agencies try such alternatives, however, they discover obstacles. First, regulations governing the purchase of design and construction services generally rule out the alternatives to traditional organization. When they are able to solve the regulatory problem, agencies often find the alternatives do not meet the claims of their advocates.

For example, in the 1970s, the General Services Administration (GSA) decided to speed the construction of federal building by establishing a system of phased construction and construction management, anticipating dramatic savings in time. Once approved, the new method failed to deliver the hoped for results. The learning curve for both the GSA staff and the private contractors proved to be long, costs for the projects far exceeded budget estimates, and in one project, a subcontractor sued the GSA and won. In the early 1980s, the GSA went back to the traditional linear process with competitive lump sum bids.

Now, government agencies are experimenting with design/build contracts, anticipating solutions both to the lengthy contracting process, in that design/build changing traditional regulations governing the purchase of design and construction services, and to long delivery schedules and high costs.

Design/build replaces multiple contracts for design and construction services and individual subcontracts for certain trades with one "single responsibility" contract. Instead of advertising, selecting and then managing several contracts, the public owner has one contract and one entity to hold responsible for a project. By radically changing the contracting process, design/build gives agencies the opportunity to create a new way to buy services. By centering responsibility in a single entity, design/build re-connects the functions of design and construction, the separation of which under the linear process is often blamed for problems with construction performance.
The Performance Problem in Construction

The performance problem is of concern not only to government agencies but to other owners similarly dissatisfied with the cost of buildings, the length of time to complete projects, the quality of the finished product, and the increasing frequency of litigation. These owners blame the industry. Architects are accused of being out of touch with economic realities; builders are accused of excessive conservatism in promoting technological change; labor is blamed for lagging productivity. These weaknesses in the industry have been exacerbated over time by increased project complexity, interest rate volatility and inflation.

Besides attributing specific problems to specific causes, many building owners, architects and builders link the problems collectively to "traditional methods" of design and construction and the particular structure of the American design and construction industry. Economists and other analysts point out how fragmentation in the industry has promoted competition among project participants over shares of construction dollars, leaving inadequate resources for investment in research and development of materials and production methods and making the industry resistant to technological change. The system of incentives in traditional project organization encourages each participant to maximize his or her own share of resources and fails to reward total project performance.

The focus of criticism is on the separation of design from construction, most evident in the development of commercial and institutional buildings. In this sector of the market, which represents about 30 percent of total annual construction expenditures, architects working in professional firms practice "traditional design", isolated from the general contractors and subcontractors who build the projects. The one way flow of information from the architect to the contractor is said to disconnect design from economic realities, create inefficiencies in management, and inhibit technological progress. Because architectural designers do not have direct experience with costs, products, or procedures, despite their purchase of such information from special consultants, the design process often does not account for critical field based information until it is too late to be of use. The consequences are long project schedules and high project costs.

As solutions, both construction management and design/ build re-connect design and construction. Construction management makes the connection from the outside, linking the architect and general contractor through a third party. Each participant, the owner, the architect and the general contractor surrender some of their usual management responsibilities to the construction manager, who takes charge of the production process. Many private owners have
turned to this alternative, but some public agencies have shied away from construction management, some say because of the GSA experience.

The Design/Build Solution

The other solution is design/build. This strategy connects design and construction from the inside, putting the architect and the contractor in one organizational entity. By uniting the designer and the builder, design/build provides owners with a powerful metaphor—that of the master builder who combines the craft of building with the art of design. The image is of the master mason, the enlightened builder, or the architect trained in construction who, once upon a time, integrated design and construction at the building site. The master builder is the common ancestor of both designers and builders, thus the analogy connects current practice with its history. The question is posed: Can't we do that again? Can't we just force the designer and the builder to put their heads back together?

At the same time, design/build promises modern production efficiencies. When proponents of design/build talk about the benefits of integrating design and construction, the emphasis is on the application of a modern production practices to building. A second question is posed: Why can't we apply modern manufacturing processes to the building and achieve the same economies of production?

It is also a "radical" solution, in that it challenges historic practices of architecture and general contracting, practices that are institutionalized in the building system, especially in the sector that produces government building. For example, until 1978 members of the American Institute of Architects were prohibited from participating in design/build projects. Design/build also violates traditional laws that govern public contracting, and government agencies seeking to use design/build contracts have had to secure legislative approval for the process.

In turn, design/build promises significant improvements in building performance. According to claims, by internalizing the production process in one entity, design/build improves project based time and cost performance; it reduces adversarial behavior among participants; it unifies and simplifies project management; it makes possible the use of innovative products and procedures and thus can stimulate greater technological progress in building.

Although the promises are attractive—faster delivery, improved economy—there are counter claims. Critics argue that quality suffers as time and cost improve, thus there are no real "efficiencies", just trade-offs for inferior building. The process is said to be hard to control, and thus owners may not end up with the precise building they want. Relative to use
of design/build by public owners, critics point to the associated use of subjective purchasing, suggesting that such arrangements reduce competition and invite litigation.

In this context of controversy and legal constraints, state and federal agencies are increasing the use of design/build contracts, and some predict that this process may emerge as a primary alternative to traditional methods for public projects. An interesting feature of the public use of design/build is that evidence from practice does not support either the advocates or the critics. There has been little detailed analysis of performance, and what evidence is available shows uneven results. All most practitioners will say is that there are advantages and disadvantages to the method, and public agencies still have to work out the procedures. It's a good idea: they just have to figure out how to make it work.

This research finds that there are many barriers to the implementation of design/build by public agencies. Most of the barriers arise from underlying conflicts about how to organize building production. The linear process may be an "historic concept", but it remains rooted in the practices of owners, architectural and contracting firms that produce public building and in the system of implicit rules that govern relationships among these entities. Design/build breaks the rules and challenges ways of doing things at almost every point in the system, and it requires those who undertake projects to negotiate their way through minefields. Good negotiators, like those involved in the projects studied here, survive, but the products of the negotiating process, the "hybrid" solutions generated, undermine implementation of the new concept. In order to achieve the claims of the theory, participants must free themselves from old ideas and learn new ways of practice.

The Research

This research examines the dilemma facing practitioners of public design/build, addressing the following questions:

What can we learn from public design/build projects about whether, how, and to what extent design/build brings design and construction together?

Does design/build solve the performance problem with the traditional linear public process?

What are the impediments to implementation, and what are the new problems?

What are the prospects for future public design/build project?

What can other owners learn?
There were two components to the research. First, I studied in detail the use of design/build contracts by the state of Massachusetts building agency, the Division of Capital Planning and Operations (DCPO) which built five correctional facilities between 1986 and 1990 using the method. Within that study I focused on the development of a new jail in Boston, known as the Nashua Street jail.

The Massachusetts legislature authorized the use of the design/build method for five design/build projects. The first three projects, prison expansions ranging from $2 to $11 million, were approved in a $273 million Prison Construction Bill passed in 1985. DCPO packaged the three in a single $20 million contract. In 1986, the legislature approved the use of design/build procedures for a fourth project, the Nashua Street Jail, initially estimated to cost $43 million. Design/build authorization for the fifth project, the Suffolk County House of Correction, estimated to cost $85 million, came in 1988. The following table identifies these projects.

Table 1
DCPO Design/Build Contracts 1986-1989

<table>
<thead>
<tr>
<th>DESIGN/BUILD CONTRACT 1</th>
<th>TEAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCI Concord</td>
<td>Gilbane Building Company</td>
</tr>
<tr>
<td>South Middlesex Pre-release Center</td>
<td>Hennigson, Durham &amp; Richardson</td>
</tr>
<tr>
<td>Bay State Correctional Center</td>
<td>Stull and Lee, Inc.</td>
</tr>
<tr>
<td>DESIGN/BUILD CONTRACT 2</td>
<td>TEAM</td>
</tr>
<tr>
<td>Suffolk County Jail on Nashua Street</td>
<td>George Hyman Construction Co.</td>
</tr>
<tr>
<td></td>
<td>The Stubbins Associates</td>
</tr>
<tr>
<td></td>
<td>Voinovich Monacelli Architects</td>
</tr>
<tr>
<td>DESIGN/BUILD CONTRACT 3</td>
<td>TEAM</td>
</tr>
<tr>
<td>Suffolk County House of Correction</td>
<td>George Hyman Construction Co.</td>
</tr>
<tr>
<td></td>
<td>The Stubbins Associates</td>
</tr>
</tbody>
</table>

The second component involved a study of the experience with design/build of other government agencies around the country, done through a survey of 23 agencies that had used the method as of 1989.

The methodology used in gathering data for the case grew out of my own practice, and it differs somewhat from the participant-observer model used in similar case research. I began the research in 1985 as a participant, as one of a group of people brought from MIT to DCPO
by Tunney Lee during his tenure as head of the agency. From then until 1988, I participated in the DCPO design/build projects in several capacities: in developing procurement procedures for the first projects, in managing the start-up of the special staff unit that would oversee the projects, and later in negotiations with the Office of the Inspector General over expanding use of the method to new projects.¹ My role as participant allowed me an insider view of the agency and facilitated access to project data.

In 1988, I left DCPO to devote full time to the research. During this period I reframed my role as "observer", conducting interviews of project participants and preparing preliminary findings. My independence from DCPO turned out to be critical for my continued research. It was important for me to gain perspective, since my role with the agency had been one of advocate. This independence was also a necessary condition for the agency to permit evaluation of the experiment without opening that process to political threat while the research was ongoing. DCPO was highly protective of its new innovation in its "formative years", and I have since discovered this is a common pattern for public agencies. Once I was outside of the public system, my work ceased to be open to political threat, and participants in turn could be and were open in their conversation. I was given access to documents, files, and staff. By its support of my research, DCPO provided me with credentials for interviewing private firms, whose principals were generous with their time and open with information.

At the end of the research, when I had prepared a draft of the story, I asked participants for their comments. By that time, after many hours of conversation, these participants felt part of the research project, and they provided me with detailed feedback. This was extremely useful to me in crafting the final version.

One finding from this research relative to general experimentation by public agencies with the building process was that barriers to learning were as important to the implementation problem as barriers to implementation themselves, yet the participants in this case were anxious to learn about their own practices and connections to the practices of others in the new project context. They treated this research as a vehicle to do that.

¹ I should note that at no time did I have direct responsibility for direct project management. My role at the agency remained a "staff" function.
Organization of the Thesis

Chapter two sets design/build in the context of the design and construction industry and the prevailing practices of owners, architects, contractors and others. I argue that for commercial and institutional building, while the industry is flexible with respect to demand for quantities and types of projects, it is highly structured with respect to the design and construction process. It is this process that design/build challenges.

Chapter three frames current use of design/build in the context of a long-standing pattern of experimentation by public agencies with the building process. Current patterns of practice as revealed in survey are presented.

Chapters four, five and six comprise the case. The first of the three chapters presents DCPO's initial decision to use design/build as motivated by the agency's frustration with the effects of procurement regulations. It also presents the background for the choice of the Nashua Street jail to showcase the method. Chapter five describes implementation from the state's perspective. Chapter six describes implementation from the perspective of the industry participants, those that made up the design/build team of Hyman-Stubbins Inc. and its competitors.

Chapter seven analyzes the case by looking at three components of the public building process: the purchase of services, the organization of design and construction, and the design process. For each component, I compare the new process to traditional practices under the linear process, identifying the conflicts that arose in practice and how they were resolved. I then show how the newly negotiated practices dictated project outcomes.

In the final chapter I discuss the implications of the findings in the case, relative to experimentation by public owners in the building process and relative to the future of public design/build. I conclude by suggesting an agenda for future research in this area.
II: The Building System and the Public Owner

A. Overview of the Industry: Product Sectors and Building Systems

1. The Design and Construction Industry

The design and construction industry as defined in this research includes firms that undertake construction projects and firms that provide related producer services: design, engineering, management, and the like. Although the industry is substantial, averaging 10 percent of the gross national product annually, some analysts are reluctant to define construction as an industry because of its fragmented, atomistic characteristics. It is an industry made up of many firms, the vast majority of them small. Its services are provided to other sectors of the economy: business, industry, government, and institutions. Residential and non-residential construction together account for 65 percent of investment activity in the United States.¹

Analysts seeking to explain the fragmented characteristics of the industry have concluded that the particular structure, or lack of structure, is a function of the dependence of the industry on the demands of other sectors, strongly influenced by changes in the economy, and on the fact that construction products are immovable and largely custom crafted for individual owners. In 1952 Colean and Newcomb characterized as the industry pattern,

looseness of organization and dispersion of management control among the numerous independent and quasi-independent elements that participate in the construction process. (xvi).

In 1976 Moavenzadeh and Rossow described similar characteristics.

The industry's fragmentation gives firms flexibility and makes regrouping of participants reasonably feasible, which, in turn, helps lessen the necessity for contraction and expansion of individual firms as they adjust to the frequent changes in the type and level of construction demand (278).

In 1979 Lange and Mills concluded that construction was less an industry than a sector of the economy, like manufacturing:

It is not a single activity but a group of activities loosely related to one another by the nature of their products, technologies and institutional settings. (Lange and Mills 1979, 1)

¹ National Income and Product Accounts.
The picture these analysts paint is of a organizationally fluid system, growing and shrinking in response to volatile demand fluctuations, and forming and reforming in groups to match the idiosyncratic requirements of each project. Flexible is the operative adjective.

This research focuses on another feature of building: the implicit rules that guide production. At least in that sector of the industry that builds large institutional buildings, the industry's organizational fragments fit into a highly structured system organized around a central paradigm—that building is a linear sequence of discrete specialized activities. This premise drives a set of rules about building that, while not always explicit, are mutually accepted by all participants. It is the common adherence to these rules that allows diverse groups of firms and individuals to join together in the short term project organizations which create actual building projects. The system of rules extends to owners, who join with firms in the industry in the production of buildings. When owners such as public agencies seek to change certain of these rules in ways that challenge the paradigm, for example by deciding to use single responsibility contracts to purchase services, they confront the system.

2. Product Specialization and Firm Practices

Industry sectors correspond to product categories: residential building; commercial and institutional building; industrial projects; and heavy engineering projects. Annual sector shares of the total volume of construction vary according to economic conditions. Between 1982 and 1988 shares ranged as follows: residential, 35 to 49 percent; commercial and institutional, 27 to 31 percent; industrial buildings and process facilities, 7 to 15 percent, heavy engineering, 16 to 21 percent. Of interest for this research are sectors relevant for public projects (commercial and institutional, engineering) and the sector in which design/build originated (industrial).

---

2 Based on permit values. From Construction Review, 1983 to 1989. The distinctions between sectors are not rigid. Multi-family housing is sometimes considered part of the commercial and institutional sector, as is some industrial building. For example, Building Design and Construction uses groups "Commercial, Industrial and Institutional" building in one category.
The organizing paradigms of these sectors differ. Public projects are undertaken primarily in the commercial and institutional and engineering sectors, where a linear process of design and construction prevails. Activities are differentiated by function, the design or "thinking" is separated from construction or "manual work", and the different functions are undertaken by separate firms. These firms then come together in temporary combinations for specific projects. For building projects, design is mostly the practice of architects, members of the American Institute of Architects (AIA), and specialized consultants who belong to their own professional groups.\(^3\) Gutman (1988) found that 75 percent of the work of architectural firms came from this sector. For heavy engineering, also known as heavy and highway projects, design is mostly the practice of engineers, dominated by those in the civil engineering discipline. The relevant professional association is the American Society of Civil Engineering (ASCE). In both cases, construction is done by general contractors who bid competitively for each project. Unionized contractors, who do most of the public work, are members of the Associated General Contractors of America (AGC), which has three subdivisions: heavy construction, highway, and building.

\(^3\) I identify sectors with specialized industry associations to illustrate the institutional structure of sectors of the industry. These associations in turn shape practices within the sector. The structure and practices comprise the system of building within which individual design and construction firms, related organizations such as insurers, and project sponsors operate.
In contrast, many industrial projects are equipment intensive, and project design must reflect installation and construction requirements. Here, design/build is an established building method. In the design of plants for continuous process production, for example oil refineries, power plants, and paper mills, equipment is integral to the building, and the requirements of the industrial process drive design. Large engineering and construction firms have developed specializations in the complex industrial process technology and associated building design and construction. These "design-constructors" are members of the industry association known as the National Constructors Association. For other industrial projects, the building houses the equipment, and design/builders such as the Austin Company have developed building specializations.

3. Public Building and Private Contracts

Public agencies sponsor a significant share of total construction; in 1986, federal, state and local agency direct construction accounted for 22 percent of new commercial and institutional building construction. Federal agencies, primarily in the Department of Defense and the Government Services Administration, are the largest individual sponsors of commercial and institutional building projects. Government also sponsors almost three quarters of highway and highway construction. For both types of projects, the organizing paradigm for the building process is the same—the linear model.
### Table 2
Building Construction in the United States in 1986 ($000s)

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Building</td>
<td>$188,604</td>
</tr>
<tr>
<td>Commercial/ Institutional Building</td>
<td>125,396</td>
</tr>
<tr>
<td>New Construction</td>
<td></td>
</tr>
<tr>
<td>Offices</td>
<td>$23,191</td>
</tr>
<tr>
<td>Hotel/ Motel</td>
<td>6,270</td>
</tr>
<tr>
<td>Other Commercial</td>
<td>22,102</td>
</tr>
<tr>
<td>Private Institutional</td>
<td>7,772</td>
</tr>
<tr>
<td>Federal, State Local</td>
<td>16,629</td>
</tr>
<tr>
<td>Improvements</td>
<td>49,432</td>
</tr>
<tr>
<td>Industrial building</td>
<td>15,404</td>
</tr>
<tr>
<td>Farm</td>
<td>2,072</td>
</tr>
<tr>
<td><strong>Total Building</strong></td>
<td>$331,476</td>
</tr>
</tbody>
</table>

#### Sources:

The practices of government in construction are of interest because public owners are major participants in the business system and because they set standards for other owners and for providers of services.

The types of buildings governments choose to build, where they choose to locate them, the methods they use to select architects, and the architects they finally commission, all establish norms and ideals that other clients and building sponsors often imitate. (Gutman 1988, 86)

In implementing its building projects, government buys design and construction services from private individuals and firms using private contracts. Contracting arrangements with private firms are tightly regulated. Private firms are profit motivated, and selling services to the government can be lucrative to individuals. Public officials are supposed to respond to broader "public interests", but over time scandals have routinely surfaced connected with officials awarding public contract awards for private gain. The largest public contracts often involve construction, and many scandals have involved public building. To counter this, legislatures at the state and federal levels have developed a regulatory system for public "procurement", or "acquisition" as the system is designated in federal regulations, designed to

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4 Federal regulation for purchase of services are known as Federal Acquisition Regulations (FAR).
prevent corruption and to secure appropriate services at a fair price. Regulation has three objectives:

- Honesty: To prevent collusion in the award of contracts
- Equity: To place all businesses on the same footing
- Economy: To secure goods and services at the lowest price (Lange 1979)

For example, competitive bidding laws prevent collusion by basing awards to contractors solely on price, equity is achieved by making the bidding process open to all firms, and bidding by large pools of competitors is intended to produce the lowest price. The concept of equity was expanded in the 1970s to include special consideration of firms owned by women and minorities, as an effort to make up for past inequities. Over time, government procurement regulation has evolved into a cumbersome set of procedures blamed for prolonging the schedules for building projects beyond what officials considered to be reasonable.

The problem of accountability in public contracts has been the subject of much study. The fundamental conflict appears between the desire of the owner to maximize control of the contractor and the contractor's desire for autonomy. The traditional building process addresses this by making the architect the mediator. The architect assures the accountability of the contractor to the owner by monitoring construction and supervising material testing.

4. The Business System: Owner Group Plus Product Sector

The network of designers, contractors, and owners of buildings can be considered participants in a system which is in the business of building. For commercial and institutional projects, that system includes the organizations that will own and use the finished product, the architects and engineers that specialize in these buildings, the construction firms, specialty subcontractors, equipment manufacturers and suppliers, and labor that provide services, labor and material for production.

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Firms and individuals are connected to one another by flows of goods and services, flows regulated by an underlying system of rules, practices and procedures. These are described in the next section.
B. The Rise and Fall of Traditional Practices in Commercial and Institutional Building

1. Professionalization of Design Segments the Building Process

The linear process and associated practices have strong roots in the historic development of architecture and construction in the United States. Despite current variations of practice, the idea of a linear process underlies most current commercial and institutional building. The process itself was formalized in conjunction with the professionalization of design and the separation of design from construction, and it is reflected in assumptions about the activity of design, specifically about the source and flow of knowledge, the origins of technical innovation, and design documentation. Current public construction practices related to the purchase of design and construction services, the organization and management of construction, work rules and the organization of tasks, reflect the historic pattern of functionally differentiated activities. Many participants in the process of building are knit together by a system of implicit rules about practice centered on this model of organizing work by linear segments.\(^6\)

Parallels between the organization of work and the professionalization of certain disciplines is discussed by Magali Sarfatti Larson. As Larson points out in her *The Rise of Professionalism*,

> the evolution of ... [medicine and law] and the professionalization of other occupations pertains to general dimensions of "modernization"—the advance of science and cognitive rationality and the progressive differentiation and rationalization of the division of labor in industrial societies (Larson 1977, xiii).

In the United States, the development of a differentiated and rationalized building process and the professionalization of the practice of architecture occurred at the end of the nineteenth century. In this process, the functions of design and construction were pulled firmly apart, architecture acquired licensing requirement (first in Illinois in 1887), a professional association (AIA in 1857), formalized university education (first school of architecture at MIT in 1869), and written standards of practice.

The premise was that the overall building process could be broken down into segments, that knowledge about building could be extracted from production and in turn taught in schools to aspiring practitioners and taught by practitioners to students through practice.\(^7\) These

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\(^6\) As discussed later, many private owners are more able to modify their practices and use models that vary from the model described here. I also suggest that these variations do not challenge the underlying premise of the linear process, as does design/build.

\(^7\) Practice of architecture is taught through a combination of schooling and apprenticeship.
professionals would be the thinkers about building, creating designs and written instructions for their execution by workers. The architect was at the top of a hierarchy of prestige and decision making. Contractors, suppliers and labor were responsible primarily for following the plans.

As buildings have become larger and more complex in the twentieth century, a trend which began in the late nineteenth century and contributed to the professionalization of architecture (Saint 1983), the design professions have become increasingly subdivided and specialized. In 1987 the AIA listed 25 different specialist fields in architecture, and similar specialization has occurred in related engineering disciplines. Some architectural firms, many in the mid-west and western states, have internalized these specializations, becoming diversified architectural/engineering (A/E) firms. Others, mainly in the east, have retained a specialization in architectural services and package the services of independent specialized firms on a project by project basis. The result has been an increasing distinction between the practice of architecture as design and the practice of the management of design (Irwig 1977).

Since the 19th century, the architects' responsibilities in the field have diminished. For example, general contractors now assume direct supervision of labor, which, in historic times, was the function of the architect. Field responsibilities of architects today are limited to "observations" of construction. This has created another fracture in the process, between product design and production design. Production design, or "construction means, methods, techniques, sequences of procedures," is the responsibility of general contractors and is formally excluded from the architects' area of responsibility. Architects create product designs, and the plans and specifications they produce detail the completed building.

The linear process also separates ownership from design and construction. As part of the professionalization of the practice, architects have actively opposed the use of public employees to design public projects, successfully lobbying in the late nineteenth century for the use of private design firms under standard contracts (Saint 1983). The arrangement continues today. Later, in the 1920s and 1930s, the AGC lobbied for contracts with private contractors as opposed to the use of public construction forces (Mooney 1965). Thus the system of public construction through contracts with private firms is part of the linear process and grew out of the organized efforts of the industry.

As professionals, architects defined themselves as agents of owners, representing their interests in dealings with builders and other tradesmen. Current standards require that the architects "serve their clients competently and in a professional manner, and should exercise

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8 Building Design and Construction reported in 1988 that 90 percent of the largest government builders did less than half of design work in house and 82 percent did no in house construction.
unprejudiced and unbiased judgement on their behalf" (AIA Code 1987). In this vein, codes of ethics developed in the 1900s prohibited architects from financial participation in projects, and this prohibition lasted until 1978.

In contrast to architects, contractors are defined as vendors, selling services to owners on the basis of price. Part of the premise of awarding public construction contracts by competitive bid is that price is the only factor that might distinguish one contractor from another; construction documents prepared by architectural firms are sufficiently detailed to control the quality of services provided by any contractor, although bidding rules do allow agencies to exclude obviously unqualified or unscrupulous contractors from bidding pools.

The early twentieth century saw general contractors emerge as the "top management" of building construction (Colean and Newcomb 1952). The primary function of the general contractor today is financial management (Mills 1972); subcontractors are responsible for the actual hiring of labor and the supervision of most work. In 1982, about three quarters of material and labor costs of general contracting firms was passed through to subcontractors.\(^9\)

Subcontractors, often referred to as "specialty subcontractors" are specialized by building system. In some states, including Massachusetts, public bidding laws known as "filed sub-bid laws" require separate bidding by subcontractors, and these subcontractors hold contracts directly with the public agency. Absent such laws, many general contractors regularly include particular specialty subcontractors as part of the builder's team. Eccles (1981) argues that longstanding relationships between general and subcontractors create a firm-like relationship, and these "quasi-firms" behave like single organizations.

Labor is specialized by craft and industry, and the workforce is most highly unionized in the building sector. Procedures for work, trade agreements, practices, customs and wages are determined within specialty contractor associations, labor unions, and through agreements between the local unions and the local trade subcontractor associations. Union agreements generally govern non-union practices (Mills 1972).

\(^9\) In 1982, according to the Census of Construction, $39.3 billion of $51.8 billion in material and labor costs paid by general contractors producing commercial, institutional and industrial buildings went to subcontractors.
2. The Rules of Practice

A single reasonably large building project will involve tens of organizations and hundreds of individuals with different knowledge bases, practices, communications systems and institutional alliances. To cope with production requirements of buildings, each one of which is different, and the diversity of participants, which changes for each project, the industry and owners have developed a system of rules that treat the building process as the same. Within professions, rules of practice akin to bureaucratic procedures are promulgated by professional communities and their institutions (Larson 1977). In the transfer of instructions from architects to builders to subcontractors to labor, design documents function as work instructions about the product; the use of standardized formats, standard notations, and standard specifications allows the different cultures of architecture and contracting to communicate precisely with each other. Within the construction trades, the craft trade unions provide the functional equivalent of bureaucratic rules for planning and carrying out work
(Stinchcombe 1959-60). As long as each participant follows the rules for its component, a building will get built.

In theory, work flows in a linear sequence from step to step. A different work unit is responsible for each, beginning with the owner. Standard steps include: the development of a "building program"; the preparation of three groups of design documents: "schematic design", "design development", "construction documents"; competitive bidding, and construction. During construction, a final group of design documents is prepared, known as "shop drawings". 10

The building program describes the owner's specific needs for space. The owner may hire an architectural firm or a specialized programming firm to assist in this task, or the owner may prepare the program in-house. The program is the most general description of the space, and it does not include building drawings. Programs do include "bubble diagrams", showing the relationship of spaces to each other.

Unless the owner has asked the an architectural firm to begin the design process with the program, the owner then hires such a firm to prepare a design. The architectural firm assembles a team of specialists, either within the firm or using other firms, to match the requirements of the particular project. The design process follows a standard sequence beginning with a "concept" and proceeding to increasing levels of detail and specification. In the "schematic design", interior building areas are delineated by scaled line drawings showing the building plan and general structure, and elevations describe the exterior treatment and massing of the building. During design development, the bones of the design acquire flesh; drawings show wall thicknesses and the characteristics of building systems, and specifications begin to identify the quality levels of products.

Construction documents are the most complete description of the building. There are separate sets of drawings for architectural, structural, plumbing, heating ventilating and air conditioning (HVAC), and electrical work, each following an accepted format and using standard notation. Final drawings are sufficiently accurate to allow bidders to calculate costs by measuring amounts or "quantity take-offs" for each product or material required. Specifications cover 16 product areas and are standardized based on the Construction Industry Institute format. Because public owners cannot restrict bidding to a particular group of firms, as private owners may, design documentation for public projects may be much more detailed than for private projects.

10 This description does not reflect fast-track construction, which affects the sequencing of design and construction and bidding, nor does it reflect negotiated bids used by some owners.
Cost estimating involves the progressive application of field and project specific values to increasingly well defined building components. In preliminary stages of design, estimators apply aggregated data such as that published by industry sources to gross building measures. In bidding, contractors may use proprietary data banks based on project completed by their firms or on bids prepared by subcontractors based on estimates of specific quantities of labor and materials.

When the owner bids subcontracts separately, the architect must prepare separate bid documents for each trade. Otherwise, the general contractor takes the construction documents and "pulls them apart", separating them into packages for subcontractors. After the award, the general contractor schedules and supervises the work, provides site services such as utilities and electricity, known as "general conditions" for subcontractors, and provides financial management such as billing the owner for work done and making payments to its own labor force and suppliers and to subcontractors.

The final design documents are known as "shop drawings". These provide detailed fabrication instructions for products and equipment and are prepared by material manufacturers and equipment suppliers. The architect reviews these drawings to ensure that the fabrication details and product samples conform to the construction drawings.

Standardized drawings and contract documents function as primary methods of communication among the parties, bridging the gaps between different knowledge bases and cultures. The sequential documentation of design allows the architectural firm and the owner to communicate and the owner to approve the progress of the work. Owner review occurs at intervals between steps in the design sequence, first between the program and schematic design, again after schematic design. Regulatory groups also frequently undertake formal review and approval of plans at this point. Another owner approval occurs after the completion of design development. The documents also communicate the architects' intentions to the contracting firm, which relies entirely on the written drawings and specifications in the preparation of bids. Relationships between the owners and other parties are governed by contracts, and an important function of industry associations such as the AIA and the AGC is to promulgate standardized contracts.
3. The Critique of Traditional Process

The commercial and institutional sector of the industry and owners that purchase services from it have been struggling for at least two decades with what has been described as the performance problem.\textsuperscript{11} The current crisis began in the 1950s, when the industry faced sudden increases in demand for consumer oriented building - housing, schools, and factories to produce goods. Requirements for new development patterns and more complex structures reinforced the demand for new building. Interest rate and inflation volatility put further stress on the system,\textsuperscript{12} and the upward drift of interest rates put greater premiums on time. The old technologies, both hard (materials and systems) and soft (including the traditional organizational of the building process) were inadequate for this new demand. The compartmentalized structure of the industry and the persistence of old ways of doing things were blamed for poor performance on projects, low levels of investment in research and development of new technologies, and industry resistance to technological change. Criticism of traditional methods has focused on the separation of design from construction. Problems arise from traditional methods in the following way.

\textsuperscript{11} Examples: in 1969 the chief executives of 200 major American corporations began meeting as the Construction Users Anti- Inflation Roundtable, an organization that became the New York City based Business Roundtable. Over the next fifteen years the organization sponsored a series of studies on the problems of construction productivity. Many conferences of the Building Research Board of the National Research Council have focused on this issue. See National Research Council "Construction Productivity" 1986.

\textsuperscript{12} For example, Barrie and Paulson (1984) trace the "partial breakdown" of the industry to rapidly expanding demand during the 1950s and 1960s, putting stress on existing systems and generating competition among project participants: owners, contractors and labor, for a share of the economic returns.
The one way flow of information from the architect to the contractor makes the architect responsible for learning about and designing for new processes and products. Individual architects have little experience with field practices; sources of information are generally limited to past education and training and subsequent updates of that knowledge, and product catalogues and information from sales representative for manufacturers. To improve their information about products and processes, firms often retain specialized consultants. Architects have been less effective at predicting costs. Without access to field specific cost information, architects and their estimating specialists often use aggregate published data in early stages of design, a practice that leads to pricing imprecision (Park 1966).

The resulting design dictates construction methods and costs. However the architect takes no responsibility for these consequences, neither for "construction means, methods, techniques"\(^{13}\), nor cost accuracy, since,

neither the architect nor the owner has control over the cost of labor, materials, or equipment, over the Contractor's methods of determining bid prices, or over competitive bidding, market, or negotiating conditions.\(^{14}\)

Contractors have access to field specific information on component costs, labor and equipment costs, and production technology through management of a variety of building projects. However, that knowledge cannot be used to influence design. By the time a specific contractor is selected to do a project, advice the firm may have about modifying the design to improve the building process is of little use; the design is complete, and changes can only be made through a formal "change order" process. Since changes beneficial to the owner might reduce the scope of work and thus the profit to the contractor, the contractor has little incentive to make such proposals.\(^{15}\)

Bidding processes inhibit the use of new technologies and proprietary products. Because of rules governing production processes, changes in materials, technology, and other aspects may generate jurisdictional conflicts between labor groups (Mills 1972), prompting job actions which all participants want to avoid. The specification of unusual technology presents other risks to owners—that the appropriate product quantities might be unavailable or more expensive than anticipated, and to contracting firms—which may be unfamiliar with and thus unable to price the technology (Irwig 1977). To avoid such uncertainties, architects ignore production factors and design projects to "prevailing construction practices", so that any one of several general contractors can construct the project (Cassimatis 1972).

\(^{13}\) AIA standard contract number B141, Section 2.6.6.
\(^{14}\) Ibid., Section 5.2.1.
\(^{15}\) See Barrie and Paulson (1984) on the operation of profit and fee incentives for architects, contractors and subcontractors.
A third problem is the gap between the management of design and the management of construction, as traditional architectural and general contracting firms seek to limit their responsibility to only that segment of the building process for which they provide direct services. In the historic development of the profession and in current fears over liability, architects have eliminated most field management responsibilities they once assumed, and their current role in construction is only that of "interested observer" (Lange and Mills 1979, 7). Lange and Mills see financial risk as motivating both architects and contractors to reduce their management role in projects:

Large projects, with their substantial dangers of financial loss, have forced architects and engineers to reduce the managerial responsibility they will undertake, and contractors have done the same... As a practical matter, it is not too much to say that very large projects are frequently not managed at all! The ultimate responsibility returns to the owner. (Lange and Mills 1979, 9)

Gutman (1988) describes the effect, using as an example a study by anthropologist Herbert Applebaum of the construction of a 400,000 square foot state university library building. At one point the work involved 250 workers on the site; no architect ever appeared. Meanwhile, contractors do not appear until after the contract award.

Finally, traditional methods are blamed for adversarial postures taken by project participants and rising litigation.
C. Two Alternatives for Project Organization

While the line between traditional design and construction hardens, owners and practitioners have developed various ways to reconnect design and construction through project reorganization. There are two important approaches. One approach, generally known as design/build, connects the architect directly to the general contractor in a single organization. The use of design/build originated in industrial construction, and firms and practitioners have now brought the process to commercial and institutional building. The second approach, generally referred to as construction management, links the owner, the architect and the builder through a fourth project participant, the construction manager. Construction management (CM) originated in the commercial and institutional market, first in architectural firms responding to the new performance demands of owners and to competition from design/builders. These approaches appear in various organizational models, used by practitioners as they market their particular alternative solution to potential project sponsors and used by owners who have developed preferences for specific versions.

Table 3
Use of Design/Build and Construction Management in 1988

<table>
<thead>
<tr>
<th>Strategy</th>
<th>% D/B</th>
<th>% CM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diversified Developers</td>
<td>38</td>
<td>38</td>
</tr>
<tr>
<td>Retail Developers</td>
<td>45</td>
<td>32</td>
</tr>
<tr>
<td>Hotel/Motel</td>
<td>23</td>
<td>15</td>
</tr>
<tr>
<td>Health</td>
<td>47</td>
<td>47</td>
</tr>
<tr>
<td>Government</td>
<td>33</td>
<td>51</td>
</tr>
<tr>
<td>Industrial</td>
<td>91</td>
<td>73</td>
</tr>
</tbody>
</table>

Note: Owners reported using these strategies for some, but not all projects.

Where they used to divide the sector by product (industrial to the design/builders, institutional to the traditional firms) and by function (design to the architects, construction to the contractor), multi-function firms are now in potential competition for the same projects. Some architectural and construction firms in the commercial and institutional sector have expanded their services to include management, and some have crossed boundaries between design and construction. Architectural firms such as Ellerbe Becket have acquired construction subsidiaries, and contracting firms such as Turner Construction offer design services as well. According to industry journal ENR, the percentage of large general
contracting firms providing design services rose from 18 percent in 1967 to 26 percent in 1987.\textsuperscript{16} Other firms have developed "pure" construction management as a specialized service. In competition with these firms, package builders, design/builders, and design constructors, which previously specialized in industrial projects, have become more active in the commercial and institutional sector.

The emergence of construction management and design/build for general building is also associated with two events external to the industry: the development of computer technology, and the price volatility of building resources in the 1960s and 1970s. The computer allowed managers of design and construction to plan and control schedules, costs, cash flow, product ordering, and work packaging, at a more detailed level than previously possible. This kind of control acquired added significance during times of price volatility and inflation, by facilitating schedule acceleration and "fast-track" production\textsuperscript{17}, shortening the time projects were exposed to inflation. Fast track construction is generally associated with both construction management and design/build.

1. Firms Selling Construction Management Services

Each of the two general models of construction management can be traced to origins in either architectural firms or construction firms. Firms providing CM services are now represented by the Construction Managers Association of America, which offers model contracts and standards of practice. Model CM contracts are also published by the AIA and the AGC.

In the "CM as agent" version, originated in architectural firms, the construction manager acts on behalf of the owner in managing the entire building process, including the design and construction. The owner holds all contracts directly, and the construction manager assumes no financial risk. This version is also known a "fee only" CM, and it is also used by "pure" construction management firms that specialize in management services separate from either those of the architect or the general contractor. Engineer Constructors are also active in the construction management market. Of the eight largest "Fee CM" firms in 1989, seven were engineer constructors.\textsuperscript{18}

A pioneer in the development of this version, George Heery, founder of an Atlanta architectural firm, was prompted by competition from design/builders for the business of

\textsuperscript{16} ENR, April 11, 1968 and April 14, 1988.
\textsuperscript{17} In fast track production, construction documents are prepared in packages corresponding to the sequence of construction, and these packages are bid as they are completed, prior to the completion of the entire design. This allows construction work to overlap with the completion of design.
\textsuperscript{18} ENR June 15, 1989.
corporate industrial owners in the south in the 1950s. In marketing his new services, Heery described owners' frustrations with high costs, long design and construction times, functional shortcomings of projects, inflation, labor problems, and growing bureaucracy and argued that in this context, the "fashionable designer whose technology seems to have advanced only about as far as the Middle Ages" was irrelevant (Heery 1975). Heery proposed that architects change and start managing construction. He built his firm into one of the largest in the commercial and institutional market on this strategy. Heery's current clients are primarily public agencies and institutions. Other architectural firms have followed suit. CRS (now CRSS)\(^{20}\), the pioneer in the areas of programming and building systems, was also a pioneer in construction management; in 1989 CRSS was the third largest provider of Fee CM services. In 1989, ENR reported that construction management billings totalled 14 percent of all billings by the top 500 design firms in 1988.\(^{21}\)

Some general contractors have also begun marketing their services on a construction management basis. During design, such firms provide advice to a traditional architect and owner about costs and constructibility, based on the contractor's field knowledge. During construction, these firms assume direct responsibility for subcontracts, known as "At Risk CM", although some pass the construction costs through to the owner. As a way to share the price risk, firms sometimes guarantee a maximum price (GMP), and the owner and the contractor may share savings should the total cost fall below the maximum. In 1989, ENR reported that At Risk CM accounted for 34 percent of domestic contracts of the top 400 contractors.\(^{22}\)

\(^{19}\) In 1989 BD&C (or ENR?) listed Heery International as the 26th largest in CM services.
\(^{20}\) Formerly Caudill, Rowlett Scott. See Chapter III.
\(^{21}\) ENR June 15, 1989. While ENR has reported on CM in its regular reports on the top 500 designers and the top 400 contractors, 1989 was the first year the journal devoted a separate report to firm providing CM services for a fee.
2. Firms Selling Design/Build Services

Competing with the construction managers and traditional firms are the design/builders, and here as in construction management, we find architects and general contractors as well as specialized firms providing design/build services. Unlike construction management, there are many versions of design/build, although there are two general categories. Integrated design/build firms have moved into commercial and institutional building to expand the market for their services, previously provided to industry. Within the building sector, teams of traditional firms, assembled for specific projects, also undertake design/build projects.

Design/build firms integrate functions within a single permanent organization, such as the industrial design-constructors. Firms, like Bechtel, which originally provided services in the heavy industrial sector, have turned to general building as demand for certain industrial work declined. From 1967 to 1987 the number of large design-constructors providing services in the building sector rose from 36 to 85 percent. Other firms such as the Austin Company, have provided general building services since its early days, first with light industrial and warehouse facilities and later to more complex commercial and institutional building. In general, these firms market their services to private rather than to public clients.

In contrast to integrated firms, project-based design/build teams bring together traditional firms for the duration of a project. There are several versions, depending on which

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of the participants holds the prime contract with the owner: the designer, the contractor, or, when present, a real estate developer.

In the joint venture version, traditional architectural and general contracting firms establish a partnership. Such an arrangement allows firms to participate in design/build without changing their basic area of expertise. Kirschenman notes that in this version traditional firms can participate in a single responsibility system for a project "without having to expand into providing a function in an area in which they presently have no expertise" (1986, 228). Twomey cautions that the arrangement provides single point legal responsibility, but not necessarily single point management responsibility, in that the organization may be a shell that passes through functions to traditional firms. We can consider this the "architect's version" as it is the model for the AIA's design/build documents published in 1985. (See Twomey 1988).

Another version makes the traditional general contracting firm the prime contractor, and the firm provides design services by adding designers to its core operation or by subcontracting with traditional architectural firms. For the architect, the "GC version" means a shift in the designer's client from building owner to general contracting firm. Under such subcontracts, the architectural firm finds the traditional scope of services narrowed. For example, construction administration and cost estimating services become the responsibility of the contractor. Design/build contracts published by the AGC's follow this model (See Twomey 1989).

Real estate developers also package design and construction services for owners, generally providing financing as well. Developers frequently contract with private architectural and general contracting firms for services on a project by project basis, providing an organizational umbrella for these firms. In other cases, a builder (for example the Beacon Companies of Boston), and less often a designer (for example, designer developers Portman of Atlanta or Gund of Boston) may be part of the developer's permanent organization. Developers generally provide short term financing and may also provide land acquisition and long term financing, selling or leasing the building to the sponsor upon completion.
3. The Sponsor, Project Organization, and the Industry

Given the several versions of project organization, it falls to the building sponsor...or to decide which model organization is most appropriate for a particular building. Owners do this through their procurement procedures, advertising to purchase services from traditional architects, construction managers, or design/builders. With so many options for the organization of projects, owners, part of the business system but outside of the industry, are now in the dual position of initiating projects and determining the organization of production through procurement procedures. As a highly demand responsive industry, firms in the design/and construction industry are presumed to be ready to respond. The problem is that because they are outside of the industry, owners are least knowledgeable of the parties about the production aspects of building.
To help owners choose wisely among the various ways to organize projects, some major providers and purchasers of design and construction services have developed theories about the attributes and use of each alternative. Decision matrices have been developed by architect practitioners such as Philip Bobrow of Montreal (1974), George Heery of Heery and Heery in Atlanta GA (1977), Charles Thomsen of 3DI in Houston TX (1982), David S. Haviland (for the AIA Handbook 1987), Thomas R. Napier at the Construction Engineering Research Laboratory for the Army Corps of Engineers (1988) and Timothy Twomey of The Architects Collaborative in Cambridge MA (1989).

These matrices identify factors which connect the "procurement decision" to the project organization based on a series of factors. Project characteristics include the size, complexity, and repetitive nature of the project, and proprietary or unique features (including "secret elements of military projects). Characteristics of owners involve the owner's "priorities" with respect to cost, schedule and quality and the amount of risk the owner can tolerate relative to each, attitudes, sophistication with respect to building, and ability to negotiate. Conditions in the external environment include volatility of the economy, politics, the availability of architects and contractors, and labor conditions. A common feature of these decision matrices is their emphasis on the owner's priorities. The implication is that many options are possible, it depends on what the owner wants to do.

Owners first choose families of contracts, i.e. traditional, construction management, and design/ build, and within these families, provisions for assigning cost risk, i.e lump sum price, guaranteed maximum, cost plus a fee, with or without shared savings. Practitioners have made flexibility the operative word. As Charles Thomsen put it:

The construction industry is changing: projects are larger, building systems are more specialized, and computers and communication techniques have changed management techniques fundamentally. The project delivery process--getting a project designed and built for the owner--is changing too.... With imagination, creativity, and good teamwork, project teams can adapt both their relationships and their contracts to each project's needs. Architects, engineers and construction managers have learned that they can be as creative about the process as about the product. (Thomsen 1982, 41. his italics)

To have a successful project, an owner needs to choose the right strategy. To do that, the owner matches the various factors to the attributes of the delivery strategy. Then the owner implements the appropriate procurement strategy, and the industry reacts with "imagination, creativity and good teamwork".

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24 In his masters thesis for the Department of Civil Engineering at MIT, Stephen Minden (1986) took on the task of consolidating some of these contingency approaches into a more fully developed model.
Owner experience with both construction management and design/build has been uneven. In 1983, the Duke University Law School sponsored a symposium on construction management and design/build fast track construction. In the forward, symposium editor C. Allen Foster25 wrote:

As in the case of many modifications to traditional frameworks and processes, however, these innovative approaches have been adopted without adequate analysis of the direct and indirect consequences. While a few successful projects prove the promise of the prophets, the more general experience has ranged from disappointment and disillusionment to disaster. (Foster 1983, 1)

One explanation is that owners simply matched the wrong method to the project. Owners are in a difficult position. Since they initiate projects, they are in a pivotal position to initiate changes; as White described the process in 1974, "any innovation in the building process in the last ten years has come about at the owners instigation."26 On the other hand, since most owners primary business is not building, they are least knowledgeable about the business of building, limiting their role as change agent. For example, in his study of efforts by government to stimulate changes in seven industries, including building, Nelson (1982) concluded that government generally misunderstood the details of technology and the institutional structure of the industry participants, and thus misunderstood the process of innovation and product development. In trying to influence change in building, government misunderstood the rest of the production system, and in its project experiment (in this case, Operation Breakthrough)27 it created environments antithetical to innovation.

Another explanation is that the building industry is not that flexible, at least with respect to the building process and the associated technology. In his study of efforts by the Department of Commerce to introduce new technologies to the industry, Schon (1967) found that although it was not immediately apparent, the construction industry represented a social system whose structure and values were dependent on prevailing technology (brick). This system mobilized to oppose the threat to vested interests posed by perceived sponsorship of competing technologies by the government.

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25 Foster was a North Carolina attorney and lecturer at Duke.
26 White, a principal at Inland Steel, was specifically referring to projects initiated by public owners.
27 See Chapter III.
D. The Theory of Design/Build and a Model of Practice

Design/build addresses the performance problem by re-integrating the production process. The central connection is between the functions of design and construction, hence the terms "design/build" and "design-construct". By changing the organization of building, design/build changes the contractual relationships among the parties: the owner, the designer and the builder. This section addresses three topics in the theory and practice of design/build. First I outline a theory about integrating functions in firms. Second I present a model of practice, the method used by the Austin Company. Third, I summarize the claims and criticism of design/build.

1. Vertical Integration versus Sequential Contracts

A practical model for design/build is the integrated firm, a single organization that provides those services for which an owner would otherwise contract from separate firms. Economic and organizational theory explain how the integration of services in building might affect building production, and Oliver Williamson's (1975) theory of contracting fits the example. Williamson has developed criteria that dictate when producers of products should use separate contracts to purchase production resources, such as design services, construction services, material and labor, and when these producers should integrate these resources within a single firm. Criteria include stability of market prices and technology and the ease and cost of contract transactions.

In the linear process, owners contract separately for the purchase of design and construction services, equipment, labor, and materials in sequence during the term of a project. Williamson argues that such arrangements are appropriate when contracts are inexpensive to write, resource markets and prices are stable, technological changes are slow, participants have good access to production information, and there are large numbers of potential bidders for contracts. Contracting to purchase resources becomes expensive and risky when these conditions change, and under such circumstances producers should internalize the resources within their own organization.

This theory supports the increased integration of design and construction since the 1950s in general and for public construction in specific. During periods of high inflation, prices change quickly and there is quite a bit of turbulence in relative pricing. Increased project complexity and changing methods and products create a context of changing technology and make changing information about costs of labor and materials readily accessible only to some participants—the builders. Lengthy and complex public procurement procedures make contracting expensive for public agencies, motivating them to limit these costs and to shorten
schedules. In such an environment, internalizing design and construction in one organization has two advantages. It eliminates the barriers which prevent the flow of critical information from the construction unit to design, allowing the participants in production to adapt to new information or new requirements without being forced to re-negotiate contracts in a non-competitive environment. In turn design should reflect current information about new products, technological changes, and the relative prices of resources. It also cuts contracting costs, by requiring one instead of two contracts for design and construction services.

Related benefits affect the performance of individual work units with respect to an overall project. Total project performance should improve, since individual production units no longer have claims on streams of profits, thus they would not be motivated to maximize profit on individual tasks. Convergent expectations should result in an atmosphere encouraging cooperative and beneficial rather than adversarial behavior. What disputes arise can be resolved by fiat within the organization rather than haggling in the market (from Williamson 1975).

2. A Prototype of Practice: The Austin Method

The Austin Company is reputed to be the oldest design/build firm in the United States, providing services to industrial owners beginning early in the 20th century. By 1989 it was the largest integrated firm producing commercial industrial and institutional building. Unlike other large design-constructors, such as such as Fluor Daniel and Bechtel, Austin has always concentrated its activities in general building. Austin internalizes within the firm the functions of building study, design and construction. The organization of those functions within the firm reflects the dual requirements of company-wide product specialization and local building markets.

Product Specialization and the Organization of Building

Since its founding, the Austin Company has operated within defined product areas, developing expertise in the needs of particular industries and developing buildings and building technology to meet these needs. In the early 1900s the firm specialized in factories for the manufacture of electric lamps. This led to the development of standardized industrial building to suit the aircraft, railroad, and automobile industries. Austin’s "product niches" have fluctuated with the economy. After WW II Austin developed single level integrated plants for

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29 The source of the information about the Austin Method is a 1989 interview with Dario Dimare, Manager of Business Development for the New England area. The process described is the generic "Austin Method", as used for the development of $50 million commercial project in New England.
manufacturing in growing suburban areas, along with suburban department stores, and later, research and development and electronic data processing facilities. As of the 1980s, Austin’s specialties included newspaper plants, facilities for broadcasting, research and development, facilities for the aviation and automobile industries, retail and distribution centers, as well as hotels, schools and office buildings. The company does not count complex institutional buildings such as hospitals and prisons in its standard repertoire.

The firm supports its product specialization through in-house expertise in client businesses practices and markets. National divisions, staffed by professionals drawn from client industries focus on the operating requirements of the industry. Austin uses these requirements as the starting point in building design dictating, first, equipment, then facility, then site requirements.

Building expertise is decentralized in eight similarly organized district offices. Each has three building groups that reflect functional phases in the building process. Facilities Development undertakes architectural programming and preliminary design. Architecture and Engineering produces final design and engineering drawings and specifications. Construction and Scheduling manages construction. These are supported by operations and financial control groups for estimating, purchasing (which supervises bidding), and accounting. Personnel in these groups are brought together in a project team headed by a project manager for a specific project.

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30 Pertains to organization in the United States.
The Austin Method

The company follows a two step sequence of design and contracting. Step one includes a feasibility study, an architectural program, a site location study if necessary, and preliminary design. Then Austin proposes to the client a design, preliminary specifications, a schedule guarantee and an offer of guaranteed price. Fees for step one are based on direct time costs. Step two includes final design and construction. Fees for services also change; the fee becomes a percentage of the total construction cost, for which the company has guaranteed a maximum. The design/build fee is separate from architectural and engineering fees, which are billed as project costs.

Through preliminary design, the firm works closely and interactively with the client to define industry service or production requirements, estimate future growth, and translate these into facility location and building requirements and a building scheme. Industry experts in the national divisions are brought together with district groups to define the operating and facility needs of the client. In the feasibility study, the firm prepares a program and block layouts of building areas and specifies major equipment. Several schemes are prepared, corresponding to different facility or site configurations. District estimators, using a data bank networked throughout the company, provide "order of magnitude" estimates for each option, and the
Construction and Scheduling group prepares milestone schedules. The package includes a discussion of the advantages and disadvantages of each option, and a recommendation.

After the client reviews the feasibility study and chooses an option, the facilities group produces a schematic design. This and the client's marketing and operating requirements dictate site requirements. Austin will also find a site to be purchased by the client, if the client so chooses. At this point, the client can decide to proceed with Austin or take the feasibility study to a traditional architect. Austin stresses project continuity and believes it is to the client's advantage not to break the continuity at this point.

Preliminary design is the most intense phase relative to the client. Prior to this point, the client has had little to react to - most of the information has passed from the client to the programmers. Now, the client must make decisions about actual layouts, quality levels, materials and design, among other things. There is no set document submission schedule. In some cases, Austin will locate its concept design architects at the client's place of business, to facilitate ongoing communication. In other cases, the client and the Austin team will meet, no less than once a week, to review the progress of the design.

Within the firm, project participants work together in the district office, interacting with each other informally as well as through the project manager. Primary participants come from the Facilities Development and Architecture and Engineering groups, with support by Construction and Scheduling and Estimating. For a large project, Austin will put create a task force for the project. "They will literally put everyone in one room" (Dimare 1989). Constructibility reviews and value engineering are treated as "ongoing", not formalized processes.

The preliminary design documents deviate somewhat from the standard AIA preliminary design documents, showing greater detail in drawing and specification of building systems, equipment, and finishes. For example, Austin's preliminary design drawings include one line mechanical and electrical drawings, with written dimensions. Specifications include descriptions of products, such as for the HVAC system and major equipment such as boilers, and finishes. In comparison, AIA documents would locate heating distribution systems, without line drawing and dimensions, describe electrical service without electrical drawings, and locate and generally describe major equipment type and capacity without specifying units.

At the end of preliminary design, Austin offers to guarantee to complete the facility at a given price and within a given time, giving the client contract options ranging from a lump sum to a cost plus contract, priced according to the cost risk to Austin and the distribution of savings. A lump sum or guaranteed maximum with all savings to the owner would carry the highest price.
Interaction between the firm and the client changes in step two, as the design process moves back within the Austin organization. Final design proceeds in the order of construction, and the development of documents, bidding and material purchasing overlap. Austin uses competitive bids for all subcontracted work, and it develops the associated drawings to a "competitive" level of detail.

There is no vagueness. After all, a smart businessman who sees something vague in the document won't include the item in his bid. A responsible bidder may point that out to you - 'By the way, you didn't include a door here, and you probably want one, and if you do, this is how much it will cost you.' (Dimare 1989)

Austin argues that because of the bidding practices of subcontractors, bidding under its method produces lower costs to the client. Subcontractors bidding on Austin's work "know Austin has the job", so they are motivated to give the firm the most competitive price. In a traditional bidding situation, subcontractors may give certain general contractors, those with whom they have long-standing relationships, better prices than others. In the aggregate, general contractor bids are thus comprised of some "best" prices and some "second best" prices, and higher prices overall.

Austin does not use "proprietary specifications", which might lock the firm into one supplier or subcontractor, nor does the firm practice "design/build" with its subcontractors. If competing subcontractors have good ideas that differ from the bid package, they can suggest the ideas to the firm, which will in turn seek bids from other subcontractors on the proposals. The exception to the bidding process occurs when the firm hires and supervises labor directly, for components such as concrete and brickwork. Documents for such components are developed in less detail than documents for bid.

During project administration, Austin's site architects and engineers check shop drawings prepared by subcontractors and equipment manufacturers, and project architects and engineers provide daily supervision. During final design and construction, the project manager meets biweekly first with architects, engineers and construction people at the site, then with the district office management. Meetings with owners take place "as needed", with job meetings open to the owner's representative.
Incentives and Innovation

Performance incentives focus on the total project. For example, incentives for the manager of business development (MBD) and the project manager complement each other. The project manager is accountable for the project, and anything that occurs at any point in the process is his responsibility. The manager of business development is accountable to the client, and it is to the MBD that the client turns with problems with the project manager, with the project after completion, and for the next project. The MBD is compensated based on performance, so s/he is motivated to keep the client happy enough to come back for a subsequent project. Dimare described the incentives as follows:

The manager of business development is accountable to the client. At the start of a project, he attends meetings with the client, then he will meet with the client alone, at their office, or for dinner. He talks to them about how the project is going, trying to get the client to spill their guts. Good and bad news is encouraged. Sometimes a client has a problem, but he does not want to complain to the project manager for fear of interrupting an otherwise smooth running project, so he tells the MBD. He can then resolve it with the project manager. It may be a question of personalities. The MBD will work it out; it is the MBD that the client comes back to for the next project (Dimare 1989).

Product specialization and repeat work has led to technical and process innovation within project types. Austin holds numerous patents, on, among other things, a device to measure the flatness of floors (developed for movie studios and later applied to materials handling facilities with high rack storage systems), radiation proof secure vault doors, and the construction equipment.
3. Claims for and Criticism of Design/Build

Advocates Point to the Benefits of Integration

Claims by advocates of design/build are consistent with the theory of vertically integrated functions and the Austin prototypical process. There are three elements to the argument in favor of design/build.

Procurement. Design/build is a more efficient way of buying services because you make one purchase instead of two or more (Twomey 1989).

The Integration of Design and Construction. Production efficiency and innovation made possible by the integration of design and construction services improves the product and reduces the cost and development time of buildings. Architects can learn about new processes and practices directly from builders, and building design thus can reflect current knowledge of construction. Architects can design to the expertise of the builder. Design can reflect current information about component costs and products.31 For example, in describing the benefits of the integration of construction knowledge in design, Donald Barrie, an engineer and vice president of Kaiser Engineers reports that

this method also offers the advantages of construction input into the design stage through value engineering (constructibility analysis), development of economic trade-offs for alternative methods, and identification of favored and least costly methods of construction in the project area. (Barrie 1982, 200)

Single point responsibility. The owner’s management task is simplified under a single contract with a single point of production responsibility. The design/build entity covers the management gap, thus less coordination from owners is required. Twomey expands on these benefits to suggest that there is less management stress and less litigation. Thomsen, an architect, writes that:

The integration of the two fields results in improvements in cost, time, and construction technology. And with only one organization, the client can figure on having centralized knowledge of design and construction, plus undivided responsibility (Thomsen 1975, 63-4).

Critics Focus on the Owner’s Loss of the Architect as Agent

A criticism of design/build is that by putting the architect and the builder on the same team, the owner loses the architect as his agent. Christopher Wist, Director of Legal Research for the AIA Documents Division describes the problem:

From the architect's standpoint, the design/build debate revolves around the question of whether anyone with a financial stake in the construction of a project can serve the interest of the owner above his or her own (Wist 1987).

In his or her new role, the architect may face a conflict of interest during construction: there is the potential that the architect will not report to the owner construction deficiencies, material substitutions, or other efforts by the contractor to reduce costs. As a result, according to Hasbrouck (1977), owner's management responsibilities may increase, not decrease as some suggest.

This agency role has been central to the concept of professionalism in architecture, and on that basis the AIA has opposed design/build since the late nineteenth century. In 1978, the AIA ended its formal opposition, but the question has continued to divide the profession. In 1985, the AIA published a series of model contracts for use on design/build projects. In a presentation to a design/build symposium sponsored by the Federal Construction Council, Christopher Wist described two questions posed by the AIA related to these contracts. By publishing the contracts, would the stature of architects be reduced? The document group responded yes, but that design/build would open more opportunities for architects to practice. In addition, AIA contracts would not affect the stature of architects as much as contracts produced by design/builders. A second question was whether the documents could resolve the conflict of interest question. To that, the group responded no. The only solution was for the owner to hire an independent architect to protect the interests of the owner, and that would represent an additional employment opportunity for architects.

The loss of the architect as agent not only affects the owner, it affects insurers, and for turnkey construction, it becomes a concern to lenders as well. Richard Jones (1987), a Connecticut construction attorney suggests that lenders, as well as owners, rely on architects to review and supervise projects for owners, and lenders lose accountability in the loss of the architect as the owner's agent. For that reason, lenders prefer traditional contracts. Insurers similarly look to architects to certify completed work for the purpose of authorizing payments to contractors (Foster 1982). Twomey (1989) adds that under a design/build contract, design professionals and the contractors become responsible for aspects of projects over which they traditionally would have no control. Insurance and surety companies traditionally do not provide protection for, for example, an architect involved in construction, or a contractor involved in design. As a result, design, build participants may have difficulty obtaining adequate coverage.
4. The Public Owner

Public owners face special issues in using design/build for building projects. Because design/build contracts combine responsibility for design and construction services, they violate laws regulating the separate selection of architects and public bidding for construction. For example, the Brooks Act of 1972 generally prevents federal agencies from using price competition for the selection of architects. A design/build procurement process that included the selection of a designer and consideration of project price would violate this law.

Apart from the legal barriers, abandoning the use of price as an "objective" basis for buying services introduces the question of how public owners are to be held accountable for decisions that are discretionary. Anticipating the difficulties the Massachusetts DCPO would face in its design/build projects, Minden (1986) remarked about the "inherent conflict between the necessity for subjective judgement about project quality in design/build and requirements that subjective judgements be minimized and objective measures maximized in public decision-making."

Public owners also operate in a different environment than private owners. For example, public owners more subject to pressures from interest groups. For example, the AGC formally opposes the use of design/build for public projects. Another characteristic of public work is the diffusion of decision-making in government. Reviews and approvals take a long time -- representing potentially costly mistream delays and, as the chairman of the board of a design/build firm undertaking a public project in Florida pointed out,

What if approvals are never given? What if funding is stopped by Congress or some other regulatory body? What if the public mounts a massive campaign against a proposed project? The "what ifs" are often simply too great and outweigh the potential gain (Greenfield 1982,203).\textsuperscript{32}

\textsuperscript{32} At the time the article was written, Greenfield was the chairman of the board of Parsons Brinkerhoff, Quade and Douglas, Inc.
E. This Research

Despite the constraints, a number of public owners are now or have recently undertaken projects using design/build, seeking to achieve the benefits claimed by the method's advocates and to solve problems with traditional methods. This research uses these public projects as resources to see how the practice of public design/build differs from traditional practices by public agencies and thus how claimed time and cost savings on projects might be achieved. Since the central claim of design/build is that it improves the process of design, the focus of this research is on the connections between procurement, design and performance.

1. Research Questions:

What can we learn from public design/build projects about whether, how, and to what extent design/build brings together design and construction?

Does design/build solve performance problems associated with the traditional linear public process?

What are the impediments to implementation, and what are the new problems?

What are the prospects for the future of public design/build projects?

What can other owners learn?

2. Two Theories and a Hypothesis

Two conflicting ideas about changing practices in the design and construction industry come out of the theory. One is that the industry is fragmented, flexible, able to ebb and flow and to adjust practices from project to project, according to Thorns, prepared to be "as flexible about the process as the product." On that basis, public owners might expect to initiate a design/build procurement process and the industry would respond with the kind of unified management, single point responsibility, and integration of construction knowledge into design that would lead to speedier and more cost effective building.

Public agencies presumably make such an assumption in advertising design/build projects. Agencies focus on procurement, assuming that the industry is sufficiently flexible to respond. They advertise for providers of design and construction services for particular projects, specifying that services are to be provided in a single package. The expectation is that either formal design/build firms or teams which constitute themselves as organizations for the designated project will establish an integrated structure within the organization, achieve the two way flow of information necessary to integrate construction knowledge into design, and provide an appropriate total management system for the project. The agency does not ask how
that happens, in fact a source of "efficiency" in the method said to be the discretion the organization has organizing and managing the entire design and construction sequence. The owner's primary concern is its own connection with the design/build organization.

On the other hand, evidence suggests that process changes, like changes in technology, might be resisted by the industry. If we consider that the industry and owners that purchase its services are not a collection of randomly connected pieces but a business system organized around a linear production process and institutionalized along those lines, we would expect attempts to change fundamental processes in the system to ripple conflicts throughout the system at many levels. We already know that design/build creates structural conflicts with traditional practices such as public bidding laws, licensing requirements for architects, and bonding and insurance practices.

The hypothesis of this research is that because design/build methods represent a fundamental challenge to the linear process on which traditional practices in the commercial and institutional building are based, procurement policies alone cannot produce integration of design and construction in building production. Barriers exist in the structure of the industry, and these extend to the practice of firms that market to public agencies.

3. Research and Analysis

I use a detailed case study as the primary method of research. There are several reasons for this choice. First, the research questions concern practice in specific situations, making it necessary to get "inside" of a project. Second, although building is idiosyncratic and every project is "different", I have argued that the process for commercial and institutional projects is in fact standardized. Thus what happens in an individual case with respect to changing the processes of procurement, design and construction is relevant to what can be expected to happen in general. The case study follows several corrections projects developed by the state of Massachusetts using design/build methods, focusing on the design and construction of the Nashua Street Jail in Boston. I set the case in the context of public practice by comparing DCPO's design/build process to those of other public agencies undertaking design/build projects.

The Case Study

The opportunity for an inside view of a design/build project came in 1985, when the agency for which I worked, the Massachusetts Division of Capital Planning and Operations, decided to use design/build to develop several state and county corrections projects. My research focused on the development of one project, the Nashua Street Jail in Boston. I provide a detailed picture of the procurement and production processes and the relationship between the
two, identifying connections, barriers, and opportunities for the integration of design and construction. In preparing the case study, I relied on my direct observations, detailed interviews with participants, and project documents make available to me by DCPO and other project participants. The research also covered other correctional facilities developed by the agency during the same time period using design/build and traditional methods. I interviewed 24 project participants between May of 1988 and February of 1990.

The Survey of Public Agencies Using Design/Build

The purpose of this research component was to link practices found in the DCPO case to patterns of practice in design/build projects sponsored by other public agencies. The method was a telephone survey. I created a pool of agencies to be surveyed using the 1988 survey of major sponsors of commercial, institutional and industrial projects by Building Design and Construction and trade journal reports of public design/build projects. After screening the group to identify agencies with active or recent projects, I then interviewed officials in 23 agencies knowledgeable about the agency's design/build practices and projects. Interviews were conducted between October of 1988 and June of 1989.

The interviews were semi-structured, with a focus on the following questions. Respondents were also encouraged to volunteer related information.

How does the agency define and implement the purchase of design/build services?

Why did the agency choose design/build over traditional procurement?

What were the technical characteristics of the design/build projects?

What production entities bid and won the design/build award?

What was the agency's experience with project time and cost performance under design/build?

The Analysis

The research analyses the DCPO cases by comparing patterns of design processes and project performance. Comparative design process patterns include traditional sequential design and the prototype process used by the Austin Company. These are described in earlier sections of this chapter. Comparative performance of corrections projects was derived from project data compiled by the National Institute of Justice. I used the data to develop profiles of physical characteristics, cost and construction time performance for projects comparable to the DCPO corrections facilities.

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33 The Massachusetts DCPO was included in the group.
III. Public Design/Build: Patterns of Experimentation and Patterns of Practice

Public design/build has a rich history, and the characteristics of current practice can be traced to its precedents. Certain "models" dominate current practice and are relatively consistent across agencies. Despite this, most agencies contacted as part of this research saw themselves as testing a new method, crafted by agency for the first time. In some sense, this meant that each agency beginning to use design/build reinvented the wheel. This phenomenon can be attributed to the pattern of experimentation that has led up to current practice and is a function of both the structure of the industry and the special problems of innovation in the public sector. An effect is that agencies ability to learn from previous experience has been limited. Appendix B chronicles the early public experiments, and Appendix C describes current projects as surveyed in 1989.

A. The Pattern of Experimentation

Procedures for public building are prescribed by law and follow the linear pattern described in the previous chapter. These laws generally preclude the use of design/build and other strategies that violate essential features of the linear process, especially as they relate to the selection of architects and competitive bidding for construction. These laws essentially require the separation of design and construction that design/build seeks to eliminate.

Despite such legal constraints on their operations, agencies responsible for public building have periodically implemented the use of non-linear process in special circumstances, and we can trace the development of a "public design/build process" through what I term these "public experiments". The experiments were not rigorous tests as normal science would define them. They represent iterative testing of procedural innovations, and as a group, the experiments display a pattern. This pattern repeats itself in current design/build practice, and understanding the pattern is helpful for our understanding of the opportunities and limits built into public design/build.

1. Catalysts for Change

Throughout the post World War II era, government agencies have periodically faced sudden production capacity demands for specific types of projects. Examples include elementary schools in the 1950s and 1960s, colleges, dormitories, low income housing, and military housing in the late 1960s and 1970s. While individual agencies had basic production capabilities, new demands for these facilities stretched capacity, and the agencies suddenly
needed to produce higher volumes of projects quickly and economically. In the 1980s, similar concerns have motivated the process experiments related to prisons and military facilities.

Public building agencies have used the opportunities presented by new demands to try to reorganize the building process. For example, the California School Component Systems Design (SCSD) projects and later experiments with building systems by the General Services Administration (GSA) Public Building Service and the Army Corps of Engineers (Corps) industrialized production of certain building components. Public and military housing programs drew private producers such as residential developers into building of public projects. These were known as "turnkey" projects, because the developer took responsibility for the entire process and turned the key over to the public agency upon completion. Agencies such as the Dormitory Authority of the state of New York then combined features of the turnkey process and the process used to purchase of industrialize building components in a single contract procurement method defined as public design/build.

2. Goals: Changing Public Building Production

*Industrialization: Linking Owners and Manufacturers*

Government has been interested in the problem of technological development, often focusing on the stimulation of industrialization in building, for decades. This interest has been expressed in efforts to stimulate research and development, for example, the Civilian Industrial Technology Program (CITP)\(^1\) in the 1960s and the Experimental Technology Incentives Program\(^2\) in 1970s. In 1986 a committee of the National Research Council recommended that the federal government undertake a new research initiative.\(^3\) Government agencies have also invested in specific new technologies; examples include innovations in building systems under the School Component Systems Design program in California, the GSA Public Building Service's Building Systems Program, and the Army Corps of Engineers' Two Step Formal Advertising. These are summarized in appendix B. The Department of Housing and Urban

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\(^1\) At that time, the building industry was seen as technologically lagging behind other sectors, and technological development in construction was equated with industrialization (Schon 1967), i.e. bringing the manufacturing process to building. The industry was seen to be locked into a pre-industrial craft system by structural fragmentation, which left no institution capable of industrializing and firms too small for innovation. CITP proposed direct federal support for research in specific technologies.

\(^2\) ETIP sought to use changes in federal policies to improve the climate for technical innovation. In practice, a focus of the program was on the use of procurement policies to improve technical characteristics and long term quality of products purchased by government.

Development's Operation Breakthrough is an example of investment in the factory production of housing.  

The project based efforts shared two innovations. First, the projects were to be produced by some kind of industrialized process involving factory production of major components or systems. Second, the purchase of these industrialized elements would require a change in the traditional procurement process. The important features of procurement were:

1. Changes in traditional bidding, to allow the producers of systems to compete on a performance basis with conventional products. Bidding relied on the use of "Performance Specifications".

2. The use of a single contract to purchase "products", instead of services, to be produced in factory settings. In the factory, design and construction would be integrated as a manufacturing process.

3. The use of Requests for Proposals, asking bidders to present design proposals as part of the bid.

4. A selection process that combined factors of quality and price.

While the earliest projects involved the development of new systems, the most recent projects, those by the Corps, involved the purchase of "second generation" systems and subsystems. The procurement methods used by the Corps most closely resemble current public design/build. In fact, in the mid 1980s the Corps began defining its two step method as a version of design/build and not only as a method of purchase of industrialized systems (Napier and Lierman 1885).

**Turnkey: The Development Team**

The federal Public Housing Authority and the Department of Defense created a developer based strategy for housing production, as a way to expand capacity. Known as turnkey, the method used residential developers, who had demonstrated their capacity for volume production in the 1950s and 1960s, for public production. The agencies used single step procurement to contract with developers, but the method presumed traditional building, directed by a private developer instead of the government as the owner. The single contract also allowed the government to streamline its lengthy procurement process.

The strategies used to select developers for public projects and the assignment of management functions to these private entities are quite similar to those of current public

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4 Initiated in 1969, Operation Breakthrough sought to use factory production to accelerate aggregate housing production. The program was to produce housing, develop factories for industrialized housing production, reform institutional and regulatory policies, stimulate research and development, and demonstrate new technologies. Ultimately, HUD sponsored the development of 25,000 units of industrialized housing on sites around the country.
design/build. The agencies issued RFPs specifying requirements. Developers formed teams of architects and contractors and submitted proposals prices for packages of services including building design and construction, design and construction management, construction financing, and sometimes land. The government agencies then chose developers based on factors including the quality of the design and the reputation of the A/E firms, cost, time, and other factors. For its projects, the Department of Defense developed a formal scoring system generating a "quality point value." Housing authorities used a single contract in two phases, one for design and the second for construction, and the agency negotiated the terms of each contract with the developer. Upon completion, the agency made lump sum payments for the development.

The Department of Defense turnkey model, know as One Step Competitive Negotiations, was the model for the congressional military construction design build experiment in the mid 1980s, described in the next section.

*Design/Build: Linking Design and Construction*

In 1971, the Dormitory Authority of the state of New York, an independent construction and financing agency for the state university system, decided to try a turnkey type contract for the construction of several dormitories and parking garages. The authority's goal was to reduce the cost per bed, and it relied on the procurement process to accomplish this. Philip Bobrow, a Montreal architect, developed the procurement process.

This is one of the first examples of public design/build, in that the method was strictly an alternative to traditional design and construction. Although the method neither relied on developers nor manufacturers for building production, Bobrow expressly connected the method to turnkey housing as well as to experiments with the industrialization of building. He termed the model "Design/Build/ Bid" (Bobrow 1974). The authority continues to use design/build for all of its dormitory construction.

When the authority began using design/build, architectural programming was emerging as an important specialization in the design, and practitioners of this new specialization also prepared RFPs for public design/build projects. A major feature of Bobrow's process was a highly interactive pre-design phase during which he, as the programming consultant, worked closely with the sponsor to develop a detailed architectural program that would be the basis of a request for proposals. The RFP also included performance specifications, using a format

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5 One of the earliest articles on programming, by Caudill and Pena of CRS, was published in the *Architectural Record* in 1959. In 1966 the AIA recognized programming as a specialization in its *Emerging Techniques in Practice*, and Pena and Focke's book, *Problem Seeking*, was published in 1969.

6 See Appendix B for a discussion of CRS's role in public design/build.
evolved from the SCSD and GSA programs. The authority approach used a set price, and participants competed on the basis of the quality of the design proposal. Competitors were paid honoraria for proposals.

Participants competed as members of teams, with architects and builders jointly submitting proposals. The authority then signed separate contracts with the winning competitors, a design contract with the architect and a construction contract with the builder. The theory was that by contracting directly and separately with the architect, the authority could retain the agency role of the architect during construction. Also, at the time, the AIA mandatory code of ethics forbade architects from participating in design/build contracts.

3. The Results: Limited Evaluation and Uneven Performance

These 30 years of experience with public projects has failed to produce consistently the performance claimed for the new forms of organization.

In the case of the industrialized production experiments, the buying power of the government, even aggregated over school districts and housing jurisdictions, proved to be insufficient in creating long term demand for new systems; the resulting products not immediately marketable commercially, nor did the investment result in major technological change in the industry.7

Changes in procurement did allow building products which were already on the market to compete with conventional construction.8 In a 1980 evaluation of three projects, Construction Engineering Research Laboratory, the research arm of the Army Corps of Engineers (CERL) found that the Corps' purchase of second generation industrialized building systems was cost and time effective. The evaluation reported significant cost savings, ranging from 28 to 32 percent based on government estimates of traditional procurement and construction, and time savings. In all three cases, CERL found quality to be equivalent to conventional construction.

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8 In some cases, participants went on to develop other commercially viable products. An unsuccessful bidder for the SCSD projects went on to develop and successfully market its system as Butler buildings, sold through design/build contractors.
The stated goals of the turnkey program included cost and time efficiency, but formal evaluations do not entirely demonstrate such outcomes. A study done for HUD in 1982 found that turnkey units were comparable in price to conventional public housing units, but that the construction type was inherently less expensive, incorporating less durable materials than conventional construction. (That study did not consider development time.) On the other hand, a 1974 study of turnkey and conventional housing in Massachusetts reported that the per unit cost turnkey housing was 8 to 20 percent below the cost of traditional public housing, and a 1973 study for the Boston Housing Authority suggested a time savings of several months.

The Dormitory Authority of the state of New York has not published any formal evaluation of its projects, but the available evidence indicates ambiguous results. As of 1977, the authority considered its program to be a success (Hasbrouck 1977): Bobrow (1974) reported that the seven initial projects showed a savings in capital costs of 5 to 45 percent based on the authority's original budgets (although the price for these projects was fixed by the authority). For projects under schedule pressures, the development time was reduced to three years from an average of seven years. One project won several design awards.

Subsequent conversations by the author with the Authority indicated that the cost savings were at the expense of long term quality. According to the former Director of Construction Services,

We've had problems with the projects done in the early 1970s. There were inadequate dollars committed to the program. The need overrode the money available. As a result, the Authority approved systems which subsequently failed. On one project, ten years later we are spending as much money revamping things like heating systems as the project originally cost (McDowell 1989).

4. The Disseminators

Looking at the early experiments with industrialized production, turnkey, and design/build as a group, we can identify a network of individuals associated with particular procurement innovations who carried innovations from organization to organization, and a network of organizations interested in new ways of procurement. For example, Ehrenkrantz, the designer of the SCSD systems later worked as a consultant to agencies such as the Corps of Engineers. Jonathan King, originally involved in SCSD, later moved to CRS, where Caudill and Pena were developing a specialized programming process distinct from design. John Eberhard was involved with Ehrenkrantz in the SCSD project, was subsequently at Department of Commerce (CITP), developed performance specifications for GSA, and later directed research on industrialization for the AIA. Bobrow was participating in Operation
Breakthrough projects at the time he prepared the design/build procurement process for the
dormitory authority of the state of New York.

5. The Pattern Over Time

• The impetus to deviate from the traditional linear process came from a sudden swell in
demand for a particular type of facility. This stressed regular production capacity, and
government agencies responsible for building used the "special situation" to justify innovation.

• The agencies relied on the way they purchased design and construction services to
initiate change. Changing these procurement policies was expected to improve production,
changing the way designers and builders worked, and innovations were associated with
specific of claims about what they would achieve.

• In creating new procurement processes, innovators borrowed ideas used in other
public process experiments, adapting the strategies of others to their particular project needs
and agency goals. In so doing, agencies focused on the procedural characteristics of the new
processes.

• The experiments were project based, defined as necessary for the special situation, not
necessarily to be applied to mainstream public projects. The experiments came to an end with
the end of the special production needs.

• The innovators were highly protective of the experiments while they were in process,
publicizing innovative characteristics and important positive project milestones and insulating
the experiments from criticism and political threats.

• The original claims were often not realized, but because systematic evaluations were
not done, the reasons for the specific results were not always clear. By the time evaluations
were done, if they were, the innovation was already on its way to practice in another agency,
carried by practitioners or other innovators, rerafted into a new context.

The following chart maps the early process experiments and current use of design/build
by agencies surveyed as part of this research.
B. Patterns of Current Practice

The goals of the early experiments were to industrialize building production and to draw private developers into the public production process. By 1989, interest in industrialization had waned, leaving two versions of single contract procurement to dominate public practice: design/build, which relies on an organizational and functional union of designer and builder to undertake public projects, and turnkey, which re-packages the public building process as a "development process" and transfers responsibility to a private developer.

Most agencies surveyed in this research used a version of single contract procurement that combined the functions of design and construction with neither the explicit presence of a developer nor an agenda to industrialize building. This version, which I term "pure design/build", reflects most nearly the model developed for the Dormitory Authority of the state of New York. Despite the lack of explicit agendas with respect to the use of developers or new technologies, both agendas were implicit in this version, in that most agencies reported that packaging the functions of design and construction allowed the private entity to use its expertise both in management and in new building technologies, and that this would lead to efficiencies in production. Tensions were also apparent, in conflicts over the desire of the agency to control the project outcome and to allow the private entity freedom to innovate and manage production.

On the other hand, the largest and most complex projects were done under the turnkey method. No longer restricted to housing production, turnkey developers provided packages of services including financing, land acquisition, the securing of project approvals, as well as design and construction. Agencies often used turnkey contracts to shift the responsibility for politically sensitive activities such as land acquisition, project approvals, and long term financing from themselves to private developers, and agencies sometimes used the term "privatization", as well as turnkey and design/build, to describe the method. In production, turnkey was not associated with explicit changes in the design process; developers of turnkey projects often used traditional contracts for services with architectural and general contracting firms.

Single contract procurement was also used on a more limited basis to purchase off-the-shelf manufactured building components, a link to the early more ambitious goals to industrialize the building process. Product designers were part of the manufacturers' organization, and the project designers' and builders' responsibilities were limited to the development of sites and the assembly of components.
This section presents findings from a survey of 23 public agencies that recently used design/build methods to develop building projects. Several of the larger agencies doing volume work had modified an initial version of design/build to create versions for different types of projects or circumstances, creating a repertoire of public design/build procedures.

1. Overview: The Process and its Variations

For public owners, public procurement regulations, in particular public bidding laws have been important barriers to the use of design/build. In crafting a new procurement processes, agencies have concentrated on adapting the single contract method to the public context. The resulting model is described variously as Design/Build/Bid (Bobrow 1974) and Design-Bid-Design/Build (Thomsen 1982). I define the process generally as "public design/build".

The important features of public design/build include the use of a competitive process and reliance on fixed-price or lump sum bids. The public agency issues a request for proposals that includes performance specifications and a program generally created by a special consultant to the owner. Competitors then submit price and design proposals. When the selection process is defined as a design competition, agencies sometimes pay honoraria for the preparation for proposals. No honoraria are paid when the competition is defined as a bid. The agency then evaluates and selects a winner based on some "objective" combination of price and quality.

Design/build skeptics point out that the public version of design/build presents new problems for practitioners. An area of concern is the use of an RFP to specify project requirements, and practitioners suggest that performance requirements must be "very clear and they must reflect every requirement" (Haviland 1987). On the other hand, owners seldom know up at the start of a project exactly what they want, nor are they aware of potential trade-offs. Some practitioners recommend that owners retain independent architects to prepare RFPs, and that these architects also supervise the design/build process for the owner.

Architects also express concern with the reliance on costly competitive proposals. Haviland (1987, 16) points out that the "amount of design work that each bidder must do inevitably limits the number of bidders, reducing competition for the project." Wist (1987) suggests that ultimately, designers participating in competitions must get paid, and the cost of the competition may eliminate the savings in construction. Twomey (1989,99) points out another problem, that selection based on a subjective decision about design may cause participants to see the proposals as a "sales tools of the design/build team and not necessarily [developed] with the thought warranted by the project and program issues."
Although public design/build uses a lump sum bid, the use of a selection process that includes non-cost factors has become another point of criticism for the method. In 1987 the Massachusetts chapter of the Associated General Contractors, whose membership included union general contractors who bid on traditional public work, developed a position paper opposing the use of design/build in public construction. In it, the AGC described design/build as a system that works very well in the private market but that it was "foreign to the public process which is open to all competitors, and which is managed by a public agency with its layers of decision-makers and controls", that the subjectivity of the selection would allow opportunities for corruption and political influence, and that it would restrict competition. The AGC concluded that the public construction process in the United States is based on three legs: the public agency/owner, the designer, and the contractor, that each had specific functions, and that these functions were blurred under design/build. "Like democracy, public bidding is not a perfect system, but is far ahead of whatever is in second place."

2. Pure Design/ Build: Connecting Construction and Design

This version is defined as the consolidation into one contract of design and construction services. The previous section describes one of the first public experiments with this version by the New York State Dormitory Authority in the early 1970s; the authority still builds all of the dormitories for the State University of New York campuses using the method. Nine federal agencies and those in seven states used this method. Most had used the method repetitively over a period of years.

Procurement Through Design Competition

All but two agencies reported selecting design/builders through a design competition, relying on detailed architectural programs and performance specifications to define their project requirements. Agencies that did not use design competitions retained consultants to prepare preliminary designs (through 25 to 35 percent completion), and design/builders competed on the basis of qualifications and price. The Naval Facilities Engineering Command (NAVFAC) and the Air Force took this approach.

Agencies that used design competitions followed similar procedures. The first step was the competition itself. The agencies, using traditional architectural firms as consultants, prepared programs, performance specifications, and budgets or maximum prices for particular facilities. Bidders then prepared and submitted schematic designs (complete to between 10 and 30 percent), technical proposals converting the performance specifications to prescriptive specifications, and prices.
The selection process was formal, involved committees or boards, and relied on explicit selection criteria. All but one agency based selection on combined weights of quality and cost. A board would first evaluate and score the technical merits of proposals. That board or a separate board then adjusted these scores based on price, arriving at some kind of quality/cost value.

Price and bidder qualifications were sometimes treated as threshold requirements, i.e. bidders who did not meet the requirements were eliminated from the competition, and sometimes as factors in the evaluation. For example, bidders were pre-qualified by Massachusetts, California State University, and the Dormitory Authority of New York and post qualified by NAVFAC. Maximum prices were set by California State University and the Dormitory Authority of New York. Two owners, the Postal Service and the New Jersey Buildings and Construction agency, requested bidders to guarantee a maximum rather than a lump sum price.

By changing from a linear multi-contract process to a single responsibility contract, design/build impacted the design process. The design competition imposed new transitions on design: the transition from program to design became an important benchmark in the design process, as did the transition from proposal design to design/build. Correspondingly, the RFP became a formal legal and design document, with characteristics that shaped the nature of the subsequent competitions.

An important concern of agencies was the cost of proposals to bidders. These agencies reported that the high cost of participating in the competition had narrowed the pool of bidders. Agencies saw several ways to counter this problem: compensate competitors, simplify proposal requirements, or restrict the use of design/build to large projects. Both California State University and the Massachusetts DCPO used honoraria, payments to all competitors or to losing teams, to defray some of the cost of proposal development. The Postal Service and NAVFAC restricted the use of design competitions to large projects, which might generate enough profits to attract bidders. By including a developed design in its RFP, NAVFAC conversely simplified proposal requirements for smaller projects, eliminating the need for design proposals entirely. Bidders submitted only a price and a commitment to complete design and construction based on the given design and specifications. Other agencies simply required the bidders to absorb the cost.

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9 Virginia used a two step selection process, first developing a pool of acceptable proposals, then making the final award based on low bid. The Corps also continued to use its Two Step Sealed Bidding, developed in the 1970s, for certain projects.
Increasingly Complex Projects

Repetitive users of design/build applied the method to a range of project types, and over time to increasingly complex projects. Projects ranged from very small (NAVFAC and Corps fire stations on the order of $500,000 in construction) to large (the most expensive projects were the Massachusetts corrections projects). Agencies either used design/build for a particular category of projects, or, as in the case of the two primary Department of Defense building agencies (NAVFAC and the Corps), had developed criteria for variations in the procurement process corresponding to a wide range of project size and complexity.

Most of the federal agencies based use of the design/build on the familiarity of private designers and contractors with project characteristics. Projects defined as simple (such as warehouses), repetitive (such as family housing), or comparable to facilities built in the private commercial construction market (commissaries, physical fitness centers, bowling alleys, short term housing, office buildings) were considered suitable for design/build. That did not mean that the projects were small; for example the post office used design/build only for its largest projects, defined as those over $10 million.

Although states and cities had not developed criteria for the use of the method (either they had undertaken few projects to date, or they had used the method for particular categories of projects without designating criteria), college dormitories and corrections facilities were the most common projects. Dormitories, both low rise and high rise, and parking garages were built by agencies in four states: California, Maryland, New York and Virginia. Agencies in California and Alaska used the method, responding to court pressure, for single low complexity minimum and medium security corrections projects. Large complex maximum security corrections projects were undertaken by Massachusetts, New Jersey and the District of Columbia.

The Design/Builders: Traditional Firms Form Teams

Most competitors for design/build work included the same firms that bid on traditional public projects. Providers of design and construction services for architectural design/build projects typically were traditional design and construction firms who created temporary organizations to compete for design/build work. Firms included joint venture relationships between general contracting and A/E firms and prime general contractors with A/E firms as subcontractors. Among the federal agencies, the State Department indicated that firms with prior experience with the agency had an automatic advantage in competitions.

Some agencies suggested that this made implementation of design/build difficult. Commenting on the experience of the New York State Dormitory Authority, former Director of
Construction Services McDowell suggested that while authority saw a single entity as responsible for the project, the producers, individual architects and general contractors, saw themselves as independent firms, behaved according to traditional rules, and found the application of new rules uncomfortable. He indicated that the architects and contractors undertaking design/build projects for the authority had difficulty with and were not as happy with the process as they would have been with traditional methods. This, in turn, affected performance.

We wish that the architect and the contractor would participate in the same team spirit as the Authority does, but we see the same old thing. For example, we expect cost effective design. Instead, we get the architect preparing a design, handing it to the contractor for a price, and having the contractor tell the architect that the design is over the budget and to do a redesign. Then we go around again. (McDowell 1989)

Deviating from this pattern, the U.S. Postal Service explicitly used design/build to attract contractors other than traditional bidders for federal work. The Postal Service was also an exception in that it reported bidding by and contract awards to integrated design/build firms.

3. Turnkey

Turnkey contracts were used by fewer agencies than "pure" design/build, but projects included the largest and most complex in the survey. The largest project in the survey was GSA's $395 million international cultural commission center to be developed by the Pennsylvania Avenue Development Corporation in Washington DC. Another major project was the development of a $140 million public library in Chicago. All but one agency reporting turnkey projects also used other versions of design/build, using the turnkey method for the largest and most complex buildings.

Key Services: Financing and Project Approval

Although turnkey is considered under the umbrella of design/build, use of the method had little to do with the integration of design and construction. The most important features of recent turnkey strategies were developer responsibilities for securing project approvals and long term financing. Both features reflected concern about project "politics" rather than project production.

In many cases, turnkey was associated with a time purchase arrangement known as "lease-back" or "lease-purchase". Payment was frequently over a 20 to 30 year period and termed a lease payment, although it generally included an amortization of the capital cost. (Texas, Missouri, Connecticut, GSA). In these cases, the developer retained responsibility for maintenance for a 20 to 30 year period. By leasing the facilities, public builders could pay for
them over time from operating funds rather than through general obligation bonds. In some cases, the agencies issued revenue bonds, secured by lease payments from operating funds. One state building official remarked that his state was considering the use of lease-purchase contract for a new state office building, but only if the legislature failed to authorize the necessary capital funds for the project. The administrative agency saw the method as a way to circumvent the capital budget (Richardson 1989).

For the Postal Service, the securing of approvals for complex projects and the provision of land in certain "socio-economic areas" were the critical political issues driving the use of turnkey. Referring to the development of a central mail handling facility in Washington, Ours said:

Two significant problems with this project led to the choice of design/build. The postal service could not come up with a site - given the neighborhood problems in Washington, the Postmaster General had decreed that the agency could not use its power of eminent domain to acquire land. Second, the facility had to be approved by the National Capital Planning Commission, a difficult group to deal with. We felt that a well placed developer would have a better chance for success with the Planning Commission than the Postal Service would (Ours 1989).

Similarly, the state of Missouri decided to use design/build so that, among other things, the developer would be responsible for finding a site.

An exception was the use by the city of Chicago of turnkey design/build for a new public library. In this case, the use of a design competition was an important criteria for the city, and design/build assured the sponsor that the design submission would be accompanied by a price commitment.

Production

Except in the Chicago case, there was little evidence that agencies using turnkey design/build were interested in the integration of design and construction. Awards went to developers who used project based teams with traditional architects and general contractors. Again, the exception was the Postal Service's use of integrated firms. There was also no evidence of time and cost efficiencies. Agencies reported either that quality levels of turnkey projects were comparable to projects developed under traditional methods, at equivalent costs, or that quality levels were lower than traditional, and that costs were correspondingly lower. For example, agencies in Connecticut and Texas reported that developers produce public projects at a lower cost but that were less durable than those developed using than traditional procurement. The Postal Service reported comparable levels of quality and cost.

Agencies with completed projects uniformly reported time savings. The Connecticut building agency reported that turnkey cut the traditional five to seven year development time to
two years and attributed the savings to the transfer of responsibility to the private developer and freedom from traditional procurement requirements. The Postal Service also reported substantial time savings.

4. Purchase of Pre-Manufactured Building Components

Seven public agencies used design/build for the purchase of particular factory produced products. Federal agencies, which used the method for permanent facilities, had some history with the purchase of industrialized products. States used the method for temporary facilities including corrections projects.

Building components were standardized, factory produced and assembled buildings or building sub units marketed directly by vendors to owners. Public purchasers designed their procurement around the specific off-the-shelf products they want to buy; products included pre-engineered metal buildings, wood and steel building modules, and steel and pre-cast concrete prison cells. Manufacturers, along with designers and contractors responsible for site assembly, became members of bidding teams, responsible for working out the mechanics of field assembly, adapting the standardized package to the owner's specific needs, and adapting the product to the specific site.

The vendor was generally an established manufacturer (for example Agway, Butler Buildings, or Arthur Industries) or a general contractor who purchase components from the manufacturer. These firms retained architects and engineers as necessary for assembly and site design.

Permanent Facilities vs Temporary/Emergency Projects

Agencies purchased building packages for both permanent and temporary facilities. Federal agencies purchased pre-engineered permanent buildings suited for specific purposes. The Corps, in an evaluation of its pre-engineered projects, was quite explicit is pointing out that "pre-engineered building systems are suitable for permanent Military Construction- Army (MCA) facilities and provide the functional and architectural qualities required for these applications (Napier and Lerman 1985).

In contrast, state and local agencies almost all defined factory produced projects as temporary or relocatable buildings, as non-building projects (defining purchases as equipment), or as emergency purchases (the latter often associated with corrections projects). For example, Connecticut purchased temporary modules for "instant legislative offices", to house legislators during the renovation of the Connecticut State House, and the state used design/build for the emergency purchase of modular additions to two corrections facilities. Massachusetts used design/build to purchase pre-engineered agricultural buildings, for hay
storage and as dairy barns, specified as "equipment" rather than buildings, and for temporary housing for prison inmates.

Corrections projects were generally defined as emergency purchases, but projects were treated as permanent. For example, the New York City Department of General Services purchased modules for several thousand units of housing at the city jail at Riker's Island. These were termed temporary, although a spokesperson for that agency noted that "we expect these buildings to be around for a while" (Multz 1989). The product characteristics were only loosely related to the agency's definition of the permanency of the structure. Texas, which purchased pre-engineered buildings to house 3500 inmates in three state prisons defined the facilities as permanent. Pre-cast concrete modules in Boston were defined as temporary, as were the wood modules used on Riker's Island.

Savings from Off-the Shelf Technology

Almost all agencies surveyed reported that use of pre-manufactured packages saved time and reduced costs, and they made the purchases for that purpose. Owners reported that these projects were built (site assembled) as well as procured faster than possible under traditional methods. The Department of Energy and the Corps also reported cost savings. The DOE used the method to reduce the cost of facilities through the purchase of minimum quality construction, which it achieved, and the Corps claimed a cost reduction for equivalent facilities. Other agencies reported cost reductions and corresponding quality reductions, defining the pre-manufactured elements as a "non-standard" and less durable construction type.

States developed correctional facilities using pre-manufactured components, and these projects were included in a data bank developed by the National Institute of Justice. Overall, the NIJ collected data on 168 new correctional facilities for adults built between 1978 and 1988.\(^{10}\) Eleven were identified as design/build projects and eight of these used pre-manufactured building components. On average, the projects using pre-manufactured components were somewhat less expensive ($133.10 compared to $141.60 per square foot) but much faster to build (15 months versus 23.4 months) than other projects in the pool. However, the design/build projects averaged lower costs because of the use of different materials. Pre-manufactured components were made of wood and metals, and projects using wood modules were substantially less expensive than those masonry or concrete, as did most conventionally build facilities.

\(^{10}\) See Section D for a discussion of other projects in NIJ data bank.
C. What Do These Patterns Suggest?

Procurement

The primary barriers to the use of design/build by public agencies were regulatory, and agencies focused on crafting solutions to those problems. Since agencies faced similar problems in procurement, they developed similar solutions, a procurement model, that allowed agencies to match the requirements of public purchasing with a single design and construction contract. The features of that model include:

- The development by an outside consultant or other specialist of a document that detailed the agency’s requirements. That document acquired legal weight in the procurement process.
- Competitive design proposals, generally asking for a level of design completion of between 10 and 30 percent. Competitors bore some if not all of the proposal cost. During the competition, agencies generally did not negotiate with competitors.
- An evaluation process that weighed cost, quality and schedule.
- A negotiation process after award, during which unresolved details were worked out.

Savings in procurement time was an explicit agenda for some agencies. As a respondent from the GSA put it:

Design/build is primarily a procurement issue. Design/build reduces procurement by 50 percent. Instead of having to procure both an architect and a contractor, you just have to procure one entity (Feiner 1989).

Variations

"Pure" design/build and turnkey were the most significant variations of the method. In both cases, participation involved teams of traditional architectural firms and general contractors that participated in other public projects. Specific organizational arrangements varied: turnkey projects were led by developers, who added other services such as financing and land to the package. A certain level of tension and conflict in the development process was associated with projects undertaken by direct designer/builder teams, and in these projects owners struggled with design/builders over design control.

Production

With the exception of turnkey projects, almost every agency said that its use of design/build was motivated by the need to complete facilities quickly. Prisons were overcrowded or
under court order. Department of Defense agencies were feeling the scrutiny of Congress and pressure to expedite appropriated construction projects. In turn, these agencies reported that design/build saved considerable time on almost every project, cutting project development time from on the order of 5 to 7 years to about 3 years. The evidence was that this time saving was due to shorter processing time, which is that part of the production process under the control of the owner, and, less often, fast tracking of construction. The exception was construction time for pre-manufactured facilities, which was significantly faster than conventionally built projects, 4 to 6 months in the case of several corrections projects.

In general, cost efficiencies, defined as lower costs for equivalent quality, were not evident. Except for the Corps of Engineers (which evaluated two current projects) most agencies reported that the costs for design/build projects were comparable to costs under traditional methods for projects of comparable quality or that lower costs were associated with lower quality levels.

Claims for design/build included the generation of innovations in construction, but the survey revealed little evidence of this. Conventional methods prevailed for architectural design/build projects, and the use of single contract to purchase factory produced components was targeted to off-the-shelf products.

Figure 10
Public Design/Build versus Traditional and Integrated Firm Design
Relationship to Prior Experiments

Both the procurement process and production results were consistent with those of prior experiments. This raises an interesting point. If the results of such experiments are so ambiguous, what keeps agencies interested in them? One answer may be in that agencies are at least as concerned about the procurement process as with production, and the use of a single contract allows agencies to achieve efficiencies in this area.
IV. An Alternative Method of Procurement

In 1985 the Massachusetts Division of Capital Planning and Operations (DCPO) decided to test the design/build process for four projects. Later, the state proceeded with a fifth project. In this chapter I discuss the background of the initial decision, looking at the processes of procurement and building traditionally used by the state, the administrative crisis that made consideration of an innovation such as design/build possible, the precedents on which the DCPO planners relied, DCPO's decision to make the Nashua Street jail the "showcase" project for the method, and the agency's strategy to secure approval for the use of design/build. Later, we will see how conflicts in implementation grew from these roots of design/build as framed by DCPO. The most important conflict was between ideas about the procurement and production aspects of design/build.

DCPO saw design/build as a way to buy building services faster, a strategy designed to match an administrative crisis presented in the severe overcrowding of the correctional system. The agency had found traditional contracting to be too cumbersome, and DCPO's planners thought that shifting from traditional multiple contracts to an "alternative"¹ single contract would allow DCPO to develop projects more quickly. The planners collapsed into a single process the separate processes of designer selection and construction bidding, adapted the idea of the single contract to public procurement requirements for "fair and equitable" contract awards, and established tight production schedules for each project. DCPO saw in design/build a way to accelerate traditional building production for certain high priority projects.

A. Background: The Massachusetts Contracting System

The Massachusetts public contracting system was the product of decades of legislative decision making through which the traditional linear building process was progressively detailed, specified, and periodically reformed. The most recent reform, Chapter 579 of the Acts of 1980, sought to change the administrative apparatus by abolishing the state's Bureau of Building Construction (BBC) and creating a new agency, DCPO. In part the reforms transferred the BBC's procedures and employees to a new context.

¹ The identification of design/build as an alternative to the traditional method of procurement appears in the Ward Commission's Final Report (1980, 96).
1. The State's Building Agency

DCPO is a division of the Executive Office of Administration and Finance (A&F), the office responsible for the state's financial management. DCPO is responsible for the planning, development, and management of non-residential building projects for state agencies, the counties, and municipalities undertaking state funded projects. The head of DCPO, formally the deputy commissioner of the agency, is appointed by the secretary of A&F. In 1983, MIT professor and architect Tunney F. Lee was appointed to head DCPO. When Lee returned to MIT in 1986, John I. Carlson, Jr., former president of the design/build firm the Carlson Group, was named deputy commissioner.

Oversight of the contracting system is institutionalized in two forms. The state auditor undertakes periodic review of financial transactions, and the Office of the Inspector General (IG) investigates complaints about wrong doing in contracting and reviews proposed changes in contracting for potential waste, fraud and abuse. The inspector general is appointed jointly by the governor, the state auditor, and the attorney general. (See Figure 11).

DCPO builds institutional buildings such as state office buildings, public and mental health hospitals, facilities for the state college and university system, state prisons, and county courthouses, jails and houses of correction. The annual volume of construction has fluctuated since the agency's creation in 1980, ranging from a low of $51 million during 1982 to $253 million in 1984. During the period on which this case focuses, 1985 to 1988, the annual volume ranged from $150 to $190 million.2

2. How the Ward Commission Shaped the Building System

The administrative and legal framework governing DCPO in the 1980s was the work of the Ward Commission,3 seven private citizens appointed as a special purpose group in 1978 after several highly publicized scandals brought public attention to the problems of corruption in the award of building contracts. These citizens wanted to eliminate corruption as a "way of life in Massachusetts" and to bring professionalism and order to an "inchoate and inferior system of public administration"(Ward Commission 1980). The commission's work ended in 1980 with the publication of a 12 volume account of the problem and the passage of reform legislation, Chapter 579.

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3 Named for its chairman John William Ward, former president of Amherst College.
The Commission based the organization of DCPO and procedures for contracting on the traditional sequential method of design and construction. Three themes dominated the commission's view. The purchase of services from private entities should be isolated from the management of building projects. Public management should be professionalized. The process of building and the organization of the building agency should be rational and ordered according to traditional practices. The commission also institutionalized its own oversight function by creating a permanent watchdog agency, the Office of the Inspector General (IG), and its view of public construction was patterned after that of the Commission. According to commission member Peter Forbes, corruption was a product of the mismanagement of the traditional process, and legislation should make corruption by the dishonest difficult and expensive (Forbes 1989). These themes, and concern about potential corruption, exerted a strong influence on DCPO's definition of design/build.

*The Separation of Purchase and Management Decisions*

One reform removed authority for the selection of architects from the client, the public agency, and gave that authority to private professionals, predominantly other architects. The reason, according to Peter Forbes, were first that if clients were allowed to pick architects, the clients would pick people with whom they had worked previously, the relationship would become too cozy, and there would be no way for new people to enter the system. Private professionals were more competent to make such decisions (Forbes 1989). Second, honest designers should be protected from dishonest people in the legislature and the state administration. Forbes was the only architect on the commission, and he had an influential role in the recommendations about the design process.

The commission accomplished the separation of architect selection from project management by using an independent board, the Designer Selection Board (DSB) to select all firms providing design services to the state. Although the DSB was not a creation of the Ward Commission⁴, the reform legislation changed the structure and operation of the DSB. Before the passage of Chapter 579 the board had five members, and the BBC and project user agencies⁵ had each a vote. Chapter 579 gave the board eleven members, all volunteers. The DSB based its selection on qualifications, not of the price of services.

In contrast to the selection of designer services, construction services were bid in open competition. The commission provided for the pre-qualification of general contractors, to

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⁴ The DSB was created in 1967 based on legislation filed by Michael Dukakis when he was a representative from Brookline.

⁵ DCPO builds for other agencies of government that actually use the facilities, called "user agencies"
exclude those firms whose past work had been inferior or whose financial resources were too limited for projects of a certain scale. Otherwise, all contractors were presumed equal and the price of services the only variable.

**Bureaucratic Accountability versus Innovation**

The commission sought to rationalize the DCPO's administrative structure by specifying the processes of study, design and construction for all new buildings as an ordered sequence and by creating corresponding order in the organization of the new agency. Both reflected the traditional sequential method. The commission based its procedures on the sequential method for three reasons. The method was "rooted in the statutes and practice of the Commonwealth and many parties - both public and private - have vested interest in preserving the status quo". It was easy to assign and supervise the activities of individuals in the building process. "Not only are the activities readily distinguishable but so are the actors at each stage ("programmer", "designer", "contractor", etc.), and the role of the Commonwealth in overseeing them" (Ward Commission 1980, 7:95). Finally, the commission had found state employees to be so inept that it decided they should first learn to manage the familiar method before attempting anything more sophisticated.

"The evidence is overwhelming that the ability of the Commonwealth to administer even the conventional sequential process is sorely lacking. It is, therefore, first necessary for the Commonwealth to strengthen its ability in that area before moving into one which typically requires considerably more expertise, resources, and judgement. (Ward Commission 1980, 7:96)

Accordingly, Chapter 579 defined each step of DCPO's standard process for the study, design and construction of building projects. To assure accountability within the bureaucracy, the law first defined responsibility for decisions and then specified procedures for decision making.

The Ward Commission left the door ajar for procedural innovation, to be explored at some future date.

Nonetheless, the Commission feels that although no new procurement process should be written into law at this stage, it is a matter which those responsible for building projects should reflect upon and, when appropriate, should make recommendations on a case by case basis (Ward Commission 1980, 7:96).

Following this logic, the commission included in Chapter 579 provisions for DCPO's deputy commissioner to research innovative methods of project delivery and to propose alternative methods of procurement such as design/build. I refer this as the "alternative methods" provision of Chapter 579.
Oversight by a Watchdog Agency

The Ward Commission also created an Office of the Inspector General. The commission, which had a limited purpose and life span, wanted to institutionalize its work, and it saw the Office of the Inspector General as a permanent "mechanism for self-criticism and self correction - to prevent and detect fraud and waste" in government procurement (Ward Commission, "Statement", 1980, 19). In 1981, then governor Ed King appointed Joseph R. Barresi, an attorney, as the first inspector general. Barresi remained in office throughout the 1980s.

The Office of the Inspector General was independent of the three branches of government. If anything, Barresi saw himself reporting to the legislature. He took his direction from the Ward Commission, from Chapter 579 and from the twelve volume report prepared by the commission as its final act. The inspector general's responsibility was to detect, i.e. investigate charges of corruption and to prevent, i.e. to look for areas prone to corruption or vulnerable to waste, so that the situation confronted by the commission when it began its work in 1978, the massive amounts of corruption and waste in government, could not recur.

Barresi organized his office into divisions focusing on judicial processes (for formal investigations of wrong-doing) and management (where there was the potential for waste or wrongdoing), with support divisions such as engineering. On management questions, the IG worked directly with administrative agencies. The IG also issued public letters to the legislature when he felt there were overriding issues of public concern or if the administrative agencies disregarded his advice in some matter. The legislature had failed to give the IG authority to investigate its own activities, which the Ward Commission had recommended, so the IG's focus was on the administrative agencies such as DCPO and agencies of the counties and municipalities contracting for work with private entities.

The Ward Commission wanted to improve the management of the traditional sequential process and making it corruption free. Barresi took that as his purpose as well, and he was reluctant to support risky changes in traditional methods that threatened the "protections" against abuse created by the Ward Commission reforms, and he saw his office as inherently cautious and conservative. Barresi was trained in the advocacy system of law, and he saw his job as alerting the public and the legislature to potential problems as well as actual violations of the law.
Summary

Three themes guided the Ward Commission's efforts to make corruption in traditional building contracts difficult and expensive: the isolation of procurement from management, a system of bureaucratic accountability—that is a hierarchy of responsibility and decision making procedure, and, as a check on the system, a watchdog. The commission also implied that an alternative system might be possible in the future, but such a system would depend on the eventual development within the bureaucracy of expertise, resources and judgement.

In developing the state's design/build method, DCPO retained the underlying themes articulated by the commission and adapted these to a new system. The problem was that systems for accountability and control, effective for a building system in which actors are separated and functions rationalized, was not effective for a production process premised on the integration and overlapping of functions and the exercise of professional judgement.

Figure 11 depicts the organization of the building and oversight functions in Massachusetts.
Figure 11

DCPO in the State Administration
B. Origins of DCPO Design/Build: The Limitations of Traditional Methods

Design/Build as an innovation resulted from converging conflicts. The new architects and planners that Tunney Lee had brought to DCPO to professionalize the management of public projects, who were interested in bringing sophistication and innovation to the public sector, faced a highly prescribed contracting process seen by the planners as giving them limited room for professional discretion. Second the building system created by the Ward Commission seemed unable to respond to an immediate administrative crisis, the need for rapid expansion of the state's correctional system.

The contracting system was under pressure on two fronts, and the pressure was sufficient to make the DCPO experiment with design/build possible. DCPO planners wanted to innovate. The governor, the legislature, the Department of Correction and the county sheriffs wanted new facilities quickly. Tunney Lee argued that to speed production for the designated projects, the legislature would have to authorize DCPO to abandon the sequential method (Lee 1985).

The origins of design/build are important because they imposed on the DCPO experiment a sense of urgency. That meant that while the application of the design/build method to corrections projects was a test of the method, there was little room for mistakes. The urgent need for the particular facilities drove implementation.

1. The Agenda for DCPO: Professionalize and Innovate

Tunney Lee became deputy commissioner when DCPO was only two years old, and many of the Ward Commission reforms remained to be implemented. The new agency needed new staff and new procedures. Lee also wanted to make state design projects attractive to reputable local firms that had avoided state work during the previous decade.

_DCP0 Includes New and Old Employees._

The Ward Commission wanted to professionalize the management of public building, and Lee did that by hiring a number of people new to state employment, many from MIT. Not all of DCPO's employees were new, however. In the transition from the former Bureau of Building Construction, DCPO had inherited a number of BBC employees. Many had taken jobs in the new Offices of Project Management, created to supervise the design and construction of major new construction and renovation projects, and Facilities Management, which had parallel responsibilities for repair and maintenance projects. These offices
consolidated activities which had previously been done by the BBC in its offices of engineering and construction.

Chapter 579 had created a new agency and a new system of administration for building projects, and Lee's other responsibility was to put the Ward Commission's procedural reforms in place. According to Lee (1988), the most important feature of the traditional procedures for design and construction was that they were "idiot proof. Any idiot could manage the process." Lee wanted to give his staff new procedural tools with which to work, i.e. to allow them to make professional judgements rather than just run bureaucratic processes. Before he agreed to take the DCPO position, Lee had read Chapter 579 carefully to see how much latitude it allowed, and he saw the potential for such tools in the alternative methods clause of Chapter 579. Alternatives such as design/build would allow a kind of discretionary decision-making impossible under the traditional design and construction process, and Lee saw design/build as a new tool that would allow DCPO staff, especially the planners in the Office of Programming, to carry out the reform intent of the Ward Commission without the constraints of Chapter 579.

Lee Reaches Out to Local Architectural Community

Lee also wanted to attract high quality firms to state work, and to do that he used his connections to the local architectural community. DCPO held open workshops for design firms, to let them know in advance of projects the state was about to undertake, that the agency welcomed top quality firms, and that it valued and would reward quality. DCPO also instituted a program of design awards, to recognize the best studies and the best architectural designs for state building projects.

2. A Product of Reform: Cumbersome Traditional Procedures

By 1985, the task of reforming the new bureaucracy was substantially complete. The DSB had been restructured. Programming was now a formal process independent of design and under a separate office of the agency. The Offices of Project and Facilities Management were in full operation, and a computerized project tracking and control system, known as CAPICS, was in place.

Procedures for project administration were also in place. Projects moved through the sequences of development and through DCPO as if through a pipeline. The entire sequence divided into discrete tasks, each supervised by a particular entity within DCPO: the DSB, the Office of Contracts, the Office of Programming, back to the DSB, the Office of Contracts, the

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6 Computerized Accounting and Project Informations Control System. The Ward Commission had mandated such a system as part of the reform.
Office of Project Management, the Bid Room, and back to the Office of Project Management. In addition, there were various prescribed approvals by user agencies and others. Each task was prepared for, executed, and confirmed, frequently in writing, before the next step could occur.

Despite staff dissatisfaction with its cumbersomeness, this process was the major point of reference used by DCPO planners in creating the design/build method. The new method retained old features such as the program requirements, designer screening by the DSB, contractor pre-qualification, lump sum bidding, traditional design documentation, and traditional oversight.

*Programming as Design Regulation*

In its final report, the Ward Commission had labelled programming the most neglected of the state's capital planning activities, its neglect by the BBC had caused schedule delays, cost over-runs, design failure, and project abandonment. Ward commission member Peter Forbes explained the problem this way. In the "old days", architects had provided services to the state at fees tied to the cost of construction--the bigger the project, the bigger the fee. Some architects had consciously enlarged project scopes to generate bigger fees. The commission felt that if you could fix the project scope through the program, you could prevent over design (Forbes 1989).

That reasoning led to the requirement that studies be completed prior to final design, preferably prior to the decision to approve construction funds. The study was a legal document, "certified" by the user agency and DCPO. This document controlled the eventual square footage of the building project, limiting deviations to no more than 10 percent of the "certified program". By controlling the scale of the project, the study would prevent over-design and the inflation of fees. Programming was strictly separated from design, and Chapter 579 restricted firms providing programming services from providing subsequent design services for those projects. Studies were the responsibility of the Office of Programming.

*Programming as a Formal Practice*

One of Lee's recruits from MIT was Deborah Poodry, whom Lee appointed as the director of the new Office of Programming in 1984. She in turn brought many new architects and planners to DCPO and the Office of Programming. Poodry directed the office until 1989.

Guided by Chapter 579, Poodry established a formal "study process" and format for building programs. The program included an evaluation of site conditions, detailed descriptions of building areas, an assessment of design alternatives, a sample schematic
design, "outline specifications", and a cost estimate. Architectural firms selected by the DSB prepared most studies.

The legal status of the study meant the study had to be accurate, and one problem Poodry had faced was the difficulty in developing accurate cost estimates prior to actual project design. Her approach was to increase the accuracy of the estimate by improving the level of detail of the study and by requiring that consultants use independent cost estimators. Thus, while Chapter 579 said nothing about the inclusion of a schematic design nor specifications in the study, Poodry felt these details were needed by the independent cost estimators. Final designers were not to be bound by the study schematic or specifications, only by the certified gross building area, so the freedom of the final designer was not compromised. The cost of the final project was bound by the amount of capital appropriated by the legislature.

**Final Design as a Sequential Process**

Final design involved its own formal sequence: schematic design, design development, working drawings and specifications. Architects submitted documents at the ends of each phases for formal review by DCPO and the user agency. Project management staff followed written standard procedures in its activities. Many of these procedures had remained unchanged through the reforms. For example, the standard "Instructions for Designers and Standard Specifications" in use in 1985 had been used by the BBC at least since 1973.

The first step was designer selection. Upon completion of the study the Office of Programming notified the Designer Selection Board to advertise for an architect, and a project moved from the jurisdiction of the Office of Programming to the Office of Project Management. The DSB advertised a set fee and selected designers according to their qualifications. Designers submitted qualifications and design brochures, and the eleven member board considered and ranked the applicants. The DCPO deputy commissioner made the final award, providing justification in writing if the first ranked designer was not given the contract.

The director of the Office of Project Management assigned a project manager, and during construction, resident engineers to each project. Both positions were creations of the Ward Commission. The project manager was to be the single person accountable for each project; s/he provided overall supervision of the project throughout design and construction and was responsible for guaranteeing that the design conformed to the study. The resident engineer replaced the architects’ clerks of the works. The commission had found the clerks to be underpaid by architects, who tended to use up their fees in design, and the commission had found a pattern of collusion between the clerks and contractors. As a solution, the commission
decided that the state should supervise construction work with its own employees, resident engineers, assigned full time to each project.

*Buying Construction Services According to Price*

The dominant criteria for the purchase of construction services from general and subcontractors was price. The Ward Commission had attempted to introduce non-price criteria, with limited success. The commission succeeded in establishing a contractor pre-qualification process, with threshold requirements for general contractors. DCPO relied on bonding companies for financial evaluations and used contractors' past experience to determine the size of projects for which contractors were eligible to bid. The commission failed in its efforts to allow general contractors to choose their own sub-contractors without separate sub-bidding.

The price basis for subcontractor selection was a feature of the state's filed sub-bid law, that required separate competitive bidding by sub-contractors in sixteen individual trades prior to bids by general contractors. General contractors were required to use sub-bidders listed by DCPO in the relevant trades. General contract awards went to the lowest eligible general contractor, who built up his price using the subcontractor bids plus the cost of his own work, overhead and profit. The Ward Commission had found that the low bid requirement and the filed sub-bid removed from the general contractor the power to put together his own team, diffused responsibility for performance, and thus "maximize[d] the probability that construction work will be poor" (Ward Commission "Statement", 1980,17). Nevertheless, the legislature had refused to repeal the law.

Figure 12 describes the steps in the DCPO building process.
Figure 12
The DCPO Building Program

The Time Costs of the Procedures

Assuming nothing interrupted the process, typical DCPO projects took 4 to 6 or more years, depending on the project size. DCPO staff estimated project schedules by identifying each step in the sequence, estimating a time for each activity, and adding activity times together. By 1985, DCPO had completed the installation of its CAPICS system, which created a standardized schedule for various tasks based on past experience with projects of different size. According to CAPICS, studies averaged 228 days (contracts under $100,000) to 375 days (larger projects) after the selection of a study consultant. Design and bidding took between 353 days (projects of under $1 million) to 593 days (projects over $10 million). DESIGNER SELECTION and contracting with the designer generally took 4 to 5 months. Using these standards, DCPO could estimate the schedule for the study, design and construction of projects of $1 to $5 million to be somewhat over 4 years. A project of over $20 million, such as the Nashua Street Jail would take 6 1/2 years.

3. Prison Overcrowding: Dilemma for Traditional Process

The deliberate pace of building projects moving through the DCPO pipeline was a problem when policy makers and user agencies, such as the governor, the legislature, and the Department of Correction, wanted fast action such as rapid construction of new jails and prisons. DCPO faced such a problem in 1985. The governor and the legislature, responding to increasingly grim reports by the Department of Correction and the county sheriffs about overcrowding and obsolescence in existing facilities, had decided to fund the expansion of existing and the construction of new prisons and jails across the state. Once the decision was made, these elected officials wanted quick delivery of the new facilities. According to DCPO projections, however, under traditional procedures new facilities could not be delivered in less than 4 to 6 years, a slow response to what had been defined politically as "an urgent need right now" (Dukakis 1985, 19).

Overcrowding of jails and prisons had been a growing problem in Massachusetts and the country in the late 1970s and early 1980s. In Massachusetts, increasing commitments by the courts to corrections facilities caused the prison population to swell dramatically after 1980. In a special message to the legislature on the prison overcrowding problem, Massachusetts Governor Michael Dukakis reported that as of April, 1985, the Department of Correction was housing 5121 inmates in space designed for 3500. There was similar overcrowding at the county level.

As described in the governor's statement,
a walk through one of our correctional institutions provides one with an immediate and overwhelming sense of the human consequences of such overcrowding. Temporary beds have been placed in every available space within our prisons. Inmates are housed in industrial buildings, recreational space, program space, office and hospital space. Many prison cells are double bunked; some are triple bunked (Dukakis 1985, 2-3).

The following chart was included in Dukakis' Special Message

Figure 13
Commitments to Massachusetts Correctional Facilities 1974 to 1984

The governor attributed increases in inmate population to the growth in the at risk population during the 1970s, longer sentences, increased rates of commitment relative to crime (which he reported had declined dramatically in the previous two years) and, at the county level, increased enforcement of drunk driving laws. The governor projected continued growth through 1989.

Dukakis' statement both reported the magnitude of the local problem and requested funds to expand the state and county systems, adding 1124 permanent state beds through the renovation of two and the expansion of six facilities. The state would also provide financial assistance to the counties to build new facilities. The governor proposed leasing modular buildings for temporary housing, and he proposed increasing the use of punishment programs which did not involve housing persons in state institutions, such as intensive parole. The legislature subsequently approved $273 million, more than double the governor's initial request, in the 1985 Prison Construction Bill.
Lee and his staff, had provided extensive assistance in the preparation of the governor's funding request. They believed development schedules of 4 to 6 years were unacceptable given the immediate overcrowding crisis. Lee's reading of Chapter 579 persuaded him that despite the focus on the sequential method, the legislation contained a room to explore non-traditional methods. Chapter 579 directed DCPO's deputy commissioner to undertake research on innovative methods for project delivery and to propose procurement methods such as design/build in budget recommendations.

During the preparation of the special funding request for prisons, Lee met with A. Joseph DeNucci, chairman of the Joint Legislative Committee on Human Services and Elderly Affairs, responsible for corrections legislation, to talk about prison construction. One of DeNucci's constituents, a builder, was present, and the three discussed the Chapter 579 "process" and the impact on building schedules. Lee suggested that alternatives such as design/build could speed up the process, and the builder agreed. DeNucci asked Lee to draft a provision in the special message allowing the use of alternative methods for prisons, and he promised to "put his weight behind the provision" (Lee 1989).

Lee included a proposal to use "alternative construction and procurement methods" for the expansion of six facilities in the special message. Four were estimated to cost under $4 million, one was estimated to be $7.6 and the other $10.5 million. Actual methods would be determined after an evaluation of the alternatives. The evaluation was to be done in consultation with the affected state agencies and an advisory committee consisting of the inspector general, a person experienced with alternative methods, and a person experienced with corrections construction.

Shortly after the governor delivered the funding request, Lee asked Deborah Poodry and her staff in the Office of Programming to begin an evaluation of alternatives to traditional methods. There were two questions: what alternative method should DCPO propose and for which of the six facilities should be method be used? Later, the Office of Programming also prepared the specific DCPO Design/Build procedures.
C. Two Ideas Shape DCPO’s Design/Build Method

As DCPO framed it, the contracting system embedded in Chapter 579 and previous legislation was the real problem. It tied the hands of the agency's planners, making it impossible for them to respond to the current crisis. The contracting system was a function of the procurement process, thus the solution was to change procurement. DCPO narrowed its search to the ways the state might purchase design and construction services more quickly. The agency did not look at how changes in procurement might affect how designers and builders provide services, i.e. the processes of design and production of buildings.

In creating a procurement strategy that varied from Chapter 579 procedures, DCPO planners nevertheless were strongly influenced by the legacy of the Ward Commission, by a residual paranoia about potential corruption and by ideas about its source and prevention. The planners used the commission's ideas about the separation of procurement and management, distinguishing between decisions to be made by state employees and those to be made by "professionals" who were outside of the state system. The new contracting method would have to survive the scrutiny of the watch dog, the inspector general, and the IG favored clear bureaucratic accountability. The contracting method thus had to have written procedures assigning decision making responsibility to specific individuals.

DCPO planners used several public and private models, but in the final choice of design/build, the most important procedural precedents came from other public owners who had faced similar dilemmas in buying services from private entities. The use of public procurement models reflected and reinforced DCPO's assumption that the design/build method was most importantly a new way to buy services. It allowed private entities to decide the best way to design, produce, and manage projects. For example, DCPO relied heavily on turnkey housing contracts as models. The turnkey method packaged traditional design and construction services, substituting a private owner for a public owner during the production process.

1. Private Professionals Advise on Method

The legislature had to approve the use of any procurement method not defined in Chapter 579. Initially, Lee wanted the legislature to approve in general the use of alternative methods for the correctional facilities funded in the 1985 Prison Construction Bill. The inspector general and several outside professionals would then assist Lee to determine which alternatives to use. When Lee decided on particular methods for particular projects, he would first file a report with the inspector general for his review, and then he would proceed. This
strategy left Lee with discretion over methods and projects within a general legislative agreement. The governor’s special message described this approach.

Through his assistant Stephen E. Cotton, the inspector general responded immediately and negatively to the proposal. He declined to serve on an advisory committee, and he charged that the proposal "would allow this or a later administration to remove every safeguard put in place by the Ward Commission with respect to defining these projects, calculating costs, selecting designers, examining the qualifications of contractors, and bidding competitively." This immediately placed DCPO and the inspector general in an adversarial relationship over alternatives to the procedures prescribed in Chapter 579. The inspector general would view any changes to Chapter 579 as "flouting the law."  

The inspector general's stand set the stage for DCPO to define "urgency" as the major criterion for the use of design/build. The IG’s public position was that all that stood between the state and the rampant corruption of the past was Chapter 579. There were two implications. DCPO had to find a way to say that the alternative methods were necessary not because of the failure of Chapter 579, i.e. the failure of the Ward Commission reforms, but that some circumstances were so special that they required special exemptions. The urgent need for corrections facilities fit that requirement. DCPO also had to craft a new method that looked as much like the traditional method as possible.

The legislature responded to the inspector general's comments by requiring that Lee provide to the legislature a written report specifying the procedures for alternative methods and the projects. Lee's report would first go to the IG, who would provide his comments to the legislature prior to approval of alternative method for specific projects. This left the IG with the opportunity to advise the legislature directly on Lee's process and projects requests, and it bound DCPO to the written procedures. The legislature asked Lee to submit his report by October 1985.

Lee proceeded to assemble a "professional advisory committee" without Barresi's participation, drawing on private professionals outside of state government, from the design and construction industry, to assist in coming up with a recommendation for the prison projects. For specific advice on construction issues, Lee asked James Becker, senior vice president of the Beacon Companies, and Henry Irwig, director of administration and planning for the Beacon Construction Company, to participate. Both were formerly professors in the Department of Civil Engineering at MIT. Lee also asked former Ward Commission member Peter Forbes to be on the committee. As Lee defined his strategy: "The inspector general was

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using Chapter 579 as his rationale to oppose alternative methods. I wanted Forbes on the committee to counter the inspector general" (1988).

The fourth member was Jack Carlson, to be Lee's successor as deputy commissioner of DCPO. Carlson had been president and chief executive officer of the Carlson Group, a design/build firm based in Cochituate, and in the late 1950s he had transformed his father's construction company into a full service design/build firm. Carlson had recently sold his interest in the company, and he had expressed an interest in serving Governor Dukakis in some area. A&F Secretary Frank Keefe and Lee had met with Carlson early in 1985 to discuss his taking the job of DCPO deputy commissioner when Lee returned to MIT the following year. To ease the transition, Lee brought Carlson in on an "informal basis" as a member of his advisory committee.

2. The Necessity for Radical Change

To effectively cut through the contracting system, any new method had to materially change traditional contracts and thus traditional methods. Tinkering with traditional methods left DCPO bound by the existing system of laws. DCPO planners narrowed the various options to design/build early in the process, devoting most of their time to ways to adapt what they saw as an essentially "private sector" method to the public sector.

The departure from traditional methods pitted DCPO's planners and outside professionals against DCPO's Office of Project Management, which had already demonstrated that it could shorten the traditional process considerably for projects similar in scale to the four smaller prison expansions. For a recent $4 million hospital project, DCPO project managers had shortened the designer selection process to one month, cut design to 4 months, and provided a bonus for early completion of construction. Similarly, the project managers had accelerated the design and construction of a recent $4 million jail expansion, completing the design in 45 days and the total facility within one year of the start of design.

Internally, DCPO planners argued that special circumstances attended these examples and that any alternatives should be measured against the "typical" performance of the agency as reported by CAPICS. DCPO first estimated the time saving that might accrue if the state used a fast-track construction schedule. Under such a method, the architect would complete design packages according to the sequence of construction, and early contracts could be bid and construction begun while design for the remaining elements was being completed. The state would hire a construction manager to coordinate the entire process. CM, as it was known, could cut 8 months off the typical construction schedule. On the other hand, design/build could cut 15 to 21 months, saving time in procurement, bidding, and in construction.
The planners rejected construction management because of the time factor and because CM's reputation in the state was tainted. The scandal that led to the establishment of the Ward Commission involved the corrupt purchase of a construction management contract and Lee felt that the legislature and the inspector general would not accept construction management as first alternative to Chapter 579. Another option was a turnkey contract, using a private developer to provide financing, land and design and construction services. The planners thought that turnkey could have offered savings equivalent to design/build, however, they saw the use of a private developer for prisons as too radical to pass the legislature, and Lee's experience with turnkey public housing projects indicated that it would be too difficult to control the design and quality. DCPO planners decided to create in design/build a modified turnkey process.

Design/build would replace with a one time selection a triple process—the selection of an architect, filed sub-bids, and general construction bids. The consolidation of designer and contractor selection would generate time efficiencies in procurement. Because the builder would be assured of the contract before the start of construction, the state would also save time in mobilization.

According to Lee, the control issue "pushed people away from the other alternatives. There were negative experiences with those alternatives. But no one had tried design/build in the public sector, so there were no negatives"(1988). Given that, Jack Carlson's input on the advisory committee and his future role at DCPO became significant. "He had done design/build before, he had a lot of confidence in the method, he knew how to make it work"(Lee 1988).

Thus DCPO planners disposed of the other alternatives, including accelerating the traditional process, early in the evaluation, and they concentrated on how to structure a design/build process to address the technical and political realities. Lee's report to the legislature focused on making the case for design/build; the evaluation of alternatives was included as an appendix.

3. The Precedents That Shaped DCPO Design/Build

Both Lee and Carlson saw design/build as a method used by private owners and the central problem the relationship between the design/builder and the public owners. However, each had a different perspective. Lee saw things as a public owner, Carlson as a design/builder.

Lee's view was that design/build was a more controllable version of the turnkey housing developments with which he had been involved when he was in private practice. He also saw the single contract as a mechanism to simplify DCPO procedures just as it had simplified procurement of housing by local housing authorities in Cambridge and Boston. The
design/build team, like the private developer's team, would take care of production. DCPO's task was to build accountability and control into the system (Lee 1988).

Carlson saw the problem as adapting the typical business relationship between a private owner, which most of Carlson's clients had been, and the firm to one between a public owner and the firm. Like Lee, Carlson assumed the firm would take care of production issues. His goal was to cause design/builders to see government agencies as potential customers.

Lee's Image: Private Developers and Turnkey Housing

Lee had direct experience with turnkey housing while in private practice, and he turned to local housing authority staff and developers involved in public housing projects in Boston and Cambridge for advice on design/build. Lee saw the projects themselves as the equivalent of housing. Five of the six prisons were minimum security facilities which shared many design features of college dormitories. Only one of the projects, a classification center in Concord, was really a prison, a "hard facility" within a walled compound. The owners were public agencies, like DCPO. The developers, in addition to providing financing, assembled the architect and contractors into a team and provided design and construction services in a package.

The housing authority staff advised DCPO to exert maximum control over the process. The public agency should be very clear about what it wanted in the Request for Proposals, anticipate conflicts over details, and build in negotiating leverage for itself as far into the process as possible. One person suggested that a set of design specifications should be included, written by an "outside" specification writer. According to the experience of these agencies, anything in doubt would become a painful issue. Developers would tend to cut corners and cheat the customer. This squared with what a state architect in California had told Lee previously: "Don't do turnkey unless you have a complete set of documents" (Lee 1988). The agencies did suggest that there might be a trade-off between a high degree of specificity and control versus speed and the ability to take advantage of innovation. The weight of the advice, however, involved strategies to control the developer.

The developers raised a different set of issues. They suggested that DCPO should avoid the tendency to distrust the private sector for being in business to make money. The problems these developers had had with the turnkey projects involved "sophisticated smart housing authority staff, with a basis distrust of the private sector, wanting to get too involved in making big decisions" and intruding on the developers decision-making territory. They felt that the agencies had become inappropriately involved in decisions over design details. More

9 Meeting of 7/17/85.
important. DCPO should establish a good management system, centralize project decision-making, streamline document review, and make the rules of the game clear to the competitors. Beyond that, the agency should pick people it trusted and then let them do their jobs, to allow them to do what they did well.

*Carlson's Image: Design/Build Firms*

Carlson saw DCPO's problem as attracting firms used to working for private clients to do public work, and he saw the attractiveness of the bid package as an important component in DCPO's marketing strategy. Carlson concentrated on how to attract the design/build firm. Carlson visited each of the six prisons: DCPO was considering for design/build expansions, and he considered how a design/build builder would respond to each project. He recommended that only three of the projects be delivered using design/build. He found the other three projects to be too simple or too remotely located to be attractive to big design/build firms. Such projects could better be done by local contractors. He also recommended that DCPO offer a contract of $15 to $20 million, defined as a threshold amount to attract national firms. None of the project budgets were close to this amount, so he suggested packaging the three projects in one contract.

The customers of his firm had been primarily private owners. There were important structural differences between public and private clients. The Carlson Group did not bid its services; it had relied on its reputation for integrity and high quality service to be invited to propose services to clients. In a proposal, the firm outlined an approach to the client's building problem and guaranteed a maximum price for the work. Unlike the practice of the Austin Company, for example, Carlson's firm absorbed some of the costs of preparing proposals as a marketing expense. Once the proposal was accepted, the firm worked closely with the client through the design and construction decisions. The firm's books were open to the client from the beginning, so the client could see the cost implications of each decision. If the firm completed the project at less than the guarantee maximum price, the client and the firm would share the savings.

Carlson described the relationship between the design/build and the client as a "team approach", and he believed that a successful relationship should be based on mutual trust between the owner and the design/build. His firm worked to maintain a positive relationship with owners throughout the building process, since the reputation of the firm was the primary source of new work. The team concept operated within the firm as well: Carlson's organization incorporated separate design and construction entities within the umbrella firm: the Aldrich Co (design) and Carlson Corporation (construction), and project teams drew people from throughout the organization (Wilhelm 1975).
4. The Method as a Hybrid Process

The procurement process created by DCPO was a hybrid, including elements from Lee's turnkey model, Carlson's private firm model, traditional selection processes, and traditional contracts. The process collapsed the sequential purchase of design and construction services using multiple contracts into a single step. Through its roots in traditional contracting, DCPO design/build retained the ideas of the Ward Commission about how to prevent corruption in the purchase of services and how to ensure accountability and control in contract administration.

The DCPO process began with a pre-design phase modelled on the study. An independent board modelled after the DSB, to be called the Design Build Selection Board (DBSB) would review the qualifications of interested design/builders and invite entities to prepare proposals. The proposals would be equivalent to schematic design, and design/builders would receive some compensation for their work, as had Carlson's firm. The price, a lump sum, would be fixed at the time of proposal submission. The DDBSB would evaluate and rank proposals and make a final selection. There would be a two phase contract, one for design and one for construction.

Designer Selection as Model for Choosing a Design/Builder

To achieve its single contract system, DCPO blended elements of the sequential selection of designers and bidding of construction. Key elements were the selection of design/builders by an independent board, the Design Build Selection Board (DBSB) and the sequencing of the selection process into qualification, proposal and bid phases.

A working hypothesis of the Commission had been,

that corruption involving public officials was most likely to occur at the point where discretion was exercised by a public official, and where substantial sums of money and profits were to be made by private firms who were the beneficiaries of the public officials' discretionary action (Ward Commission 1980, vol 9,78).

The selection of a design/build team, like the selection of a designer, involved discretion, thus Lee decided to create the DDBSB patterned after the DSB.

A crucial adaptation was the DDBSB. In other circumstances, I would have allowed the deputy commissioner to make the decision. The ultimate model is the Boston Redevelopment Authority. You issue an RFP. The staff evaluates the proposals, and the executive director makes a decision, with the approval of the board. That model would never fly. The question was how to remove the decision from the deputy commissioner without going to a low bid (Lee 1988).
Lee proposed that the governor appoint to the DBSB members with expertise in construction, design, and corrections, to evaluate and rank qualifications and project proposals submitted by design/builders.

The selection process would occur in steps. First, the DBSB would screen design/builders for qualifications. Then, qualified entities or teams would submit project proposals to DCPO. Project proposals would include designs, technical descriptions of materials, and lump sum bids. Staff would analyze (but not evaluate) the submissions. The DBSB would then evaluate the proposals and rank them, first on the basis of the quality of the technical proposal, then on the basis of price, and advise DCPO's deputy commissioner of its recommendation for the final award. If the deputy commissioner did not select the top ranked candidate, s/he would justify the selection in writing.

**Qualifying Designers and Builders as Design/Builders**

The process of qualifying design/builders in turn joined the traditional designer selection and contractor pre-qualification. The "design" and "build" components of the entity would be qualified separately from the entity or team itself. The "design component" would have to meet the requirements the DSB had established for all state architectural firms, including the provision of professional liability insurance. In a parallel way, the "build component" would be pre-qualified as if it were seeking a general contract for the project, and the builder would have to provide bid and performance bonds.

The competition was defined broadly, open to the design/build firms Carlson hoped would apply and turnkey type teams of general contractors and architects. Carlson believed that the success of design/build rested on the quality of the design/build organization, and he preferred that the organization be an integrated design/build firm. If not, teams should include highly qualified architectural firms and general contractors who had a history of successful work together. He believed it was important that the builder not just be a "manager" but a contractor, capable of doing the work with his own forces even if he chose to subcontract most of the work. The bonding requirement would exclude construction managers as well as shell entities—those with no assets or resources to which the state could turn in case of problems.

Based on its evaluation of design.builder qualifications, the DBSB would invite those most qualified to submit proposals. DCPO would establish project performance requirements, a maximum price, and a maximum development schedule. Design/builders would propose specific designs and specifications, incorporating the appropriate innovations and economies in its proposal.
The proposal phase incorporated two features Carlson felt were critical to attract large design/build firms. First, the number of proposals was restricted, so each competitor would have a reasonable chance of winning the contract. The state could not informally restrict the competition to a select group of bidders, as private owners might do, so it relied on a set of formal requirements for applicants, spelled out in DCPO's Request for Qualifications. Second, competitors were to be compensated in part for the preparation of proposals through the payment of honoraria.

Using the Program to Control Design

Lee was concerned about the ability of the agency to control the process, to make sure the final product met the state's requirements, an issue emphasized by the housing authorities. DCPO included several mechanisms in its method to ensure this control. First, DCPO would retain the Chapter 579 requirement that a certified study be completed for all design/build projects prior to issuing the request for proposals. The study, including cost estimates and outline specifications, would be the single most important aspect of the process (Lee 1985).

The requirements of the study were expanded to become the basis of a Request for Proposals (RFP). The most important change was the expansion of the outline specifications into a separate set of "technical requirements". The study cost estimate became the basis for the maximum budget for each project, which DCPO specified in the RFP. The program fixed the maximum size of the facility.

Entities would submit relatively detailed design proposals, at least at the level of schematic design, in response to the RFP. The DCPO staff would review the proposals for completeness and conformity to the RFP, and it would "array" the information for the benefit of the DBSB. The DBSB would evaluate and rank the proposals, first without reference to cost, then considering the cost. The entity with the first ranked proposal would receive the award. At that point, the design, the price, and the schedule became part of the contract between DCPO and the design-builder.

DCPO would require that the design/builder complete design documents prior to the start of construction. DCPO would also assign a full time project manager to the design/build projects and resident engineers at each site to provide on-site inspections and monitor the day to day work.

The Design/Build Contract as Linked Traditional Contracts

Initially, DCPO planned to use a two phase contract, phase one at the contract award, which would essentially be a design contract, and the second at the end of design, authorizing construction. The development of the schematic into design development and construction
documents would occur after the contract award, through interaction between the designer and the builder. This interaction, begun during the development of the proposal would generate beneficial efficiencies and innovation, and the design would reflect the special knowledge and skills of the builder. Technical innovation would occur because the bidders themselves, who were most knowledgeable about building methods, would propose the technology. Once design was complete DCPO would execute the second phase of the contract, and construction would begin.

Because it eliminated lump sum bidding based on completed documents, the design/build process also eliminated the requirement for filed sub-bids. Peter Forbes indicated that the elimination of this requirement was one reason he supported design/build. "Design/build was the thin entering wedge to get rid of the filed sub/bid law" (Forbes 1989).

5. A New Management Structure for the New Process

The quality of management was highly dependent on staff, and the management of the new method presented a dilemma. The advocates of design/build were in the Office of Programming, but they were new to state work and relatively inexperienced in project management. Formally, responsibility for project management rested with the Office of Project Management, but a large proportion of its staff had come from the old BBC. These project managers were accustomed to managing traditional contracts and were skeptical about design/build. They were concerned that advocating design/build implied that the traditional procedures had failed and reflected poorly on their substantial efforts to make Chapter 579 and thus the reforms of the Ward Commission work. The director of project management framed the problem in response to one of the early drafts of the design/build report: "In my opinion, the report is more than discourteous to those personnel who have worked diligently to improve a process under difficult conditions, - work load, restrictions, changes in laws etc."(Correia 1985). Office of Programming staff felt differently. A successful experience with one kind of innovation might lead to other innovations and other applications.

Turney Lee solved the problem in two ways. First, under design/build, the Office of Programming would have an expanded role in the management of projects, not turning this responsibility over to project management staff until after contract was awarded. At that point, project management would assign resident engineers to the project. Second, DCPO would establish a separate unit known as the Corrections Special Unit to manage all corrections projects. The special unit would be staffed with hand picked people. DCPO would hire an experienced project manager for the design/build projects. Jack Carlson also would be available to provide specific advice. (See Figure 11).
The special unit would itself be an integrated team of programming, project management, facilities management and support contract management, financial and legal staff. Initially, the special unit was to be a loose matrix superimposed on the formal DCPO organization. The special unit would have a "coordinator" to centralize communications on corrections projects and to make sure that the various offices worked together. Deputy directors from the offices of Programming, Project Management and Facilities Management would be assigned to special unit corrections projects. Jack Carlson in his new function as "special advisor" would provide technical support during the start up. Subsequently, the agency decided to provide the special unit with its own director with line authority, and in 1986 DCPO hired Alan R. Burne, former director of the Office of Project Management to head the special unit.
D. Design/Build and the Nashua Street Jail

At the time they were creating procedures for DCPO's new design/build method, Lee and his staff were also helping to package a major public project for the city of Boston—the development of a new jail for Suffolk County. The new jail would replace the Charles Street Jail, a 140 year old structure ordered closed by the courts due to unconstitutional living conditions for inmates. Neighborhood opposition to various proposed locations for a new jail, the inability of the mayor and the city council to agree on financing, and several re-designs to accommodate projections for increasing inmate populations had stalled the project for over a decade, but in 1985, DCPO found itself a participant in the project's rescue. A key to the final development package turned out to be design/build.

1. Eleven Years of Local Politics Shape Project.

Planning for the replacement of the Charles Street Jail began in 1973 when W. Arthur Garrity, then judge of the Federal District Court, ordered the old jail closed. For the next five years, Boston mayor Kevin White and the city council had argued about where to locate a replacement facility. The mayor had directed his building agency, Public Facilities Department (PFD), to evaluate several options including the consolidation of the jail with the city prison at Deer Island in the town of Winthrop. PFD planners also had looked at other city and state owned sites, but these faced heavy opposition within city government and in the affected neighborhoods. The city council had consistently backed the rebuilding of the jail at Charles Street.

By 1978, the mayor and the city council had agreed to build a new jail on the existing site. Despite progressive constraints posed by the small site and the potential difficulty of renovation, plans proceeded. When PFD's architects, Stull Associates and HOK\(^\text{10}\) found that the old jail could not be renovated to current constitutional standards, PFD decided to build a new jail on the old site, possibly demolishing the existing building. When the Boston Landmarks Commission decided that the existing building ought to be preserved, PFD decided to use the only available open land, the old recreation yard, for the new jail. The new jail took shape as a 309 bed 13 story facility next to the old granite building.

The subject of the controversy then shifted from the jail's location to its capacity and the plan for financing. Capacity became an issue in the early 1980s as the courts began committing more and more people charged with crimes to the sheriff's custody. In turn, the sheriff began

\(^\text{10}\) Hellmuth Obata and Kassabaum.
to press for a larger jail. The existing site prevented the expansion of the footprint of the building, so the architects proposed increasing its height. By 1984, the plans were for a 435 bed jail in a 17 story building to be built next to the old building. At that point the site agreement that looked reasonable in 1978 began to break down. Residents on Beacon Hill did not like the prospect of a "needle" building at the foot of the hill. Neither was Suffolk County sheriff Dennis Kearney happy with the prospect of operating a vertical facility, dependent on elevators to move everything and everyone around.

As the jail grew in scale, financing became more and more of an issue. In 1978, the city had agreed to spend $15 million to renovate the old jail. Later, Stull Associates had estimated the cost of a 309 bed jail in a new tower to be $35 million, and the 435 bed facility proposed in 1984 would cost $43 million. The city could not afford the project: the passage of Proposition 2 1/2 in 1980 severely limited the ability of the city to raise revenues.\textsuperscript{11} The city decided to seek state assistance. In September of 1984 Governor Michael Dukakis requested $28 million to complete the necessary financing,\textsuperscript{12} but local opposition to the design discouraged legislators from approving the request.

2. The State to the Rescue with Land and Money

Plans for the site, design, and financing of the jail again had become subject to political controversy, and the failure of the city to resolve the controversy opened the door to a state solution. There were two reasons for the state to become involved in the project. At the time, some legislators were proposing that the state "take over" and consolidate the operation of the county corrections system with the state system. Second, under Lee, DCPO had the staff and the expertise to undertake the project. The opportunity for state intervention came when the state successfully proposed a new site for the jail. With the new site, DCPO proposed a development package to the legislature. The legislature would authorize funds, DCPO would use its new design/build method, and the state would develop and deliver the project for the city in time to meet the latest court deadline of a March 1, 1990.

Finding a new site was the work of several key state officials, specifically senate president William Bulger and A&F secretary Frank Keefe. Through conversations with Senator Bulger, Massachusetts General Hospital (MGH), the major abutter to the old jail, agreed to swap land it held on Nashua Street in return for the right to acquire the old jail. The hospital was growing, had little room to expand, and had long eyed the jail as a potential

\textsuperscript{11} Proposition 2 1/2 limited the ability of municipalities in Massachusetts to raise revenues from property taxes to 2 1/2 percent of the total assessed valuation. The measure had the greatest impact on central cities such as Boston, whose tax rates at the time were in excess of 2 1/2 percent of market value.

\textsuperscript{12} To be added to the $15 million committed in 1978.
expansion site. Keefe, in meetings with the secretary of transportation Frederick Salvucci, DCPO deputy commissioner Tunney Lee, his director of programming Deborah Poodry, and DCPO counsel Robert Garrity, saw that it might be possible to "create" a site on Nashua Street, through a combination of MGH holdings, existing state land, and land created by changing road patterns and the reconstruction of a nearby highway.13

Agreement for land and financing was finalized in the fall of 1985. Senator Bulger filed legislation permitting a land swap with MGH and providing $43 million in state funds. DCPO would assemble a site on Nashua Street by negotiating with existing owners, including MGH, and by street relocation. The city would transfer the old jail to DCPO for $1 and DCPO would give MGH the option to purchase the Charles Street site when the new jail was completed. The state would also finance the PFD's purchase of 59 modular housing units for the temporary relief of overcrowding.

3. The Development Deal Includes Design/Build

By this time, the state supreme court was overseeing the jail project14, and the court had become involved in the details of the new facility. Initially, the court had simply ordered the jail closed. Subsequently orders expanded the court's oversight to the architectural program (approved in 1979), the size of the jail (ordered to be 435 beds in 1985), conditions for inmates (involving cell characteristics) and the schedule. The judge would have to approve the DCPO deal, and as the land and financing pieces fell into place, it became clear that the critical remaining issue was DCPO's ability to satisfy the court about the development schedule.

Judge Paul Liacos, who had inherited the case from Judge Garrity, had ordered a construction start in February of 1986, the closing of the old jail in March 1989, and the completion of the new jail in March 1990. When discussions of the land swap appeared in the press, the judge issued a memorandum to the parties in the case, with copies to the local press The Boston Globe and the Boston Herald, making clear his intent to enforce compliance with the schedule for letting the construction contract and starting actual construction. According to Lee,

The impression I got from the judge was "I'll let you play around with this - but you have to show me that it won't take any longer - or substantially longer - than the city's plan. We can't wait any longer" (Lee 1988).

13 Salvucci's Department of Public Works controlled land and a state office building on Nashua Street. The state also was planning the reconstruction of the central artery in Boston. The relocation of an access ramp under the project affected the configuration of land in the area.
14 Suits regarding the constitutional issues, heard in the federal district court, and regarding overcrowding, heard in the state supreme court, had been consolidated in the state court with Paul Liacos assigned to the case.
The design/build procedures Lee and his staff had developed for the prisons promised to shorten traditional project schedules by 15 to 21 months. Such a time saving would allow DCPO to deliver the new jail by the March 1990 deadline. DCPO decided to include use of the new method as an element of the development package for the jail.

DCPO saw its use of design/build for the jail as contributing to the agency's image as a reform oriented and sophisticated public developer. With its prominent downtown location, the jail would have the kind of visibility that could showcase DCPO and design/build. The fact that the agency was using such a "state of the art" method would let the industry know that DCPO was innovative and professional. Carlson believed that the size and visibility of the project would attract national design, construction, and design/build firms to the state. Participation by sophisticated national firms would result in high quality work and thus ensure the success of design/build.

This approach extended Lee's earlier efforts to attract the best local design firms to public work and to help erase the state's pre-Ward Commission reputation for shoddy work and poor design. Observers, such as Peter Forbes, saw the adoption of design/build as a final step in the reform process, indicating that the state had re-established its integrity and credibility (Minden 1986, 169). Lee also felt innovation itself was important. He "strongly believed that DCPO should gain experience with alternative methods, even if the standard or traditional procurement method was considered adequate for most projects, in order to diversify its available options in the future" (Minden 1986, 163).
E. The Legislature, the Inspector General and the Judge

DCPO had decided on the project procedures. The legislature would have to fund the projects and approve the use of design/build methods for the three prisons and the jail. The first test would come over the prisons. Lee was due to submit his report on the prisons to the legislature in October, and prior to that, he had to submit the design/build procedures to the inspector general for his comments.

DCPO's idea of design/build contained ambiguities. These served important political purposes both inside and outside DCPO, allowing various parties to accept the idea of what was in concept a radical change. For example, the legislature was willing to consider the design/build experiment in the context of the overcrowding of the corrections system. They saw the method as a project-based innovation, necessary to deliver the prisons quickly, but not necessarily appropriate for any other public projects. These ambiguities would re-emerge later as the sources of conflict in implementation, and they would complicate Carlson's efforts to extend use of the method to other projects.

Based on his conversations with DeNucci and others, Lee believed that the legislature would approve design/build, but he knew that Barresi would be opposed. Barresi had made that clear in public statements issued when the idea of "alternative methods" was first mentioned.

1. Outmaneuvering the Inspector General

In confronting the inspector general, Lee defined the critical issues as accountability and control, and he believed that he had built both into the procedures. The problem was that Lee and Barresi differed about what those terms meant in a public context, specifically, they differed about the use of discretion by DCPO. As Lee defined accountability, individual managers had to be accountable for what they accomplished, and they were responsible for using their professional judgement in making decisions. The decision making process ought to be transparent but not prescribed. Barresi wanted the decision making procedures described up front and individuals then held accountable for following those procedures. If people followed the rules, they would accomplish the objectives. As Lee put it, "the inspector general would prefer that a minimum of judgement be involved in a decision. I would say you can't avoid using judgement. That's what you are there for" (Lee 1988).

After DCPO had completed its evaluation of alternatives and had developed a "public" design/build process for the three prisons, Lee sent a draft of his report to Barresi. Barresi
sent Norman Drucker, the chief of his management division, to meet with Lee and his staff at DCPO. Lee asked Peter Forbes to be there.

I remember a great meeting in my office, with Norman Drucker and Peter Forbes. Drucker said that the use of alternative methods would be against Chapter 579. Peter said - 'wait a minute - that was not the intent of the Ward Commission. We instructed DCPO to use alternative methods, but we didn't have time to write procedures.' That neutralized Drucker. We met the deadline for submitting the report to the legislature. We made minor changes for the Inspector General, but we had him boxed in. (Lee 1989)

In subsequent comments to the legislature, the Inspector General noted that, although the procedures proposed by DCPO were vulnerable to certain risks, the use of the procedures constituted a worthwhile experiment.

2. The Legislature

Tunney Lee submitted his report to the legislature in October of 1985, recommending that DCPO use design/build to deliver 448 new permanent beds at 3 state prisons. In arguing for design/build, Lee drew on the "alternative methods" provision of Chapter 579. He said that the prison overcrowding crisis made the case compelling for the use of an alternative procurement process. He also argued that DCPO had achieved the "expertise, resources and judgement" required to administer such a process.

Opposition to the DCPO request primarily came from representatives of the subcontractors doing business with the state. Opposition was not strongly organized, based on the assumption that the three prison projects were emergency facilities and that design/build would not be used again. Later, when the Associated General Contractors of Massachusetts decided to formally opposed the use of design/build for new projects, it said it had not opposed the initial use of the method because of the relatively small sums of money involved (AGC 1987).

In December, the legislature approved the Prison Construction Bill, providing $273 million to expand the state and county correctional system. As part of the bill, the legislature authorized DCPO to use design-build for the three specified state prisons. The bill provided $43 million for a new Suffolk County jail on Nashua Street, and it opened the door for DCPO to request approval of the design/build method for that project. DCPO did so in February of 1986. The bill also funded replacement correctional facilities in Bristol and Norfolk Counties.
3. The Jail and the Judge

On Feb 10, 1986, DCPO petitioned Judge Liacos for transfer of responsibility for the construction of the new jail from the city to DCPO and approval of the change in site. DCPO's Robert Garrity outlined the land agreement, and he presented DCPO's proposed development schedule. DCPO could meet the court ordered deadline, he said, but only if it were authorized to deliver the project using its new design/build method. The procedure promised to cut well over a year off the overall schedule, and DCPO could complete the new jail by March of 1990. Two weeks later, Judge Liacos approved the proposal, incorporating DCPO's design/build schedule into his decree and making DCPO accountable for the following:

May 1, 1986 Signing a contract with the study consultant.
Oct. 1, 1986 Issuing the requests for design/build proposals.
Mar 1, 1987 Issuing a letter of intent to the design.builder.
Sept 1, 1987 Starting construction.
Mar 1, 1990 Completing the new jail.

4. The Jail and the Inspector General

The Inspector General did not want to add the jail to what he defined as an experiment. He had reluctantly agreed to test design/build for the three prison projects, and he wanted to wait until these projects were completed and evaluated before proceeding any further. At the time there was very little knowledge within DCPO about design/build. No one knew how it worked except Jack Carlson, and that experience was in his own firm, not a public agency" (Barresi 1989). On the other hand, the jail project was under a court order, and design/build was the final piece of a complex puzzle. The judge had already approved the transfer of the project to DCPO based on the design/build schedule, and the legislature had invited a request for design/build authorization in the Prison Construction Bill.

Barresi chose not to oppose using design/build for the jail, but he remained cautious. In comments to the legislature he raised "serious questions about the prudence of adding this $43 million project to the other three projects for which these alternative methods -- with which the Division has no experience -- will be employed." At best, he thought that the procedures would severely tax the Division's management capacity and, at worst, that the Division would be unable to exert sufficient control to prevent problems and meet the court-ordered deadline for completion. Barresi said that if it weren't for the court order, he would oppose design/build for the jail. However, he conceded that for this project, "minimizing the risk of waste might not be an overriding concern" (Barresi 1986).
Although he chose not to oppose the use of the method for the jail, Barresi asked DCPO to include in its procedures explicit provisions for close scrutiny of the project by his staff. He wanted full access to the meetings of the DBSB and to DCPO’s internal documents to ensure that DCPO adhered to the safeguards it promised in the process. Those safeguards included the layering of traditional designer selection and contractor pre-qualification on the design/build selection process, the use of the DBSB as an independent decision maker, reliance on the certified study to control the project scale, specification and cost, using a two phase contract for "design" and "construction", and requiring lump sum bids with proposals.

It was now up to the legislature to approve the design/build method for the jail. In September 1986, a few days before DCPO issued the Request for Proposals, the legislature approved use of design/build procedures for the jail.
F. Summary

1. DCPO Design/build was a Hybrid

The DCPO design/build method was a hybrid, an idea about public building shaped by its origins in DCPO as an institution, in the political situation facing the agency in 1985, and by images in the minds of Tunney Lee, Jack Carlson, Joseph Barresi and the staff of DCPO. The method was framed as a modification of the traditional process. From the Ward Commission, DCPO and the IG inherited a framework for thinking about procurement and contract administration: that production was linear and corruption an ever present threat. This framework was applied to design/build. DCPO planners defined the innovative parts of design/build as the blending of traditional designer selection and competitive bidding. DCPO retained traditional features such as the study, designer screening by the DSB, contractor pre-qualification, lump sum bidding, traditional design documentation, and traditional oversight. The private design-builder would manage production.

It is important for us to understand how traditional ideas of design and building production were built into DCPO's design/build method. As we will see, conflicts in implementation grew from a conflict between organizing premises of design/build and the premises built into DCPO's method. The participants themselves did not understand this conflict because the traditional methods and framework for thinking about procurement and production were so deeply embedded in the institutions and the ideas of the primary participants.

2. Extending the experiment to the jail put DCPO under pressure.

Maneuvering itself into the central role as jail developer was one thing for DCPO; meeting its promise was another. DCPO had promised that in the space of four years, DCPO would acquire the necessary land, reconstruct a road, undertake a study, manage a procurement process never used before by the state, design, construct and open a 435 bed jail on time and on budget. The factors that made the project attractive--its visibility, its close connection with DCPO's image of itself, the oversight of the courts—in turn made the agency very sensitive to the risks of failure. This caused DCPO to maximize its control over the project and to adjust the conditions of the design/build experiment during implementation, to narrow the possibilities for error or delay.
V. Buying a Jail: The Procurement Aspects of Design/Build

As the previous chapter explains, DCPO focused on design/build as a single contract purchase of design and construction services. This chapter explores the state's viewpoint about implementation of the method for the Nashua Street Jail. I present the events leading up to the contract award to the team of The Stubbins Associates and the George Hyman Construction Company, doing business as Hyman-Stubbins Inc. (HSI). I then examine the debate between DCPO and the Office of the Inspector General over DCPO's efforts to extend use of the method to several new projects. Finally, I summarize events leading to the award in 1988 of a second design/build contract to HSI for the development of the Suffolk County House of Correction.

The chapter describes how DCPO's procurement process created conflicts in the design process, how these compromised both design and procurement, and how DCPO's selection of the jail to showcase design/build made DCPO averse to risks and uncertainties, thus non-receptive to innovation even as it undertook a process of experimentation. The agency's extensive pre-competition design process, intended to ensure that the project met its expectations, isolated the design/builder from important early design decisions. DCPO's efforts to mirror traditional procurement inhibited critical communication among DCPO, the sheriff's department and the design/builder during the development of design.

This chapter tells the story from the state's point of view. In the next chapter, we will look at the story from the point of view of the designers and builders seeking state contracts. As will become clear, the two sides, public and private, told quite different stories, interpreted events differently, and took from the DCPO design/build projects different lessons.

A. How the Study Dictated Outcomes

DCPO planners recognized that in buying design and construction services in a single step, the state would not know what kind of building it had bought. The solution would depend on the right combination of specification and control, letting design/builders know exactly what the state expected, and making sure that is what the state received. The Ward Commission's concept of the study as a regulatory control was the precedent, and the study became the basis for a Request for Proposals (RFP), a legal document describing the state's expectations. To make the study effective in its new role, DCPO planners expanded the detail and specificity of each element.
The study would define a range of physical and operating requirements, each with cost and design consequences. These included the size, distribution and arrangement of spaces, facility management approach, the height and design characteristics of the building, and quality levels for structural systems mechanical systems, and finishes. These requirements were expressed in a detailed program that included data sheets for each room, a conceptual design, and technical requirements patterned after construction specifications. The project cost estimate was a function of the "study solution". DCPO also undertook preliminary site testing.

As part of the design/build RFP, the study acquired a new status--it became the legal standard governing the details of the facility it described. DCPO had also established an extremely tight schedule with the court. The study had to be done quickly. DCPO reduced its own processing time for selecting a study consultant and executing a contract. In turn the study consultant was asked to prepare the study in record time--five months instead of the usual one year.

There were several problems with DCPO's approach. The state's rules for the selection of consultants made the preparation of studies unattractive for design firms. The political and physical visibility of the project made DCPO subject to pressure from many parties who wanted to influence the program and the design. Controversy over the management of the new jail surfaced during the study, introducing unexpected uncertainty into the programming process. Because of cost estimating practices, design decisions did not account for cost. Finally, locking in design details before the building itself was designed violated the logic of the design process. These issues remained unresolved in the final RFP, became dilemmas to be solved by the design/builder, and returned to haunt DCPO as surprises in implementation.

1. State "Protections" Dampen Consultants' Interest

Usually, it took the DSB four to five months to select a consultant and complete the contract, but DCPO accelerated this process. DCPO staff personally carried documents to various signatories rather than using the normal mail routes, thus the DSB was able to advertise for consultants four days after Judge Liacos agreed to transfer the project from the city to DCPO. The DSB had set March 24 as the deadline for applications.

Because of the importance of an accurate study in the subsequent design/build process, DCPO hoped well qualified firms would apply for the contract. This did not happen. When the deadline arrived the DSB had received no acceptable applications for the project. Informal conversations between DCPO staff and designers in the area revealed that most of the larger firms with corrections experience preferred to compete for the final design contract. Chapter 579 prevented consideration of study consultants for final contracts, and few of the good local
firms wanted to forego the big contract for the small one. The fee for the study was $110,000 plus another $100,000 if an Environmental Impact Report were required. The fee for the design of the jail would be over $2 million, exclusive of any profit participation under design/build.

Without a pool of acceptable applicants, the DSB extended the deadline nine days, and Lee asked his staff to contact design firms who had not submitted applications. Among others, Sert Jackson, contacted by DCPO project manager John Messervy, agreed to apply. The firm had experience with architectural programming, mostly for educational institutions, and it had done studies for DCPO. Because it lacked experience with corrections projects, the firm did not plan to compete for the jail contract. After talking to Messervy, the firm decided that the corrections experience was not critical: Stull Associates had completed final design documents for a 435 bed jail at Charles Street; the study primarily involved adapting the existing program to the new site. There was no question about how big the facility would be, nor how it would be organized. The Stull Associates drawings and the court approved program reflected the agreements already worked out among the parties. To compensate for the its lack of experience with corrections projects, Sert Jackson proposed as correctional consultants the firm of Cruz-Stark Associates of Florida. One of the principals, Maria Teresa Cruz had been the architect for the Massachusetts Department of Correction during the late 1970s.

On April 3, the day after Sert Jackson submitted its application, the DSB notified the firm of the award. The study began three weeks later. William Lindermulder and Huson Jackson supervised the study for Sert Jackson.

Thus the critical design/build RFP for the jail was developed by a small firm with no in-house corrections experience.

2. Many Participants Press for Program Features

DCPO had promised Judge Liacos that it would complete the study in five months, and although the various parties interested in the jail did not have formal authority to approve or veto the study, controversy could delay the project. DCPO now had to manage the interests of the many organizations and individuals with a stake in the project, without incurring delays. Groups included the Suffolk County sheriff's department, which would manage the facility on completion; the city of Boston, which would own the building; the court, which had an interest in ensuring that DCPO lived up to its agreements; the inmate's attorney, who wanted to ensure that the inmate's interests were protected; the Department of Correction (DOC), which had oversight of the planning of all county correctional facilities; and city and neighborhood
groups, such as the Boston Redevelopment Authority, the Charles River Watershed Association, Metropolitan District Commission, and MGH, who all had an interest in the site and urban design characteristics of the project. State environmental review agencies would also have to clear the project.

DCPO decided to assign to each specific group an opportunity to provide "input", in commenting on proposals during the design competition, but to work primarily with the sheriff's department during the study. Limiting the involvement of other actors in the study would limit the ability of any group to stall the project. DCPO would report periodically to the court and would manage communications within state government, with other state and environmental review agencies, independently.

DCPO was concerned about uncertainties within the sheriff's office itself, for several reasons. DCPO had no prior working relationship with the sheriff's office or staff, and the sheriff and DCPO would be participating in a process neither had been through before. Sheriff Dennis Kearney had announced he would not seek re-election in the fall of 1986, leaving open the question of who would be sheriff.1 The selection of the design/build team would not occur until after the new sheriff took office the following January, and DCPO wanted to minimize possible disruptions during the transition.

DCPO decided to establish formal procedures, documented in a Memorandum of Understanding2, for working with the sheriff during the study and the selection of the design/builder. The memorandum specified how communications would flow, who would participate in the study process, and how and when decisions would be made during the study and during the design/build process. For example, sheriff's planner David Tenney, chief of staff Michael Traft, and special sheriff Robert Rufo would be the prime participants. During the study, all decisions would be made at meetings. Only the sheriff himself could request reconsideration of a study group decision. At the start of the design/build process, however, DCPO would take charge; the sheriff's staff could provide comments, but decisions would rest with the DBSB and DCPO. The memorandum also held the participants to a tight review schedule.

The memorandum made it clear that the sheriff's best opportunity to influence the final project would occur during the study, and the staff and the sheriff concentrated their efforts here. The key participants in meetings with DCPO were Traft and Tenney. Although Robert Rufo took a leave of absence during the campaign for sheriff, he remained in close

1 The major candidates were Robert Rufo, Kearney's special sheriff, a liberal lawyer who could be expected to continue Kearney's policies, and Albert "Dapper" O'Neil, a volatile and conservative city councillor who could be expected to dramatically change the style of leadership established by Kearney.

2 An agreement was executed by Lee and Kearney on May 5, 1986.
communication with Traft and Tenney, as did Kearney. During the course of the study, the sheriff's staff requested a number of additions to the Stull Associates program. The sheriff wanted a facility with a courtroom, which DCPO ruled out on a policy basis, but it approved other requests including the officer's gym, staff lounge, training areas, staff law library, more and larger administrative offices, and more building support space.

DCPO's decision to limit the sheriff's influence on the project to the study, before the final design was known, came back to haunt DCPO later. When the sheriff's office re-entered the process, after the contract award, the staff had accumulated a list of design modifications necessary for the operation of the actual building.

Another study participant was Elliot Rothman, an architect with a long standing interest in the project. PFD had hired Rothman to prepare an architectural program for the project in 1973, just after Judge Garrity ordered the closing of the Charles Street Jail. Later, inmates' attorney Max Stern had asked Rothman to review the Stull Associates drawings, to ensure the rights of the inmates were protected in design, since living conditions of inmates had prompted the original lawsuit. Stern now wanted Rothman to review DCPO's design.

Rothman wanted an active role in the programming of the new jail, but DCPO saw him as another risk and wanted to minimize his role. After some negotiations between DCPO, Rothman and the court, Liacos appointed Rothman as the "inmates architectural expert". DCPO agreed to provide meeting notes to Rothman and include him in all major study meetings.

Rothman and medical consultant Jonathan Weisbach had their own ideas about what the jail program should contain. Rothman wanted windows with views for all inmates, and he wanted them to be able to "see the sky and feel the earth" in daily outdoor recreation. The medical consultant, Jonathan Weisbach, argued for a full medical/psychiatric unit, which the sheriff's staff strongly supported. DCPO added these to the program.

3. Reform Controversy Creates Uncertainty in Program

During the study, an important controversy arose over the management of the completed facility. The choice of management options, between direct supervision (a third generation jail) and remote supervision of inmates (a second generation jail, see Appendix D), would influence the program, design, and cost of the facility, but the schedule imposed on the study by DCPO's commitments to the court made resolution of the conflict difficult.

The controversy over management was unanticipated at the start of the study. DCPO's staff and consultants understood the program to be finalized; the building design was complete and the court itself had approved an architectural program for the project. Bill Lindemulder of
Sert Jackson’s office described his assumptions (1989): "The jail had already been designed by HOK and Stull Associates. It was already cooked. There was not much thinking to be done."

Ambiguities became evident when corrections consultant Maria Teresa Cruz began defining "the" architectural program. The Stull drawings showed 435 beds in a 125,000 net square feet building. The court program, approved in 1979 when the city planned a smaller facility, called for 309 beds in 91,000 net square feet building. That program had never been revised. To complicate the issue, early in the study process the sheriff’s chief of staff Michael Traft announced that the Stull Associates design had always been inadequate, and that additional administrative space for the proper functioning of the jail. At this point Cruz’s staff person Randy Atlas challenged the traditional jail management policy implicit in the Stull design and proposed management through direct supervision, building a "third generation" jail.

Participants familiar with corrections management took adversarial positions with respect to the direct versus remote supervision for the new jail. The most important participants were Traft and Tenney, who, on the direction of Kearney and Rufo, opposed direct supervision, and Gary Mote, Randy Atlas and Maria Teresa Cruz, who advocated direct supervision. Study consultants Lindermulder and Jackson did not take a position, and Lindermulder found the advocacy position of his corrections consultants somewhat embarrassing.

The question of direct versus remote supervision was new to the DCPO planners and interesting because of the design implications. As they learned more about corrections facility management, these planners became advocates of direct supervision. According to Mote and Cruz, remote supervision facilities were more expensive, since they relied on physical barriers such as electronically controlled sliding steel doors, indestructible steel plumbing fixtures in each room, secure glass control rooms within which guards electronically controlled inmate areas. Direct supervision presumed a more "normal" environment, the guards were stationed at desks within the housing units, rooms had swinging doors and commercial grade fixtures, and because they relied on management policies rather than hardware, third generation jails were less expensive to build.

According to Cruz-Stark, a third generation jail would have a lower capital cost due to two factors: fewer "maximum" security versus "medium" security cells in the facility and

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3 In a program, net square feet refers to the usable area within in specified rooms. Gross square feet is the total building area from outside wall to outside wall, including circulations space, building support spaces not identified in the program, wall thicknesses, and the like.


5 A first generation facility had cells along a corridor and guards make period inspections as they moved along the corridors. In a second generation facility, the cells were grouped around an open space called a day room. Guard supervised the space and entrances to the cells from behind glass enclosed control rooms. In a third generation jail, guard supervised the housing areas from within the day room itself.
more cells per housing module, known as a "pod". Third generation jails used maximum security cells only for problem inmates, estimated to be 10 to 20% of the population. These were in housing pods of 16 to 32 inmates. In the balance of the facility, there were larger pods, usually 48 beds in a group, of a more "normalized" medium security design. Based on other research he had done, Atlas estimated that each maximum security cell would be $38,000 more expensive than a medium security cell. Applying that to the jail, Messervy estimated that the difference in the construction cost of a facility with 18 percent maximum versus 100 percent maximum cells would be $14 million. The estimated construction cost of an 18 percent maximum facility would be $34.4 million. A 100 percent maximum facility would cost $48.6 million for construction.

Direct supervision as a management policy had implications beyond the jail--for the entire DOC system. The DOC had policy making responsibility for physical design and operational standards for all corrections facilities, thus a decision to use direct supervision for the jail involved policy decisions at the top levels of the DOC as well as the sheriff's department. The problem was that line staff in both DOC and the sheriff's office believed that direct supervision presented a threat to the security of the guards by placing them in direct contact with inmates.

An important advocate of direct supervision was Gary Mote. Governor Dukakis had appointed Mote to the Design Build Selection Board on the recommendation of Corrections Commissioner Michael Fair. Mote, an architect, had been an assistant director of the Federal Bureau of Prisons when the Bureau began building direct supervision federal detention centers in the 1970s, and he had built up a consulting practice based on his advocacy of the method.

During the course of the planning for the three prisons and the jail, there occurred a series of behind the scenes meetings between Michael Fair, Fair's top staff, Gary Mote, Dennis Kearney, Robert Rufo, and Lee and later Carlson over this issue. Mote arranged for staff from the National Institute of Corrections to make presentations to the local corrections people, including a presentation to the sheriff's staff in early June on the merits of "third generation jails", and he arranged for visits to third generation facilities such as Contra Costa in California. Neither Kearney nor Rufo attended the presentations, nor were they swayed by Mote's efforts.

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6 A pod consists of a large open room surrounded by individual cells.
8 Messervy to Poodry, June 23, 1986.
A few days after the presentation to the sheriff's staff, Michael Traft articulated the sheriff's position in a memorandum to DCPO. The sheriff wanted a maximum security institution with maximum security features: 32 bed pods with one control room for every two pods, with high security hardware throughout the facility. Most services would be decentralized to the housing units. The sheriff argued that direct supervision is not appropriate for a mid-rise structure such as the jail.

The consultants' were isolated from the negotiations among the state's corrections managers. In late June, after Traft had given DCPO his memorandum opposing a third generation jail, Sert Jackson presented the first draft of the program to DCPO. It called for 48 bed pods with control rooms in the segregation unit only, i.e. Sert Jackson programmed a third generation jail. Traft challenged the program, reiterated the sheriff's views, and counter proposed a "fourth generation" approach, involving direct supervision management but with the extra security of a control rooms, so that remote officers could observe both inmates and direct supervision officers, to ensure against their conspiracy with the inmates. The sheriff later agreed to slightly larger housing units--up to 36 cells-- and to use swinging rather than sliding doors.

The effect of the controversy was to introduce a major unknown into the study process, affecting the program and estimated costs. No one knew how the question would be resolved until close to the end of the study; meanwhile, the consultants had to incorporate the design characteristics of the final decision into the program and to communicate these to the independent cost estimators. Both alternatives were reflected in the program, and it was here that the communications with the cost estimators broke down.

4. The Problem of Independent Cost Estimation

During the study, DCPO had to determine cost for the building, the land, and site development within a total appropriation of $43 million. There was significant uncertainty about each element, and the total had never represented an estimate for this project--it reflected PFD's estimate to build a new jail on Charles Street. Throughout the study, John Messervy had cautioned that the $43 million appropriation would be insufficient. Excluding land costs, the $43 million represented a construction budget of $33 million, plus another 30 percent for costs such as study and design fees, construction administration including DCPO's resident engineers, furnishings and equipment, and construction contingencies. Cruz-Stark's lowest estimate of $34.1 million, for a third generation jail, exceeded the construction budget by $1.1
million. The jail the sheriff wanted, estimated at $48 million would exceed the construction budget by $15 million.\(^9\)

Site acquisition and development costs were another problem. One of the parcels to be acquired contained a transformer station which served Boston Garden.\(^10\) A major intercept sewer traversed the site. The site was on fill, and specific subsurface conditions were unknown. In June, Messervy estimated the site acquisition costs to be almost $10 million. This meant a total project shortfall of between $11.4 million and $25.6 million, depending on the final building and site development costs.

During the summer, DCPO decided it had to go back to the legislature for additional funds. At the same time, Messervy was to hold the consultants as close to a $33 million construction budget as possible. Yet, holding the line on the cost of construction meant building a third generation jail, to which the sheriff was clearly and strongly opposed. The dilemma remained un-addressed and unresolved during the balance of the study.

The study was due at the end of August, but to save time, Sert Jackson had given its independent cost estimator the draft documents in early July. Sert Jackson continued to develop the concept drawings and to finalize the program. The construction estimate of $34,954,780, or $152.85 per sq. ft., was completed in September, and Sert Jackson appended the estimate to the draft report. The study was submitted to DCPO on time.

According to Lindemulder, the cost estimators used some combination of the program numbers and the drawing to develop the budget. During final design, cost estimators use "quantity take-offs"\(^11\) to build up the systems or component costs for a complete facility. Without a schematic with clearly measurable quantities, the estimator had an insufficient basis on which to develop a detailed estimate. That made the estimate essentially a square foot estimate, highly dependent on the estimator's assumptions about the characteristics of the building construction and systems.

The lack of connection between the program process and the final design process also tended to lock in expensive features at the pre-design stage. According to Bill Lindemulder, this is how the problem arose. When an architect prepares a program as part of an overall design project, he begins with a list of needs. In the early stages, costs are abstractions - one item is relatively more expensive than another - the question is which item does the client want.

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\(^9\) Ibid.
\(^10\) Boston's sports arena, home of the Celtics and the Bruins.
\(^11\) Estimator measure the final drawings to define quantities of particular products, to which they apply a per unit price.
Later, when the overall budget is set, those items are adjusted. Budgeting is done at the schematic design stage, and this process provides the critical "contact with reality" necessary to establish program priorities. This never happened for the jail.

Time was an important problem.

There were a lot of issues brought up during the meetings, but there was no way to price all of the alternatives. The only way you can check yourself is by using gross measures - square foot measures. (Lindemulder 1989)

5. The Sert Jackson Jail

By late August, Sert Jackson had completed the program, conceptual alternatives, and a "schematic" design. The program called for 435 beds, including a 22 bed medical/psychiatric unit. There would be one control booth for every two 35 bed units. The net programmed area, approximately 150,000 square feet, was 19 percent larger than Stuhl Associates' program.

The schematic design portrayed a four story building spread out over the entire site. The sample specifications called for a concrete frame with brick veneer and granite trim over concrete masonry units. The design/build 'technical requirements" were based on the Sert Jackson outline specifications.

The budget cap specified in the October 1 RFP was based on the study estimate, escalated to the midpoint of construction (November 1988). The total construction cost would be $37.4 million, plus a design fee of $2.6 million bringing the total design/build cost to $40 million. DCPO would hold an additional $2.4 million for construction contingencies. At the same time, Messervy reported that the total budget would be short by $14.74 million, largely due to unanticipated land acquisition costs. The Department of Correction had submitted a supplemental budget request that spring, and DCPO asked that $14.74 million be added for the Nashua Street jail. The legislature subsequently approved the request as part of Chapter 658 of 1986, passed in December.

6. Conflicts Embedded in Study Compromise its Regulatory Role

The study for the jail presented several dilemmas for the design/builder. A traditional program would provide an overall guide to the final design. The RFP was a legal document that controlled each detail that it specified, but because there was no fully developed design, there were hidden inconsistencies in the detail. These inconsistencies were present in the concept design, room data sheets, and technical requirements. These inconsistencies were not immediately apparent to DCPO, but the bidders soon discovered them, and the results emerged in implementation.
An example is the conceptual design. Sert Jackson focused on the space needs and the room data sheets, using the concept plan only to test whether the program was possible. The study contract did not provide compensation for, nor did DCPO require, a full schematic design.

You know at the beginning that you will never build the building. It will never go up on the wall or into your portfolio. As a result, you put together a design to satisfy yourself, and you stop there. You check to see if it fits on the site and the circulation works. You don’t test the efficiency, and you don’t fine tune the design. You show the cost estimator the drawing, but you tell him to use the numbers in the program. If you do the schematic properly, you would expect to be paid 10 percent of the final design fee. But even if you do that, no one is going to build it.

(Lindemulder 1989)

Lindemulder provided an example of the lack of “fine tuning” in the concept. For the jail, if a projected column was in the way on a particular floor of the plan, the study designer just omitted the problem column. The designer did not attempt to work out a new structural system. Thus a column could appear on one floor and not on another.

Another issue was the location of the recreation yards. Rothman wanted inmates to be able to “feel the soil and see the sky” (Rothman 1989)—that mean recreation at grade level. The sheriff wanted all services decentralized to the housing units, thus each housing unit would have its own ground level yard. However, the site was irregular, in a busy downtown area, and not that large, and the building would be at least three stories. That made it difficult to design at grade recreation space for each housing unit. The Sert Jackson concept provided such recreation areas, but at the expense of a complicated internal circulation system.

None of the design/builder competitors could resolve the conflicts in the Sert Jackson concept, and they abandoned the scheme in final design.
B. The Pitfalls of Procurement by Design Competition

In Chapter 4, I showed how DCPO framed its design/build method first as a new way to buy design and construction services. The "innovation" in procurement involved the consolidation of a multiple purchase process into a single step. DCPO intent was to save time in procurement by adapting traditional selection of designers and bidding, maintaining "the notions of equity, free competition and fairness (Ward Commission 1980)."

In this section I show DCPO's procurement process amounted to a design competition. The terms of the competition for the jail, the schedules, team qualifications, and proposal requirements, were outlined in Lee's Alternative Methods report to the legislature and further detailed in the project RFP.

The jury was the Design-Build Selection Board. As a way to remove from project management the decision to award contracts to private parties, DCPO had created an independent Design Build Selection Board (DBSB). There were three architects on board: Gary Mote (see previous section), former DCPO professional advisory committee members Peter Forbes and Henry Irwig. Other members were Richard Gourdeau, president of a local construction company, and Harry Spence, a private developer and former director of the Cambridge and Boston Housing Authorities.

Procurement through a design competition created conflicts at several levels. The idea of free competition was at odds with the idea that DCPO wanted to attract only the most qualified firms. DCPO's structuring of threshold requirements focusing on teams of traditional architectural, engineering and general contracting firms was at odds with the idea of the integration of design and construction within a single firm. The premise that procurement and management should be isolated from each other was at odds with the need for open communication between designers and owners during the building design process. DCPO wanted competitors to guarantee a lump sum bid and a schedule to meet court mandated deadlines based on sketchy and uncertain information. Finally, DCPO required that the builder provide full bid and performance bonds. The reluctance of the underwriters to provide bonds to design/build teams reduced the competition even further - to one bidder in the final round of competition for the jail.

Implementation was complicated by DCPO's decision to award both design/build contracts at roughly the same time. The original plan had been for processing of the jail to follow processing of the three prisons package by about six months, giving DCPO some opportunity to learn from and apply that first experience to the jail. However, because of
delays affecting the first contract, DCPO ended up processing the three prisons and the jail almost simultaneously, and the jail was the first project "in the ground".

1. The Field Narrows Rapidly

DCPO intended its rules for team combinations to screen from the competition small poorly qualified firms. The team qualification requirements DCPO spelled out in its initial Request for Qualifications for the jail functioned as successively fine screens. Designers and builders had to meet individual requirements. Firms were to have had experience building medium to maximum security correctional facilities, preferably in the range of $30 to $50 million, experience with other institutional or public sector projects, and experience working with other team members on these projects. DCPO expected 15 to 20 "entities" to apply. In fact 30 firms entered the competition, but since firms entered in teams, this reduced to 10 initial applications.

DCPO began advertising the project in July 1986, casting a wide net in search of the top national design and construction firms. DCPO notified the leading trade journal Engineering News Record of the projects, and it directly contacted 285 architectural, design/build, and construction firms. DCPO was able to attract national firms to the competition, but three rounds of competition narrowed the limited pool of competitors to a very small group. On September 2, DCPO received 10 applications, all from traditional firms that created teams solely for the DCPO projects. Many applicants joined two architectural firms, often a large firm (a member of ENR's top 500 designers) with no experience with DCPO and a small firm with DCPO experience, with a large out of state construction company (a member of ENR's 400 top contractors, most of which used construction management contracts for the bulk of their work) or with a DCPO "regular" general contractor. Two applicants teamed the two kinds of general contracting firms. A total of eighteen architectural firms and twelve general contractors were in the group. No integrated firms applied.

The DBSB met in late September to review qualifications and select finalists. At that time DCPO announced that the proposal process would be split into two stages. Five finalists would first submit design proposals for the facility. DCPO staff and the DBSB would analyze these proposals and the DBSB would invite a smaller pool of competitors to submit more detailed documentation of their proposals. Each competitor in stage one would receive an honorarium of $50,000. Competitors in stage two would receive $100,000 (later increased to $150,000). Design submissions were due on November 25, 1986; detailed proposals would be due January 2, 1986.
Entering the competition required firms to take on substantial financial risks. For architectural firms, the risk was that design services in preparing proposals would not be fully compensated. For builders, the risk was that the bid price, based on sketchy information, would be inaccurate. Only certain firms in the market could afford to assume these risks, limiting the pool of competitors. The competition for the jail was complicated in that proposals for the the three prison project were due at the same time as those for the jail, putting the two projects in competition for the pool of bidders (See Figure 14).

DCPO'S initial plan had been to stagger the two contracts by several months. The three prisons were first advertised at the end of April. Qualifying teams would prepare proposals in July and August. DCPO would make a final award in November. Proposals for the jail, due in January, could be prepared between October and December. In fact the RFP for the three prisons was delayed until the middle of August, with submissions due in November, while competitors were preparing proposals for the jail.

Bidders for the two contracts overlapped. Of the ten teams competing for the jail contract: four were finalists for the three prisons contract and two were contractors who had applied for the prisons contract but who had not been invited to submit proposals (these had found new design partners). The cost of submitting qualifications was small: it involved filling out forms, submitting financial statements and designer's brochures. The biggest question involved assembling the team. The four finalists in the three prisons project faced a more difficult choice--investing in two costly competitions and preparing two proposals at the same time, or choosing one competition that the team had the best chance of winning.

The cost of submitting a proposal was substantial, between $300,000 and $500,000 for the jail. DCPO required proposals based on schematic design, or 20 percent design completion (although builders usually would not guarantee a price until they saw drawings at least 35 percent complete). With a budget of $40 million for the project, the cost to prepare such a design was $400,000. Builder estimating and management planning services was another $100,000, bringing the total close to $500,000. For the jail project, the honorarium was to be $150,000, $50,000 for phase one and $100,000 for phase 2. That meant a net out of pocket expense of $350,000 for the losing teams, mostly falling on the design partner, an estimate confirmed by several bidders.

The cost of the three prisons competition was also high. Designers had to prepare proposals for three very different facilities, a maximum security classification center and two minimum security facilities. The maximum security center was to be built within the secure wall of an existing facility, and the other two projects involved renovations to an existing facility. One participant estimated the cost to the team of these proposals to be $200,000., and DCPO initially offered a $20,000 honorarium.
The four finalists in the three prisons project decided to compete for both projects and to ask DCPO to reduce its requirements for the three prisons. In mid September, they jointly requested that DCPO reduce the level of detail required. The request made DCPO very nervous -- having the teams withdraw from the first design/build competition would jeopardize the entire experiment. DCPO was also very worried about its ability to control the design and did not want to reduce its proposal requirements. DCPO decided to increase the honoraria for the three prisons, from $20,000 each to $50,000 each, to reduce the detail required to describe the building systems, and to give teams more time to prepare proposals. The proposal deadline was postponed from early to late November. DCPO also split the proposal process for the jail into two stages. Instead of having very detailed proposals due at the beginning of January, a first stage design proposal would be due in late November. A second phase technical proposal would be due on January 2. The deadlines for the two competitions were now only eight days apart.

Qualification for the jail became a process of attrition. Prior to the DBSB meeting to review qualifications, two of the four teams who were participating in both competitions withdrew from the jail competition to concentrate on the three prisons. The DBSB then eliminated three of the eight remaining teams, including the two remaining teams who had elected to participate in both competitions. Three weeks after the RFP was issued, another team withdrew, indicating that the new two step proposal process and the required level of proposal detail was unacceptable. The remaining four teams then submitted design proposals for the jail.

The following illustrates the processing schedules of the three prisons project and the jail.
2. Phase One Competition: Procurement Rules Compromise Design

DCPO explicitly recognized in its RFP for the jail a fundamental dilemma:

The critical question for DCPO in establishing the framework for the implementation of design-build has been how to create an environment which allows for innovation within the context of a highly structured public building process (DCPO "RFP" 1986).
This question was to surface at each step of the jail project, and it first emerged in the development of proposals as a conflict between the need for communication during design and the desire to isolate procurement from management.

The formal first step in design under the DCPO design/build method was the preparation of proposals, a point at which communication between the owner, the user and the designer is usually most important. W. Easley Hamner, of the TSA/Hyman team termed interaction at this point in design "crucial". Because of its procurement requirements, however, DCPO chose to isolate itself from designers at this stage, relying on written criteria in the RFP to guide designs created independently by competitors.

In the first stage of the competition, each team was to submit a conceptual design. DCPO instructed teams to treat the Sert Jackson concept design as a guide and to improve on the design solution. Improvements would include "innovative design and production methods", which would come from improved coordination between the designer and the builder.

Despite its emphasis on innovation, DCPO created conditions which tended to limit innovation by making the cost of failure high. The financial risk was described previously. Another risk related to design. Competitors were given a limited amount of time to create proposals, and thus had to commit to a design scheme quickly. Since DCPO limited to written documents and formal public workshops interaction between itself and the competitors during the initial design phase, competitors had little opportunity to test their design ideas with the owner and no chance to change significantly the initial concepts.

Even though the study schedule had been highly compressed, Sert Jackson had worked on the design concept over a two month period, with regular meetings with the sheriff's representatives and DCPO. In contrast, the design/builders were asked to prepare a much more detailed scheme without any feedback from the owner or the users. DCPO had made this restriction to protect itself against charges of collusion in the contract award, restricting private conversations between members of its staff and potential bidders beginning with the initial advertisement of the projects until the actual award. During preparation of stage one proposals, no private conversations with DCPO were allowed. Bidders were to engage in an "interactive process", but only with members of their own teams. In the second stage, at the request of the bidders, DCPO established structured "interactive workshops", but these did not allow for the free exchange of ideas. These barriers to communication with the owner caused the bidders to play strategic games to determine what DCPO and the sheriff really wanted. It also meant that even the best of the proposals on which the contract would be based would inevitably contain some elements with which DCPO and the sheriff would not agree.
Teams Make Differing Assumptions in Design

In the first stage, DCPO used the RFP and three formal workshops to communicate its requirements to the teams. The RFP contained the program and technical requirements and instructions about the competitive process. At the workshops, teams viewed the site and could ask DCPO questions. According to one designer, substantive issues were not discussed at these meetings. "Most of the discussion was about issues such as what size paper the drawings had to be on." (Pedersen 1989)

On November 25, DCPO received proposals from four teams.12

The George Hyman Construction Co./ The Stubbins Associates/ Voinovich Monacelli Architects

Morse/ Diesel / Jung/Brannen Associates / Gruzen Sampton Steinglass

Peabody Construction Company/ Whitney Atwood Norcross/ Silver and Ziskind

Perini Corporation/ Cambridge Seven Associates/ Philips Swager Associates

The teams submitted rolls of plans, presentation boards, written documents and three dimensional models describing their particular design solutions, to DCPO's bid room. DCPO had established a formal review process for the analysis of the various proposals. Sert Jackson prepared a detailed comparison of the proposal programs to the study and provided a written evaluation. The sheriff's office (focusing on operations), the inmates' architectural expert (focusing on sensitivity to the residents), and DCPO project management conducted separate analyses. DCPO then invited other participants, and abutters to participate in a staff workshop to discuss the proposals in detail. Finally the teams presented their proposals to the DBSB, which selected the finalists.

Without benefit of feedback from DCPO and the sheriff's department, the four designs made very different assumptions about what DCPO and the sheriff wanted in a jail. Two of the four proposals, those of Jung Brannen and Whitney Atwood Norcross (WAN), adhered closely to the study, keeping the height of the building low and filling most of the site. However, according to the sheriff's planner, the interior layout of the WAN proposal did not respond to the sheriff's needs. Jung Brannen had improved upon the study layout, but there were problems with that design as well. The pattern of movement was complex, and because the structure covered so much of the site, the amount of parking was less than that required.

Two designers, Cambridge Seven Associates and The Stubbins Associates (TSA), proposed mid-rise 6-8 story structures. Cambridge 7 had the most innovative space

12 The order of listing: general contractor, prime production architect, corrections or design architect.
arrangement, clustering three pods around one detached control room. However, although DCPO staff felt that Perini, Cambridge 7's contractor, was the strongest contractor, the Cambridge 7 design was totally unacceptable to the sheriff. According to Forbes(1989), the team was "badly served by its corrections consultant. The DBSB almost wanted to tell them to go back and redesign it, but we couldn't do that."

The Stubbins Associates design departed from the study in important ways. First, it was eight stories instead of the three described in the study, creating a vertical rather than horizontal pattern of movement. Second, the outdoor recreation areas were not at ground level nor open to the sky - they were stacked on top of one another. During the study, Sert Jackson had proposed such an arrangement, and it had been rejected. However, when the participants saw the Stubbins scheme, according to John Messervy, they changed their minds.

Judging the Competition

According to Bill Lindemulder, prior to the proposal submission, he and Huson Jackson used to debate about the best winning strategy. Lindemulder felt that the architects would adhere to the study scheme and the competition would be over the strength of the contractors and price. After all, DCPO, the sheriff, the inmates representative and others had signed off on the study solution. Feldstein of WAN took this approach- he thought it would be crazy to deviate from the study scheme, and he so advised his design architect Silver and Ziskind.

The design had been created by the sheriff and Sert Jackson, and both of them would be on the evaluation committee. Changing the design would have been like making the Queen Mary change course. There is such a thing as pride of authorship (Feldstein 1989).

Huson Jackson predicted otherwise. He argued that for a team to win, it would have to distinguish itself from the others with an unusual design. TSA interpreted the process this way, as a design competition with a constraint, the Sert Jackson scheme. According to Easley Hamner,

The sheer process of Sert Jackson taking the client into the design process, then sawing it off, creates enormous problems. The client becomes invested in certain ideas. You not only have to come up with a better scheme, you have to unlock the client's minds about all the time they had spent getting to that point (Hamner 1989).

The DBSB interviewed the teams in December of 1986. According to the RFP, the DBSB would judge proposals based on four equal factors: design quality, building performance, the team's project management capabilities, and the proposed schedule. In practice, design proved to be the most important element. This was in part due to the way
DCPO set up the process: the schedule was set by court order, and prices would not be submitted until the end of the competition. In its deliberations, the DBSB focused on the design qualities of proposal; with respect to the project management capabilities of the teams, the DBSB found the competitors to be relatively equal. The dominance on the board of architects reinforced the image that this was primarily a design competition. For example, DBSB member Peter Forbes described his priorities:

At one meeting, Gruzen asked me how important the appearance of the building was. I told him I cared about how it looked, and if I didn't like it, the team wouldn't win, unless the others on the board convinced me that the construction management issues were overwhelming (Forbes 1989).

The DBSB intended to consider the relative costs of each proposal after the formal evaluation, however, this would not occur until the second stage. Teams did have to promise that their design could be built within the $40 million budget cap, and, according to Hamner, all of the competitors faced the same problem--it just couldn't be done.

I remember an awkward discussion. Jack really put us on the grill. It was before the DBSB. He asked if we could build the building for the budget. They knew it could not be built for the money available. Carlson also said that the consequence of saying no was that we would be disqualified. We asked if we could say yes and cross our fingers. Could we say yes and shake our heads at the same time? He knew how difficult it was for us to say yes. We finally said yes (Hamner 1989).

On December 19, 1987, the DBSB announced that three teams, Hyman/TSA, Morse-Diesel/Jung Brannen, and Peabody/WAN would be invited to submit detailed proposals. On January 6, Carlson notified these teams that the deadline for stage 2 submissions would be postponed until April 1, 1987, and that the honorarium for phase two proposals would be increased from $100,000 to $150,000. Price proposals were to be submitted on April 13.

3. Phase Two Competition

During the preparation of stage one design proposals, several participants complained about the difficulties of designing without close individual communication with DCPO. The Hyman/TSA team in particular had asked for private meetings, "in legal practice one might term this "early discovery (Hamner 1989)," in lieu of the group workshops. When DCPO saw the stage one proposals, it recognized that greater communication with the teams was necessary to produce stage two proposals, with associated technical details, with which DCPO and the sheriff would be comfortable. DCPO agreed to weekly meetings individually with the three finalists.
DCPO established ground rules for these "interactive workshops" to protect the integrity of the procurement process. Each team had a two hour time slot on Wednesday. Substantive exchanges of information were limited to formal meetings at which a team, representatives of the sheriff's office, and at least two DCPO representatives would be present. Teams would be treated "equivalently", given equal time and access to information. General information provided by DCPO during an interactive workshop would be communicated subsequently to the other teams in writing. Information about team proposals would be kept confidential. All other contact would be restricted.

Peabody/ WAN met with DCPO once and, on the basis of that meeting, they decided to withdraw from the competition. According to Feldstein (1989), the team was included in the competition "because you need a certain number of finalists. We weren't going to win. We had made a fatal mistake in our design strategy." It would also have cost the team over $200,000 to continue. Feldstein estimated that the cost to produce the required stage 2 drawings would be $350,000. The compensation was only $150,000. Although Peabody was willing to underwrite the cost, Feldstein did not think it was worth the risk. The team withdrew on January 12, 1987.

The Hyman/ TSA team had asked for the private meetings, but Hamner found specific feedback hard to get during the DCPO interactive workshops. The meetings tended to be very large, and the discussion was stilted. DCPO staff would not express preferences about the various ideas presented by the team. The meetings were "attended by 10 to 20 people at a time. Sometimes hordes of people were in the room (Hamner 1989)." Hamner decided that within the group, the DCPO project manager John Messervy and the sheriff's planner David Tenney were the key people, and he directed the discussion to them. He also finally established a pattern of conversation that seemed to surface DCPO's and the sheriff's preferences. Instead of asking which of the various ideas the staff preferred, he would point out that it seemed to him that one option worked better than another. Did they agree? (Hamner 1989)

The deadline for submission of stage 2 proposals was postponed twice, first to March 2, 1987, then to April 1. DCPO continued to meet with Jung Brannen and TSA, and on April 1, both teams submitted technical proposals. On April 16, the two teams submitted price proposals.

*Final Proposals Contain Bid Surprises*

The two final proposals represented different approaches to design and different approaches to construction, and each had its proponents. Hyman/ TSA proposed an eight story "mid-rise" symmetrical structure that relied on elevators to move people and things around, a way of management the sheriff had opposed in the PFD design. Recreation areas
were stacked, leaving some only open on the side and all some distance from the ground, a solution Rothman had opposed during the study. Nevertheless, the sheriff's department and Rothman favored the TSA design for its corrections operation. The plan was conceptually straightforward, the housing areas easy to observe, and interior circulation clear and simple. The structure was to be of pre-cast structural concrete.

The Jung Brannen/ Morse Diesel design was for a four story "low rise" structure that stretched across the site. The team planned to use pre-cast concrete modules for rapid construction. According to the DBSB, Morse Diesel's management plan and schedule were superior to Hyman/ TSA. The Jung Brannen plan was favored by the Boston Redevelopment Authority and abutters in the North Station area based on its exterior design, site design and massing. The proposal had the support of Peter Forbes, and Rothman found the urban design aspects of the scheme superior to the TSA scheme, although he favored the TSA scheme as best for the inmates.

On April 16, Morse Diesel and Hyman submitted bids of $53.5 million and $55.46 million respectively, 34 and 39 percent above the specified DCPO cap. Apparently, both teams had gambled that price was negotiable.

During the stage one proposals, all of the teams had mentioned to DCPO that price might be a problem. According to Easley Hamner, when his team saw the program, the plans, the specifications and the construction estimate, they knew there was a problem. They said as much to the DBSB in the interviews. Until they got into the design sequence, however, they did not know how much of a problem it would be.

We figured everyone else had the same problem. We opted to gamble on the price. We knew the program was not negotiable. We predicted that the dollars were, given the pressure on the system (Hamner 1989).

At meetings with DCPO, Hyman/ TSA also explored the question of additional appropriations.

I also recall exploring the issue of appropriations and the budget in conversations with DCPO. I got the impression that DCPO thought the budget was on the low side, that they would take the initiative and could go back to the legislature if it had to be done (Hamner 1989).

According to Raymond Carroll of Morse Diesel, the problem was the square footage of the building. "You could not accomplish everything that was in the program, with the parking requirements and everything, in the square footage provided" (Carroll 1989).

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DCPO anticipated bids somewhat above the cap, but actual bids were a surprise. DCPO responded in two ways. First, it decided to make sure it was not being taken advantage of, verifying the reality of the bids by asking an independent cost estimator to price each proposal. The estimator verified that, based on the characteristics of the proposals, each bid represented real costs. Second, DCPO decided to try to negotiate price reductions with each bidder. DCPO met with each team to identify areas of potential cost savings, asking each to resubmit a bid based on a reduced scope of work. On April 28, both teams revised their price proposals:

Hyman: $48.8 million,
Morse Diesel: $47.9 million.

According to DCPO's John Messervy, the most important modification to the Hyman proposal was a change from a pre-cast concrete structural frame to a steel frame system. With the change, the Hyman proposal was 13 percent above the Request for Proposals budget for construction (including the budget contingency held by DCPO).

DCPO went back to the legislature for additional funds. In June, 1987, the legislature increased the total appropriation for the project by another $13.7 million, to $71.45 million.

Decision Based on the Bond

In its RFP, DCPO had specified that bid and performance bonds would be required, and when each team first submitted statements of qualifications, the bonding companies for both Morse Diesel and Hyman had certified that the companies could secure the necessary bonding. By the spring of 1987, that was no longer true.

The George Hyman Construction Company was a subsidiary of the Clark Construction Group, a firm based in Washington DC. It had 2000 employees in the Washington area, and customarily used its own forces for 35 to 40 percent of its work in the Washington area. Clark had a very broad asset base, and because of these assets, Hyman had almost unlimited bonding capacity. Hyman had a long history of bonded public construction work for federal and state governments, and it tried to maintain a ratio of 50 percent public and 50 percent private work. Engineering News Record reported that in 1987, Clark Construction Group received $954 million in construction contracts.¹⁴

Morse Diesel, on the other hand, was a construction manager, using subcontractors for all of its construction work and relying on performance bonds provided by those subcontractors. Engineering News Record reported that the firm received $402 million in

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¹⁴ ENR April 14, 1988.
contracts in 1987, with 67 percent of its revenues in construction management contracts.\textsuperscript{15} Morse Diesel's bonding capacity was only about $200 million (Carroll 1989). Early in 1987, the firm had accepted a large hospital project requiring a bond. The firm's remaining bonding capacity was less than the cost of the jail, and the firm gambled that DCPO would modify its bonding requirement as it had modified other requirements during the design/build process.

Morse Diesel tested this assumption in March, by advising DCPO that it would not include a bid bond in its April submission. DCPO responded by reiterating its bond requirement but, according to Morse Diesel, the DCPO general counsel urged the firm to submit a proposal anyway. He would see what he could do.

The DBSB considered the proposals during two meeting in April. At the second meeting, Carlson advised the board that Morse Diesel could not secure a bond. The DBSB decided that the Morse Diesel/ Jung Brannen proposal should be disqualified on that basis, and on April 29, 1987, the DBSB announced the award of the contract to the team of Hyman/ TSA.

\textsuperscript{15} \textit{ENR} April 14, 1988.
C. DCPO Decides to Use Design/Build for More Projects

In March of 1987, while DCPO awaited final proposals for the Nashua Street Jail from Hyman/TSA and Morse Diesel/ Jung Brannen, Carlson decided to request legislative approval for more design/build projects. The ensuing debate over design/build illustrates how DCPO and the inspector general interpreted their experience with the first projects. DCPO modified then implemented the new procedures for a subsequent design/build project, the Suffolk County House of Correction (described here as the house).

1. The Carlson Barresi Debate

DCPO first tried to get blanket approval for broad categories of projects, for example, newly authorized mental hospitals, facilities for higher education, and new correctional facilities. The inspector general successfully opposed the moves, charging as he had done in 1985 that such authorization

would essentially throw away the Ward Commission rule book for hundreds of millions of dollars in State construction. The result would be the wholesale elimination of most of the statutory safeguards against waste and abuse developed by the Ward Commission. (See Chapter IV for further reference.)

The legislature declined blanket project approval, and Jack Carlson began negotiating directly with Joseph Barresi about new projects.

Jack Carlson and Joe Barresi held differing opinions about whether design/build was appropriate for public projects and, if so, for what kind of projects. They addressed two questions: how did the initial experiment work, and how many, if any, new design/build projects should DCPO undertake?

The debate, focused as it was on how the "experiment" worked, could have become an evaluation of the method. Instead, the debate was ideological, in part because of the circumstances of the experiment, i.e. the high visibility and urgency associated with corrections projects, and in part because Carlson and Barresi had vested interest in the outcome: Carlson’s reputation was linked with design/build, Barresi’s with the Ward Commission and Chapter 579. Neither Carlson nor Barresi sought to include in the discussion non-state participants, for example the designers and builders.

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17 This debate is documented in minutes of meetings at which the author was present and in briefing papers prepared at the time.
How did the Experiment Work?

Barresi had defined the first projects as an experiment, and Carlson and Barresi framed the evaluation of that experiment differently. Carlson wanted to focus on final project outcomes. Were the prisons and the jail built well and faster than they would have been using traditional methods? Would the jail open in time to meet the court order? He argued that yes, DCPO had achieved these outcomes and should do more projects. Barresi was more concerned about whether DCPO had followed the rules it had set out. Did the final buildings conform to the original programs and the original cost estimates? Had DCPO staff checked all of the competitors' references? Had DCPO paid honoraria to teams that submitted proposals that did not meet all of the requirements specified in the RFP? Had DCPO adhered to its original schedule for the competition, review, award, and contract signing? Barresi found that DCPO had not met its own projections, thus it had failed to control the projects. DCPO's failure to adhere to the initial procedures suggested that the safeguards in design/build were inadequate, that the method was riskier than traditional methods, and at minimum DCPO should impose stronger controls on future projects. Barresi suggested that DCPO monitor the DBSB and within DCPO, that the agency assign a management unit to monitor staff involved in the design/build projects.

In addition to specific criticisms, Barresi believed that design/build was inherently vulnerable to waste, fraud and abuse. The fact that the designer was no longer the agent of the state meant that the contractor would be free to cut corners on construction. The absence of competitive bidding left the state without cost controls. The use of a design competition meant wasteful investment in designs by competitors and a heavy investment by DCPO in management.

Carlson countered that Barresi's focus on interim procedures missed the point of design/build. He argued that unforeseen events, which occur in all projects, not the design/build method nor DCPO's management of the method were responsible for changes in cost, schedule, and program, and he claimed the costs were "reasonable" as verified by the independent cost estimates. He agreed that certain control measures should be toughened, but he also argued that design/build and traditional methods were different in production as well as procurement, and that certain controls were inappropriate for design/build and should be changed.

Barresi agreed to hold DCPO accountable for performance relative to traditional methods, but then Barresi and Carlson differed on how to measure performance. According to Barresi, "if you are going to measure against conventional methods, you should use your best performance as a measure," (1989) and on that basis he found that the experience with the first
projects failed to demonstrate that design/build was faster than "an achievable schedule for a truly fast-track conventional project" (Barresi 1988).

While he criticized DCPO's performance, Barresi praised the "integrity, dedication, and professionalism of the Deputy Commissioner, his staff, and the members of the independent selection board." In doing so, he tied the performance to the design/build method itself. (Barresi 1988)

Carlson claimed design/build could shorten the schedule by a year based on comparing the schedule for a "typical" design/build project to DCPO's schedule for an "typical accelerated" traditional project.

As the negotiations progressed it became clear that Carlson and Barresi would hold their basic positions: Carlson as an advocate of design/build and Barresi as the guardian of Chapter 579. They did agree to extend the experiment. For the next projects DCPO would modify its earlier procedures based on the initial test. The major modifications affected the Request For Proposals (RFP), the bid, and communication during the preparation of proposals.

The nature of the debate--advocacy positions on each side--meant that there was no real evaluation of the projects. Each side used information to reinforce its own case and did not report any findings that might compromise its position. In measuring performance, neither DCPO nor the IG consulted the competitors, nor did they look at other actual DCPO projects.

How Many and What Kind of Projects?

Carlson was actually less concerned with the procedural modifications proposed by Barresi--which Carlson regarded as relatively minor--than with the number of new projects that would be approved, and he wanted approval for as many projects as possible. He could always decide to forgo design/build in favor of traditional methods. He negotiated with Barresi on that basis.

Although Jack Carlson did not specify rigid criteria for new projects,--he indicated in conversations with Barresi that "some facilities just lend themselves to design/build" (Barresi, 1989)--his choice of potential design/build projects for the expansion of the experiment demonstrated the range of projects he found appropriate. Carlson proposed using design/build for the most technically complex building types: the largest correctional facilities, the largest state hospitals, and research laboratories. What these projects shared in addition to scale was that they were at the top of the priority list for the user agencies; they were urgent. By the fall of 1988, Carlson had narrowed the list to seven specific projects.

Barresi believed the traditional methods worked--the state was used to them, and if there were problems DCPO should improve its management of the traditional method. He saw
design/build strictly as an experiment, for which he found no need. He was willing to defer to Carlson's pressure to continue use of the method, but only for one or two more projects. Although Barresi was bothered by Carlson's vagueness about which projects should be in the experiment—"what does that mean that a project 'lends itself' to design/build?" (Barresi 1989)—he was willing to let Carlson decide which one or two projects would be next. By March, the two men had reached a compromise. Carlson would request three new projects and Barresi would not oppose the request. Carlson chose two corrections projects and a polymer research laboratory at the University of Massachusetts in Amherst.

The legislative committee which first heard the request was the Committee on State Administration, and its chairman Representative Joseph Herman questioned Carlson about the projects he had requested. Recalling the "urgency" criteria on which Tunney Lee had based the first design/build request, Herman found the inclusion of the polymer laboratory perplexing. He could define corrections projects as "urgent", and if Carlson had included a state hospital, as he had planned to earlier, that also might be considered urgent. What was urgent about a research laboratory? And, if urgency was not the criteria, he asked Carlson,

where do we draw the line? What do I say to legislators who have projects in their districts and want to use design/build so they can be delivered faster? We'll have design/build projects all over the place.\footnote{Meeting between Herman and Carlson, March 1988.}

\textit{The Legislature Approves One Project}

In March of 1988, after eight months of discussion, Barresi (through his assistant Stephen Cotton) and Carlson appeared before the legislature. Carlson described positively DCPO's performance with the first design/build projects. He presented his request for three new projects and the new procedures worked out with Barresi. In turn, Cotton presented a 38 page critique of the use of design/build for the first four projects, but he said Barresi would not oppose Carlson's request for three new projects. In a meeting with Jack Carlson and later in an interview with the author, Barresi characterized the two positions as institutionally disparate.

Jack's job is to tell people how great design/build is. My job is to point out the risks that design/build or another alternative represent - to say 'don't proceed' or 'put in some other form of control'. It is not my role to stand with Jack (Barresi 1989).

The legislators were confused. Representative Herman told Jack Carlson, "You and the inspector general have to get together on this. Why don't you talk to him and then come back to us."\footnote{Ibid.} Eventually the legislature approved one new design/build project, an $85
million house of correction to replace Boston's city prison on Deer Island. The closing of the
city's prison was the subject of court orders related to conditions at the prison and the need, as
part of an effort to reduce pollution in Boston Harbor, to use the existing prison site for a new
sewage treatment. The project was probably the most politically "urgent" of the DCPO projects
at the time.20

2. The Next Project: The Suffolk County House of Correction

The existing Suffolk County House of Correction, the old Boston city prison, was
located on Deer Island in Boston Harbor, and planning for a replacement facility involved
issues similar to those in planning the jail. The old facility was constitutionally and
functionally obsolete and had to be replaced. A new facility could not be built on the existing
site, in this case because the site was needed for a wastewater treatment plant. The city could
not finance the new facility, nor had the city been able to find a new site in the city of Boston.
DCPO planners were instrumental in locating a site in Boston's south end, and the state
legislature was willing to provide the capital.

The DSB advertised for a study consultant in the summer of 1987, and in September
the firm of Sert Jackson began the study. The next summer, in June of 1988, DCPO advertised
for design/builders.

DCPO Makes the RFP a Stronger Control

Despite its role as the key legal definition of the state's project requirements, the RFP
had failed to control the design, the program, or the cost for the three prison projects and the
Nashua Street jail. In both cases, the RFP failed to communicate critical aspects of the users
requirements. Proposals for all three prisons exceeded the program limits by more than 10
percent, and DCPO had accepted these proposals and revised the programs for the three
projects. For the Nashua Street jail, one of the four teams so misread the sheriff's
requirements that the proposal was rejected solely on the basis of the configuration of the
housing module. The two final bids also exceeded the study estimates, by 34 and 39 percent.

The inspector general and DCPO had disagreed on how to solve these problems. The
inspector general thought DCPO should have forced teams to adhere to the program and cost in
the first competitions, and he recommended stronger sanctions for deviating from these

20 It was the summer of 1988, when Michael Dukakis was running for president. His opponent, George Bush,
had made pollution in Boston harbor a campaign issue.
standards the next time: DCPO should reject proposals that did not meet the requirements in the RFP, and if all teams exceeded by more than 10 percent the scale or cost defined in the RFP, the IG thought the entire competition should be cancelled and the study should be redone. DCPO wanted to retain flexibility in accepting proposals that did not conform precisely to the RFP, particularly if the proposals represented a "better value" for the state.

Barresi and Carlson compromised. For the next project, DCPO would use the study as a control mechanism for the project size and would reject proposals exceeding the program by more than 10 percent. If all competitors submitted non-conforming proposals, DCPO would revise and re-issue the RFP. On the other hand, Carlson resisted Barresi's recommendation to use the study to control the price as well. Carlson argued that the price should not be an inflexible cap, that even the Ward Commission had not recommended such controls for traditional projects. He prevailed, and DCPO defined the budget as a target but not an inflexible cap. DCPO agreed to hire its own cost estimator to verify study cost estimates and to estimate the cost of each proposal, to prevent the last minute surprises which occurred the first time and to ensure that prices were "reasonable."

DCPO decided to make the study more accurate by making the document more specific. The consultant was given more time to spend on the study - 8 months rather than 5 months for the jail, and DCPO increased consultant fees to cover the preparation of a schematic design and more precise specifications. The increased level of detail would lead to a better cost estimate, which DCPO would verify using its own independent cost estimator.

Sert Jackson applied to the DSB to prepare the study. Although the firm preferred design projects over studies, this second design/build study promised to be different. According to Bill Lindemulder at Sert Jackson, studies were "bizarre things to expect architects to do." They were expensive to the firm. "you are on the steep end of the learning curve," and the building never gets built, so "it will never go up on the wall." By asking Sert Jackson to prepare schematic designs for the house, and by using those drawings to control the final design, DCPO was making Sert Jackson a partner in the project. "We expected that the schematic would control the final design, and they would come close to building the building. The project could go up on the wall (Lindemulder 1989)."

Sert Jackson's program called for 823 beds in 380,480 square feet. There would be two maximum security housing units with a total of 112 beds. The balance of the facility would be direct supervision medium and minimum security units. The cost estimator projected construction costs of $85 million, not including design fees.
Little Change in Competition Procedures

The competition for both initial design/build contracts had been expensive and only narrowly competitive. The winner of the largest award, for the jail, was the sole survivor of the final qualification screen—the bonding requirement. Both DCPO and the inspector general recognized this as a failing of the method. DCPO proposed solving that problem not by changing the process but by soliciting additional competitors. The goal was to receive six proposals for each future project. The inspector general saw that goal as achieving a "valuable public policy goal: to ensure vigorous competition", but he cautioned that such a move would require a major investment of DCPO staff time and increase the design cost to teams and to the state, by increasing the number of honoraria. DCPO and the IG agreed that DCPO would solicit more proposals but not change the basic process.

DCPO recognized that restrictions on communication during design had prevented some bidders from developing proposals that matched the state's requirements. DCPO decided that communication had to be more open and proposed using interactive workshops, based on the rules used for the jail, from the beginning of the proposal process. The inspector general agreed.

DCPO's outreach efforts failed to increase the competition. DCPO advertised the house project at the beginning of June 1988. The agency sent out 112 Requests for Qualifications, and it planned to interview 10 teams and select 5 or 6 to submit proposals. Only three teams submitted acceptable statements of qualification. Applicant teams included two general contractors who were unsuccessful bidders on the first projects, teamed with local architectural firms, plus a contractor new to state work teamed with the designer of the three prisons. To increase the competition, DCPO decided to extend the deadline and solicit more interest. Jack Carlson personally contacted several general contracting and design/build firms to invite them to participate, and Hyman/TSA, now Hyman-Stubbins Inc. (HSI) and Perini, a DCPO "regular" who had competed for the jail project, agreed to participate. The DBSB invited all five to submit proposals.

Because the teams would be required to follow the Sert Jackson scheme, DCPO had decided to use a single step proposal process instead of the two steps used for the jail competition. Teams were asked to develop the Sert Jackson schematic designs into the design development phase. DCPO offered $200,000 to each team as compensation.

Despite the $200,000 honorarium, two of the original three teams dropped out of the competition within a month. As Bernie Feldstein of WAN/Morrison Knudsen team explained the situation, the cost of entering the competition would have been $450,000 at minimum. The designer's cost would have been $350,000 and the balance would be spent by the general
contractor. With an honorarium of $200,000, even if the total amount went to the designer, the firm would lose at least $150,000 if the team were not selected (Feldstein 1989). With five teams, there was only a 20 percent chance of being selected.

The remaining three teams submitted proposals at the end of October, 1988. Again, the bond requirement was a problem — with one week remaining before the bid date, the general contractor on one of the three teams notified DCPO that its bonding company would not issue a bond for a design/build project. In the end, the choice came down to two teams, as it had with the jail.

The DBSB made the choice between teams based on the design and the assertiveness of the architect. One of the teams followed the study schematic very closely, and the contractor on the team "was the hammer. The architect did what they told him to do. That's why they lost." (Forbes 1989) The other team created a new design and "in meetings, the architect was directing the discussion and the contractor took a back seat (Messervy 1989). The DBSB chose the new design and the assertive architect, in effect, according to Bill Lindemulder of Sert Jackson, wiping out 8 months of the firm's work. Hyman-Stubbins Incorporated proposed a 16 story tower with adjacent five, three and two story wings. The final program of 393,000 square feet and the price of $92.3 million for were both within 10 percent of the RFP program and price.

The DBSB's decision to abandon the Sert Jackson design created hard feelings in the local design community, particularly between DBSB member Peter Forbes and Lindemulder. DCPO had contracted with Sert Jackson to prepare a schematic design, and it had instructed the competitors to use this design and develop it in more detail. To Lindemulder, that meant the project could go up on the wall. To Forbes (1989), however, Sert Jackson had exceeded its authority as a programmer. "The programmer should not pick up a pencil to do design."

In the proposal process, DCPO used regular interactive workshops, and DCPO staff found these to be "very successful" (Messervy 1989). However, their effect was severely compromised by the fact that the competition was reduced to two teams, and the direction of each proposal was driven by the initial assumptions teams made about the nature of the competition. The outcome of the competition was not governed by the details of the proposals, which the interactive workshops were set up to address, but by the decision to either "accept" or "change" the Sert Jackson concept.

Carlson concluded that it had been a mistake to pre-design the facility in the study, that it had cut off innovation. Proposals for the house were "stilted", showing little creativity, the process put the teams through unnecessary expense, and "it defaulted them into a rigorous set of answers" (Carlson 1989).
DCPO Retains Bid Flexibility

For the first two contracts, costs proved to be most slippery, despite DCPO's use of a "lump sum bid". For the three prisons, the contract price of $22.7 million was 13 percent above the RFP budget of $19.8, and the builder had began requesting substantial change orders soon after the start of construction. By May of 1989, the price had increased to $28.2 million, 42 percent above the initial budget. Similar increases plagued the jail project, although these increases occurred prior to the execution of the contract. The contract price for the jail in October of 1989, $52.375 million, was 31 percent above the initial budget.

In the three prisons project, DCPO and the design/builder had signed the contract based on the proposal designs, which were about 20 percent complete, only through schematic design. The designs were developed after the contract was signed, and the designer made numerous changes in response to DCPO and the DOC. Most changes added to the price. Finally, DCPO had changed the contract from a lump sum price to a guaranteed maximum price. The move allowed the agency to work more closely with the design/builder in the finalization of design for the three projects and to verify prices impacts and bid prices from subcontractors. Such a problem had not surfaced in the Nashua Street Jail project. HSI and DCPO had not signed a contract until four months after the award, during which time they conducted extensive negotiations over the contract and the design. The resulting contract had included design development documents.21

For the house, DCPO decided to try a cost plus fee contract, allowing the state to save up to $6 million. As John Messervy explained it, drawings would be about 25 percent complete when the contract was awarded. The contractor would have actual subcontractor bids at that time. To cover that risk, the contractor would add a contingency of up to 10 percent to the bid. If the bids came in at budget, the contractor would keep the 10 percent. If DCPO used a cost plus contract, DCPO would save that amount.

Using the same two phase contract HSI negotiated for the jail, DCPO would ask for two prices: a firm price on phase I of the contract, design through working documents plus site work and foundations, and a "conceptual" price for the balance of construction.

For argument, phase one might amount to $30 million, and the contractor would carry a 10 percent contingency on that. Phase two would be bid, so the contractor should carry no contingency on that work because he would guarantee the price after the bids were in. That would reduce the contingency by $3 million on $90 million (Messervy 1989).

Thus the state could save $6 million.

21 Termed by HSI "early" design development because they lacked specifications and certain design details.
There were objections to the plan. The inspector general had agreed to a target price, but he felt uncomfortable without a guarantee. Also, the plan depended on Hyman's bidding all of the subcontracts. Hyman had included certain subcontractors on his team, for HVAC, plumbing, electrical, security systems, and steel fabricating, and it did not plan to open those contracts to bids. Prior to the award of the contract, DCPO decided to use a guaranteed maximum price for the entire project and to split the savings with HSI, with 75 percent to DCPO. Hyman could use its own subcontractors, unless DCPO found the prices to be too high, in which case it could request bids.

Based on the cost estimate in the Sert Jackson study, DCPO instructed competitors to design to a budget of $85 million. Prices submitted with the October 1988 proposals ranged from $88 to $93 million. On March 31, 1989 DCPO signed a contract with HSI for a guaranteed maximum price of $92.3 million, 8.5 percent above the budget. Construction began 15 days later.

3. Postscript: the Modules

In 1988, under growing pressures of overcrowding, the Department of Correction (DOC) decided that conventional facilities, either design/build or traditional, simply took too long. The agency had previously leased pre-manufactured "modular" buildings for temporary minimum security housing, and it believed it could develop complete facilities in as little as one year by buying similar units. The DOC approached the DCPO with the proposal, and DCPO's maintenance operation, the Office of Facilities Management, agreed to create a program for the purchase of relocatable modules. At the same time, the inspector general's staff, the DCPO general counsel and the legislature developed legislation to govern the purchase and installation of such "temporary" units for emergency conditions. The authorizing legislation was passed in August of 1988.

In concept, the purchase of modular units looked like design/build procurement: the state signed a contract with a single entity for the design and construction of building components. The state's requirements were specified in a request for proposals, teams submitted design and price proposals, and the DCPO evaluated submissions and awarded the contract on the basis of a combination of price, design and quality factors.

The difference between design/build and modular procurement was a function of the design process. Modules were by definition pre-designed and available in the market prior to purchase. Product development had already occurred in the manufacturer's organization, and the unresolved design factors involved only how the modules were assembled on the particular site. Reflecting these assumptions, the DOC modules were exempted from the jurisdiction of
the Designer Selection Board, and DCPO made the section decision internally, rather than using an outside board. The Office of Facilities Management created two staff committees, one to evaluate the design and quality characteristics of the proposals, the second to measure price against quality and determine the best value for the Commonwealth. Because the modules were part building, part product, DCPO reinterpreted its study requirements. The DOC in conjunction with DCPO, not an outside consultant, prepared the program, basing specifications on the DOC's previous experience leasing modules. DCPO retained the right to negotiate with bidders over the technical aspects of the proposal after submission, as long as the changes were to the advantage of the Commonwealth.

DCPO retained its requirement that bidders provide performance bonds, although this ran counter to industry practices. Modular vendors usually did not provide such bonds. DCPO resolved the issue by encouraging vendors to enter into joint venture relationships with bondable general contractors.

In the winter of 1988, DCPO issued an RFP for a 300 bed complete facility on the grounds of the Worcester County jail. The specifications called for hardware intensive housing units and remote control rooms. There were separate contracts for three types of modules: concrete, wood and steel, and pre-engineered buildings. Bidders were traditional contractors with subcontracts with manufacturers and architectural firms. The project cost was $38.1 million, or $252 per square foot. The project completion date of May, 1990, was 15 months from the initial advertisement.

DCPO later awarded contracts for the development of facilities at Shirley and in Essex County using modular units. Both projects had been on Carlson's 1988 list of new design/build projects.
D. Summary

Although DCPO defined design/build as an alternative method of design and construction, the focus of the agency was on efficiencies associated with the "one stop" selection of designers and contractors. The state's approach was shaped by Chapter 579 and its prescription for specific procedural checks to assure honesty and equity in the award of contracts.

The effect of the application of sequential procurement to design/build, in which procurement and design were simultaneous, was to compromise both design and procurement. Conflicts were associated with the regulatory measures and "safeguards", the study, the separation of management from procurement, and the threshold requirements for competition for the projects.

The state responded to the conflicts by making numerous procedural adjustments. For the jail, DCPO broke the proposal into two stages, design and technical proposals, and it adjusted the honoraria to shift the initial cost/risk equation faced by competitors. For technical proposals, DCPO opened lines of communication to individual teams through its 'interactive workshops." DCPO backed away from strict lump sum bids when it opened negotiations over the bid price with the two finalists. For the house, the state used interactive workshops throughout the design competition, and it discarded the requirement that competitors adhere to the prototype design. The agency decided to use a guaranteed maximum price contract. In these examples DCPO moved away from its initial procedures, based on traditional notions of procurement, when these proved inappropriate for design/build. For the modules, DCPO went further. State planners and the DOC prepared studies. The separation between procurement and management decisions was redefined to one between quality and price, and all decisions were made by state employees.
VI. Implementation: The Industry's Perspective

In the last chapter I looked at the DCPO experiment from the state's point of view, examining the relationship between the owner and the design/builder in the collapsed procurement/design phase common to public design/build. I explored the underlying conflicts and explained how DCPO's imposition of traditional ideas about public procurement compromised design in the new context.

I now turn to building production and look at the impact on the integration of knowledge about construction into design under DCPO's design/build contract. The chapter takes the point of view of the designers and the builders that participated in DCPO's projects. Like the state, the designers and builders of the jail brought to the project an interest in participating in a new way to develop public buildings. In practice, however, they struggled to fit what they knew how to do—traditional design and construction—into the new procurement and contractual framework. They ran into significant conflicts.

Under the DCPO version of design/build, integration of construction knowledge into design via open communication between the builder and the architect only partially occurred and was least evident during the early stages of design. Different elements of design were done by a more dispersed group of firms than under traditional contracts, and responsibility of the architect for cost estimating and field supervision was more limited than that of traditional public designers. The contractor did not achieve significant input into design in until the latter stages of the process, when such input had the least impact on the shape of the project. Integration of production knowledge into design occurring at the level of the consulting engineers and subcontractors became the subject of conflicts with DCPO.

The focus is on the implementation for the Nashua Street Jail, but I also follow some of the participants as they moved from the jail to other projects sponsored by DCPO. Other projects form an important backdrop for the design/build projects, demonstrating the context of traditional practice in which industry participants framed design/build. Participants were design/builders on the surface only; underneath were traditional firms that formed temporary associations to secure DCPO contract awards.
A. The Architects Carry the Design Competition

1. The Organization of the HSI Team

All of the competing design/builders were teams of traditional firms that joined together solely for the purpose of securing a DCPO design/build contract. The ad hoc formation of these “entities” by traditional firms is illustrated in the creation of Hyman Stubbins Incorporated (HSI). One architect brought the project to the attention of a colleague. Neither had done a design/build project before. They then shopped for a willing general contractor who would become the prime contractor. The team came together driven by the participants search for new work and by an interest in the new contracting method.

Not only did the "entity" consist of traditional firms, in its internal organization, HSI mirrored the traditional organization of a building project. The entity was in effect a shell, which wrote a design/ build contract with DCPO and traditional lump sum contracts with the architect and the contractor.

Traditional Firms Search for Design/Builder Partners

Robert Brodeur, a principal of Voinovich Monacelli Architects (VMA) was the first HSI partner to hear about DCPO’s plan to advertise a design/build contract for the jail. Brodeur had provided design services for other state and city of Boston projects, and VMA had done studies for several correctional projects for DCPO. Brodeur had prepared cell assembly layouts for the temporary concrete modules purchased by Boston Public Facilities Department (PFD) in 1986 to relieve overcrowding at Charles Street, and he had been following the progress of the jail project.

Morse Diesel managed the assembly of the modules at Charles Street for PFD, and VMA and Morse Diesel had formed a design/build team to bid on the three prisons project. The DBSB had not invited the team to submit a proposal. When the jail was advertised, VMA started looking for other partners. Although VMA had previously worked with Morse Diesel, the two would not qualify as a team for the jail. With only (17) employees in Cambridge, VMA was too small to undertake the design alone, and VMA and Morse Diesel had not worked together on a corrections project as large as $30 million, the DCPO threshold. Brodeur decided to call W. Easley Hamner at The Stubbins Associates (TSA). TSA had designed and Morse Diesel had built the Marriott Hotel at Copley Place. Brodeur’s plan was to create a

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1 The firm was an association of the Voinovich Companies, a large Cleveland architectural firm and Monacelli Associates, a small Cambridge firm. The association ended in 1988.
TSA-VMA-Morse/Diesel team. Shortly after Brodeur talked to Hamner about the project, Morse Diesel told Brodeur that the firm's New York office had decided to form a team with Jung Brannen of Boston, with the Gruzen Partnership in New York as the corrections designer. Brodeur notified Hamner the deal was off.

Hamner was particularly interested in pursuing the project because design/build was increasingly talked about as a concept, and the firm wanted to see how it worked "from the inside". Hamner viewed design/build as the public equivalent of construction management, as a way to use fast track construction on public projects. He had been involved in the first CM project TSA had done, Citicorp Center in New York in the 1970s, and he was an advocate of the concept. Hamner began making telephone calls to other general contractors which had built Stubbins projects. The first firm he contacted was the Gilbane Company, but the firm had already made a commitment to another design firm. Next on the list was Turner Construction, who decided not to participate. "By this time, I was running out of names." Finally, Hamner decided to call the George Hyman Construction Company, who had built the Thomas P. O'Neil Federal Building, designed by TSA. Hyman had recently become involved in its first design/build project, for the Postal Service, and the firm saw design/build as a potentially important new version of public contracting. According to Hamner, "Hyman jumped at the opportunity" (Hamner 1989).

The Structure of the Team Mirrors that of Traditional Projects

Although the DCPO Request for Qualifications required the designer and builder to have worked together on previous projects, the concept of "working together" was misleading. For TSA and Hyman, that meant that Hyman was low bidder on the O'Neil building and that both held contracts with the General Services Administration. They had no previous contractual relationship with each other, and they both treated the partnership as novel. Shook described the newness of the arrangement.

Its neat for everyone involved. Its neat for Hyman's people. They get to argue with the architect. Its neat for Stubbins's people. The architects have never dealt with contractors before. To architects, contractors are just letters in the in basket that never get read. (Shook 1989)

The two firms, The Stubbins Associates and the George Hyman Construction Company, formed a joint venture entity known as Hyman-Stubbins Incorporated (HSI) to compete for the project. HSI was a paper corporation with no staff; the three officers were W. Easley Hamner, Wilson M. Shook, and A. James Clark, president of both the Hyman and its parent company, the Clark Construction Group. The dominant financial partner was Hyman, which held 95 percent of the stock, with TSA holding 5 percent. DCPO contracted with HSI,
which in turn held a traditional fixed price design contract with TSA and a lump sum contract for construction services with Hyman. Although all funds came to HSI, the entity retained only enough in fees to cover legal expenses and overhead. All revenues were passed through to the partners.

The arrangement had several advantages. "It conveyed to the state the impression that there were two firms participating equally in the project" (Shook 1990). It also met the needs of the insurers. By creating the two traditional contracts, the arrangement limited responsibility for design errors and omissions to TSA, which maintained insurance to cover this liability. TSA in turn took no responsibility for construction. Hyman provided its customary bid and performance bonds, and it took no responsibility for design.

Within the shell, each firm created traditional project organizations. The consulting engineers reported to TSA and, except for VMA, which assigned designers to work in TSA's offices, the engineers worked out of their own offices communicating with TSA in meetings or by telephone. Hyman "pre-teamed" with four subcontractors. Together with Hyman, the mechanical, electrical, and security and miscellaneous metals subcontractors were responsible for over 50 percent of the construction. According to Shook, Hyman chose these subcontractors based on long standing business relationships, the financial capacity of the firms to provide the bonds required by Hyman, and their ability to provide cost estimates of key systems at a "conceptual level" of design. The remaining 40 subcontracts were bid.
2. Design During the Competition

TSA approached the design in its traditional way. What this meant for the jail project was that TSA proceeded with design relatively independently of Hyman, in some cases giving documents to the contractor to price at the same time the documents went to DCPO. Hyman estimated costs after receiving design documents from TSA, which limited the contractors' ability to influence the design. The designer made the decisions during the design competition, but DCPO, anticipating that the builder had more significant knowledge of and input into the decision-making, expected the builder to guarantee the price. During this stage, the flow of information remained largely one way, from the designer to the builder.

Design Sequence

In the usual design sequence, the architect starts with a broad concept and moves from big to small features of the building. Based on the program, the architect first creates a block diagram showing the broad arrangement of spaces. The designer then works out the detailed
arrangements of spaces, defines the footprint of the building, and designs the elevations. This is given to the structural engineer to work out the structural grid. The architect then turns to the building exterior, the "skin", and develops the facade, windows, exterior materials, following with the design of the interior spaces. The architect brings in the mechanical, electrical and other systems engineers at this point. The final phase involves the interior architectural treatments, the walls, glass, doors, door frames, and hardware. At each stage, the designers moves from concept to detail, basing the details on agreement about the concepts.

The Phase One Proposal: Architects On Their Own

The HSI team had seven weeks to prepare phase one proposals. The primary actors at this stage were Roy Pedersen, TSA's project architect, and Terry McManus, VMA's project architect. In preparing the proposal, these architects worked independently, with no involvement by DCPO or the sheriff's office, based on DCPO's procurement rules, and with limited guidance from Hyman. Two marketing representatives and a cost estimator were assigned from Hyman's office to the project. Their input into design consisted of the following recommendations: Hyman liked using concrete as a structural system; site conditions dictated the use of piles, and with a concrete structure, Hyman recommended a particular type of piles; TSA should also use as many repetitive elements as possible and regularize the design. Pedersen noted that Hyman's people were "supportive", but that they did not become seriously involved in the project until close to the conclusion of the second phase of proposals, when firm prices had to be submitted and when it looked as if HSI might win the award.

In this first phase, Pedersen and McManus struggled to interpret DCPO's priorities from the RFP. DCPO stressed quality, but otherwise, Pedersen found that the owner's priorities were not clear in the program. The program consisted of a list of things the owner wanted, sometimes in conflict.

For example, the program said that one goal was to humanize the environment. When you read the list of materials, it said steel and concrete block. There is a conflict between those ideas. What is the owner's priority? (Pedersen 1989)

TSA and Hyman found flaws in Sert Jackson's concept. The building was four stories high, spread out over the entire site. Internally, there were problems in the circulation system and in the organization of recreation areas. Hyman's people thought the concept would be very difficult to build: the building was on stilts, and Hyman did not like the site access or the foundation plan. Pedersen and McManus decided to propose a new concept. Their proposal was for an 8 story building with housing pods stacked in groups of three. The architects described the proposal in a block diagram of the overall building and a detailed design for the
housing pods. There was no systems design, and the central area spaces were not resolved at this stage. Pedersen termed the drawings "pre-schematic".

TSA gave the drawings to Hyman at the same time it submitted the proposal to DCPO. Hamner termed this "part of the competition aspect" of the process. "Unless the contractor has something to react to, he can't generate costs" (Hamner 1989). Hyman's estimator used the drawings to prepare a square foot budget, using for reference project costs of similar buildings in the company's project data base. Because of the level of detail of the proposal, it was only possible to prepare a conceptual budget, not an estimate. Thus in December of 1986, when the DBSB asked Hyman to guarantee that the price would not exceed $40 million, Hyman had just received the drawings and prepared a budget.

*The Phase Two Proposal: Bids on Structure Blow Budget*

DCPO decided to open up communications with the teams for the development of the technical proposals, but for the designers, the "interactive workshops" were inadequate. Even in these private meetings, communication was constrained by DCPO's pre-occupation with procurement rules and TSA'S reluctance to tip its hand to its competitors. As the design moved into the development of the full schematic, it became too late to make major design changes. According to Pedersen, the designers had made many critical decisions in phase one, without the owner or the builder's involvement, and it was too late to go back.

TSA began involving its engineers, Haley and Aldrich, (soils), and Syska and Hennessy, (mechanical and electrical), in the design process, and TSA brought these engineers to the interactive sessions to discuss problems and to get feedback on design solutions.

Haley and Aldrich were concerned about the subsurface conditions. To prepare a foundation design, the engineers wanted more information than DCPO's test borings showed. There was a danger of contaminants: the site had been a storage yard for trains, and an electrical substation on the site contained PCBs, but DCPO had provided no chemical analysis. The site was beyond the colonial shore line of Boston and had been filled in the nineteenth century, but none of DCPO's borings had "cored to bedrock", most only went down until they hit some undefined barrier, possibly obstructions in the fill. Nor had DCPO provided information about ground water. DCPO was reluctant to invest in more borings without knowing if they would be used by the final team. The questions remained unresolved.

Syska and Hennessy developed the overall concept for the mechanical and electrical systems in this phase, meeting with Hyman's mechanical and electrical subcontractors, who made suggestions about the systems. Syska and Hennessy's engineers also met with DCPO, looking for comments on the mechanical systems. In those meetings, Pedersen described DCPO's staff as "professional, but neophytes with respect to mechanical systems, and they
would not approve nor disapprove of any specific proposal". Syska and Hennessy described their plans to put the mechanical systems on the ground floor, rather than using rooftop units, so the units could be serviced without having people moving through the jail. DCPO's response was only that they understood why the engineers had made that decision.

Meanwhile, MacNamara of KKBNA, structural engineers, worked with Hyman on the structural design. At the beginning of this design phase, Hamner had discussed with MacNamara the kind of structure that could be built quickly. Hyman owned a pre-cast plant in a Washington suburb, and Hyman's estimator felt that a pre-cast system would be fast — components could be pre-cast off site, trucked to the job and field assembled with cranes, and cost effective. Pre-casting would be done in a factory, so it could be done in any weather. Hyman budgeted the cost of the structure at about $9 million.

In developing the schematic, TSA re-positioned the building entrance, based on the comments on the phase one proposal, and "worked out" the central administrative and support area. Cell wings would be stacked and tied together, forming part of the lateral support system. Open areas would be bridged by long span concrete girders, supported on concrete columns. The central portion, which included the service area and the gymnasium, would have reinforced concrete joists with a concrete slab. The roof of the gym would be steel roof decking on long span steel joists. Lateral support would be provided by reinforced concrete shear walls.

The designers created a final footprint, and they gave the footprint and the drawings to the structural engineer. In March, two weeks before the drawings were due at DCPO, Hyman took the structural design and began to get prices. The local pre-casters priced the concrete at $17 million, almost twice Hyman's budget.

The team met five days before the final proposal was due. Members were not sure whether Hyman was being "held up" by the subcontractors or if the design too complicated. Although the TSA design contained repetitive design elements in the housing units, the structure was irregular, making the pre-casting complex and possibly expensive. To bring the structure back within the budget, TSA either had to regularize the footprint, i.e. redesign the building, or use another structural system. There were only a few days until the proposals were due. "It was a design competition for a monumental building in the city, and we had positive feedback on the design aspects from DCPO. We could not back down on the design. It was too late" (Pedersen 1989).

MacNamara then proposed switching to a steel structure, "working out the essential features of the new system on the back of an envelope" (Hamner 1990). The partitions of the housing units would be of bearing masonry (concrete block), and the floor a "filigree" system (thin pre-case concrete with a concrete topping). The structure of the first floor would remain
concrete; the steel frame would start at the second floor. The structure would be cheaper, but it would take more time to build. "Hyman's people said they did not care about the time. They had to bring the cost down if they were going to get the job. They would worry about the time later" (Pedersen 1989). The redesign was done over the weekend before the proposal went to DCPO. The final proposal described both concrete and steel as alternative structural systems, "to keep the concrete subcontractors honest" in re-bidding the system later.

The new structure replaced a system built off-site with a labor intensive site-assembled system. The partitions had to be installed on site block by block by masons. Certain of the masonry walls formed security envelopes, thus the blocks would be reinforced with steel rods running through the block cavities. Electrical conduits also had to run in the walls, and the cavities were filled with concrete. The tediousness of the work made it a slow job for the masons and the slow progress of the masonry work became a problem as the project headed into the fall of 1988. The building had to be enclosed by winter, but because the exterior walls of the housing unit walls were bearing walls, these walls had to be completed. HSI ended up paying overtime and for work on Saturdays for four months in the fall of 1988 and for several months in the spring of 1989 to speed things up. "We had an army of masons out there, shoulder to shoulder, to finish the work" (Barry 1990). DCPO shared this cost.

Redesigning the structure had other implications. The initial structural calculations did not reflect the weight produced by filling the masonry blocks--the filling created an enormous mass, equivalent to that of a 40 story office building. With the weight and the new partitions, the structure no longer met seismic requirements. At the "eleventh hour", after the award, the structural engineer had to add shear walls, providing cross bracing for earthquake and wind protection, to replace the support provided by the original concrete panels. New shear walls flanked the central mechanical equipment room on the first floor, where most of the duct work and piping originated, and Manfredi of Syska and Hennessy described the impact on the design of the building systems:

Everything that was coordinated up to that point had to be redesigned. The problem was the concrete shear wall that was introduced into the structure. The original design had a masonry partition. There was duct work that fit into that space. You could cut through the partition to fit the ducts. Some of those walls became integrated into the structure. You couldn't penetrate at any point - there was reinforcing (Manfredi 1989).

In redesigning the structure, according to Hamner (1989) "coordination up to this point had been undone, and we were pretty much flying by the seats of our pants. It took several weeks to put things back together."
3. The Project at Award

The phase two submission was an "advanced schematic design", or about 20 percent complete. There were full elevations, plans showing furnishings, blow-ups of individual cells and key wall sections. There were line drawings of systems, but no dimensions. The type of mechanical systems had been determined, but no equipment had been selected.

Because the systems were not dimensioned nor equipment specified, the cost estimate remained conceptual, that is essentially a square foot estimate based on assumptions about the characteristics of the building.
B. Negotiating the Contract

The project team, the owner, the designer and the builder, finally came together in May, after DCPO awarded the contract to HSI. For the next four months, these parties formally defined relationships with each other, developed the building design, pinned down costs, and converted agreements to a contract. The process of contract negotiations became a period in which the participants assumptions about each other were revealed, challenged and changed.

The extent of the negotiations came as a surprise to the parties— for example DCPO had prepared a sample contract, which it had included in the RFP, and the agency had assumed that after a brief—30 day—period of negotiations, HSI and DCPO would sign the contract and the project would proceed to the next phase, the completion of design. However, there were too many unresolved questions for anyone to feel comfortable signing a contract. During the procurement phase, the sheriff and DCPO had found the TSA design a good one in general, but they were uncomfortable about certain details and had accumulated a list of possible design modifications. For the designer, there were unknown site conditions, the structural system had been changed at the last minute, and there were still design impacts to be worked out. For Hyman, the design itself was still too sketchy for a firm contract price, and the DCPO contract did not reflect the specific design services Hyman had negotiated to purchase from TSA. The system of design documentation in DCPO’s contract and the provision for separate contract phases, one for design and one for construction, did not anticipate fast track construction, which the agency had since decided to permit. Two contracts posed risks the team was unwilling to take.

Gilbane, the builder of the three prisons design/build contract, was entering negotiations with DCPO at the same time as HSI. Hamner had a close friend at Gilbane, and he called his friend to see what that team was going to do about the DCPO contract. Gilbane was planning to sign the contract as is. HSI decided to negotiate with DCPO over changes.

1. Negotiations Over the Line Between Design and Construction

Initially, DCPO assumed that following the contract award the process of design and documentation would parallel the traditional process. Before award, traditional documents such as the program and schematic design had become the RFP and design/build proposals. From the award on, design development, working documents and shop drawings under design/build would be similar to traditional documents.

The contract was a single document rather than separate design and construction contracts, but the sample that DCPO included in the RFP really consolidated the separate
services without changing the premise of separate and sequential design and construction processes. The sample contract was really two contracts in sequence: one for design and one for construction. The design contract in turn had two phases, design development and working documents. Even the fee structure paralleled traditional fees. DCPO would pay the design/builder 40 percent of the total design fee after the completion of design development documents, the same percentage paid for work to that point under a traditional design contract. Another payment, also equivalent to that under a traditional contract, would be made after the completion of working drawings. A final payment would be made for contract administration.

Part of the contract negotiations concerned differences between DCPO's expectations of design documentation and TSA's agreement with Hyman about design services. For example, the sample contract required that the design/builder submit to DCPO a complete set of working drawings and construction documents, both associated with an intent to seek bids at the conclusion of design. Hyman planned to eliminate the preparation of certain working drawings. The agreement with TSA included working drawings only for work to be competitively bid. For work to be done by pre-teamed subcontractors, such as the installation of the mechanical, electrical and plumbing systems, Hyman planned to use shop drawings prepared by the subcontractors, based on well developed design development documents. Eliminating traditional working drawings allowed the subcontractors to design/build those systems.

DCPO's arrangement to use separate design and construction contracts did not really meet the needs of either DCPO or HSI. DCPO saw the second contract as giving the state the opportunity to bail out of the relationship prior to the start of construction if major problems developed with the project. However, to save time DCPO had decided to permit the construction to be fast tracked, and $5 to $7 million in construction contracts would be let before the design was complete. In terms of the overall design time, design overlapped the formal start of construction by about 8 months, so the arrangement did not really give DCPO a clean escape. The double contract also created an unacceptable level of uncertainty in Hyman's commitments to its subcontractors.

DCPO and HSI negotiated a single contract with two notices to proceed. TSA would complete working documents in phase one of the contract, Hyman would complete certain construction planning activities and early construction contracts, including site work and foundations would be let. Phase two covered the balance of construction. DCPO authorized HSI to proceed with phase II on May 13, 1988, a transition that marked the substantial completion of design² but that was an arbitrary point in the construction process.

² There was still a short list of unresolved design decisions.
The language of the contract made it clear that despite the terms "design development" and "working documents", design/build documents were not traditional ones. The contract specified that design development documents were intended to be the basis for approval of the design concept, the lump sum price, and for working documents, i.e. on that basis the design/builder could proceed. Working documents were to be completed in 'segments', as needed for construction, and a complete package would not be completed until the end of the design process—the reverse of the traditional sequence, which breaks out individual packages from the complete working drawings and specifications. The contract also made it clear that working documents would sometimes consist of design calculations and performance criteria and that the final detailed drawings and specifications would be in the form of shop drawings.

During the 4 months of negotiation, TSA continued to prepare design documents for DCPO approval, taking the proposal through the design development phase. To determine actual conditions, the designers needed borings based on the final building footprint. DCPO agreed to allow HSI to do the borings during the contract negotiations, and DCPO used the teams honorarium contract to provide compensation. The contract incorporated well developed design documents, and DCPO agreed that, at the execution of the contract, the state would pay HSI 40 percent of the final design fee, for design development documents plus a percentage of the fee for contract administration.

![Table](Table4.png)

**Table 4**

<table>
<thead>
<tr>
<th>Design Fees to TSA ($000s)</th>
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<tbody>
<tr>
<td>Honorarium</td>
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<tr>
<td>Design Development (40 % of design fee)</td>
</tr>
<tr>
<td>Working Documents (45 % of design fee)</td>
</tr>
<tr>
<td>Construction Services (15 % of design fee)</td>
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<tr>
<td><strong>TOTAL</strong></td>
</tr>
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Source: DCPO Project Files and 9/8/87 Contract with HSI

### 2. Design Development without a Contract

After the award, according to Pedersen (1989),

All the masks came off. DCPO did not have to worry about the competition restricting conversation, the user agency could talk, and the design/builder could respond without worrying about tipping its hand to other competitors.
During the competition, the sheriff's office had little communication with TSA. Hamner described the first post-award meeting with the sheriff's staff as "awkward, TSA hadn't played by what they thought were the rules, we had changed the prototype design." TSA in turn reassured the sheriff that the architect's purpose was to meet the needs of the client, i.e. the sheriff and DCPO, and from that point TSA worked closely with DCPO and the sheriff's staff to refine the design. In the process, TSA added a hip roof to the gym (responding to a DCPO's comments about the form and Hyman's comments about the complexity of construction for the original roof design), modified the heating distribution system (a request of the inmates architectural expert), substituted security glazing for glass block (the outcome of a series of design decisions related to light wells in the buildings interior), redesigned the enclosures for the recreation yards (proposed by TSA), and added 18 cells. HSI had included the option to expand the facility in its second proposal, and in July, DCPO took the option.

Hyman saw this design process as a problem for construction planning. At the time of the award, the design was complete only through schematics; Hyman had to pin down the costs before signing the contract, but 80 percent of design work had yet to be done. Meanwhile, DCPO wanted Hyman to start construction right away, and Hyman wanted the design consultants to focus on construction and subcontractor bid documents rather than to proceed with the usual sequence of design. Certain components were long lead items, and the construction packages for these items had to be prepared early.

The most difficult thing is to get designers to think about construction. They need to think about what needs to be built tomorrow and what materials are needed today. That is not how they think in the traditional design process (Shook 1990).

TSA met with Hyman less often than it met with DCPO, only about four times between early May and July. This was a problem for Shook. He felt that, at times, TSA regarded the sheriff as the client, when the architect's contract was with Hyman. "They spent hours and hours with the user group. They wanted to change this, and that, and Stubbins would change the design."

In fact, TSA had made an explicit decision to treat the state as its client. According to Hamner, the firm was trained to deal with a client that paid for and used the facility. Here, the client was the builder, the user was the sheriff, and the legislature paid the bill. TSA decided that its primary responsibility was to represent the interests of the traditional owner/user, i.e. DCPO and the sheriff.

Meanwhile, Shook worried about coming up with a firm price for the contract and "buying the job", i.e. bidding the subcontracts and buying materials. He used the drawings TSA had submitted to DCPO in April to get prices for the various components. Bids based on
those drawings, taken in May and June of 1987, exceeded Hyman's budgets, and Shook wanted to resolve the problems with TSA. By June, however, TSA had already changed the designs based on conversations with the user, and in early July, TSA submitted design development drawings to DCPO. These were approved for inclusion in the contract. The prevailing specifications were those included in DCPO's RFP and the team's proposal. The design development documents were less complete than traditional documents in that no new specifications had been prepared for the July submission.

Hyman priced the design changes between April and July and HSI signed the design/build contract for the jail in early September, 1987. The contract incorporated design modifications made prior to July, including the addition of 18 cells, a 4 percent capacity increase. The contract price of $49.507 million for construction plus $2.868 million in design fees was 7 percent over the price at award.
C. Roles for the Builders

1. Schedule and Cost Control: The Builder Plays Catch Up

Unlike the theory, which suggests that design/build changes the one way flow of information from the designer to the builder, under DCPO design/build the architects continued to control the flow of information. TSA prepared detailed designs in the form of bid packages, these went to Hyman, then to DCPO. DCPO in turn provided copies to the sheriff's office. Shook estimated a 6 to 8 week lag from TSA to the sheriff. TSA prepared the packages so that Hyman could solicit bid from subcontractors. If the sheriff decided to make changes, which happened, it delayed the whole sequence significantly. When prices were out of line with the budget, Hyman, TSA, and sometimes DCPO would get together to try to resolve the problem through product substitution.

Specifying the Work: The Cost of Excluding the User from Design

Design decision-making for the sheriff's office was out of step with the construction sequence. This was a function of fast-tracking the work, but it also arose from the lack of user involvement in the preliminary stages of design, a function of DCPO's procurement process. An example was the door and hardware schedules.

The specification of hardware, door locks, hinges, and the like, is a special problem for correctional facilities, particularly those like the jail that depend on hardware for inmate control. Hardware is often a fundamental concern of those who manage correctional facilities, and the sheriff's planner was particularly concerned about such operational features of the new building. In the construction sequence, these were also "long lead items". The door hardware was to be built into the door frames, which were built into the walls, which were of masonry. The door frames had to be on site before the masonry was started, and product fabrication and delivery took 12 to 20 weeks after the schedules and shop drawings were approved.

The Sert Jackson program had described the security arrangement of within the jail in terms of "secure" spaces, which were within the system of barriers to inmate movement through the facility, and general spaces, used only by administrative or security personnel involving no special security requirements. Individual spaces in secure areas were defined as either "secure construction envelopes", meaning that the boundaries of the designated room were to be of secure construction with secure hardware on all access doors, or within a "secure compound perimeter", meaning that the boundaries of the group of spaces had to be of secure construction but walls of rooms within the group did not.
As described previously, architects usually develop the final door and hardware schedules toward the end of the design process. For the jail, DCPO wanted specifications for these items up front, since whatever was in the RFP was the minimum quality the state would get. So, Sert Jackson included guideline specifications for various kinds of detention and non-detention doors and hardware. For example, there would be two types of lock-sets, and each was described. Detention lock-sets were to be equivalent to "Folger Adam 50 series with F.H. 524 position switches or equal" and non security mortise lock-sets were to be equivalent to "Schlage L9000 series with #06 lever handles." (RFP 1986). The final schedule would depend on how the secure and non-secure spaced were distributed in the final building.

There were several problems. One was that the program assigned a security designation only to rooms, not corridors, important security spaces on their own in correctional facilities, nor to incidental support spaces, such as electrical closets. Second, the guidelines in the RFP would become the basis for the specification of thousands of doors and door frames, locks, and hinges throughout the building. The sheriff's involvement in the details of design virtually ended at the completion of the RFP; there was no opportunity to check the actual door and hardware schedules before they were finalized, yet such features directly affected the operation of the facility.

Following the Sert Jackson program, VMA prepared the security elements of HSI's November proposal. That proposal did not provide details about hardware except to say that hardware would be chosen "to provide required level of security without undue emphasis on the security of equipment, for ease of operation, for long life expectancy, to provide simple and reliable operation under emergency operating situations"(HSI Proposal 1986). After the completion of the July design drawings, VMA began to prepare the schedules, so that the materials would be on site when the masons started work. Ryan Ironworks, one of the pre-teamed subcontractors, would be supplying the hollow metalwork, i.e. the doors and frames. When the schedules were complete, HSI submitted them to DCPO, "so they were conscious of what was happening-- so they knew where in the process certain orders stood." (Shook 1990). In turn, DCPO passed the schedules on the David Tenney, the sheriff's planner. Tenney received the schedules in April 1987, about 8 weeks after the schedule left TSA's office.

Tenney interpreted what he received as a draft schedule, and he proceeded to make a number of changes. According to Tenney, to complete a coherent pattern of secure construction all security walls should automatically have security doors with security frames and security locks. That was not so on the submittal. For example, there were no security locks on electrical closets, but some of the closets were in areas accessible to inmates. Tenney made what he termed "corrections" to this submittal, "fine tuning the schedule", and he returned the schedule to DCPO.
When Hyman received the "corrections", his estimators carefully recalculated the costs. For each item deleted, the estimator subtracted an amount, and he added the cost of the new hardware. Hyman then submitted to DCPO a formal request for a client initiated change order and the price, $350,000. The hardware change also meant changes in the door frames, and the order for these was delayed. This in turn delayed the masonry subcontractor, Anastasia, who then submitted his own change order request, $15,000 for a six week delay.

The participants connected the problem to the design/build method, but each defined design/build differently. According to Tenney, design/build means that you design a building as you build it. He saw the early design documents as drafts, to be detailed later. The design/build saw the contract as the final statement of the owner's expectations of design, and that changes made after that time were changes in the contract. The contract itself specified a precedence of documents, the RFQ, the RFP, the proposal, the price, and the contract documents; items shown on the latest documents were the governing requirements. According to Brodeur of VMA (1989), DCPO wanted to have its cake and eat it too - "they want design/build and they want a say in design after the contract is signed." According to John Messervy, the security design simply had not caught up with the architecture. If HSI failed to provide security hardware for a closet in a secure area, that was their problem.

Meanwhile, Hyman was on the line for both the schedule and the cost.

The Builder Catches-Up

Bid prices were often out of line with budgets, and Hyman faced a choice - figure out a way to control costs, or lose money. Hyman found that the only way to control costs was to control the products, through the bid specifications. This became a focus of negotiation and a source of friction within the team. As Pedersen described it, TSA would pick out a product and write a specification for the color. Hyman would bid the product and find it was over the budget. Hyman would then propose substituting both the product and the color. DCPO had some leverage over a product, if the product was specified in the RFP, but no leverage over the color. "TSA could not control how Hyman bought the job."

As Shook saw it,

the architect views the whole thing as an ongoing negotiating process. They want to do things in an extravagant fashion. Sometimes they get caught, and then we can get them to scale back. They see it as a way to get what they want. Meanwhile, we have to worry about the budget.

The DCPO project manager was often caught in the middle between the designer and the builder. "Sometimes Hamner calls me and says "Shook wants to do thus and so -- don't let him get away with it. Other times, Shook calls me and says "Hamner want to do thus and so --
you've got to help me out. Neither of them knows the other one calls me. I just try to work things out" (Messervy 1989).

Part of this dynamic arose from the way HSI decided to structure the organization. By creating a strict separation between the designer and the builder, the structure relieved the designer of financial responsibility for cost performance other than the designer's traditional responsibility for the performance of the design. The situation was also a typical characteristic of negotiated construction, where a designer and a construction manager both push an owner to decide if s/he wants a building "good" or "on time" or "on budget" (Irwig 1990). Such negotiation is inconsistent with what the theory of design/build leads us to expect.

2. The Subcontractors Design/Build the Systems

Integration of construction knowledge into design did occur in the design and construction of the building systems, the plumbing, HVAC and electrical work. Hyman included the subcontractors for the major systems in the design/build team during the development of the proposal. These subcontractors advised the designers during the proposal preparation, and later, the subcontractors assumed responsibility for part of the systems design. In practice, the field foreman and the DCPO resident engineers found the new roles so unfamiliar that major on site conflicts erupted between trades and between HSI and DCPO over inspection of the systems. The idea of systems design/build, conceptualized in HSI's offices was not well understood nor liked in the field.

The idea of design/building the systems began as an idea to control costs. Hyman wanted to "reduce[s] the expense of the design function, provide[s] for cost efficient design details and eliminate[s] redundant efforts by the designer and the builder" (Shook 1987) by streamlining design documentation and allowing subcontractors' input into decisions about which systems to use. The package of design services purchased from TSA by Hyman include a coordinated design for the entire project, (approximately design development), a coordinated design for the components in construction, and coordinated design for packages necessary to procure subcontractors. For subcontractors on the team, the documents would be limited to the design of broad systems. The shop drawings would substitute for construction documents. Construction supervision and on site coordination was to be Hyman's responsibility, and TSA services in this area were very limited.

TSA contracted with Syska and Hennessy Consulting Engineers for systems design. A first, the Joseph Manfredi was nervous about having the subcontractors do part of the design, but his firm had tried the process on another TSA project, and the approach had worked. Manfredi found the interaction with the subcontractors useful. During the development of
proposals, the engineers met with the electrical, plumbing and HVAC subcontractors to get ideas about the relative costs and advantages of various systems. The engineers then used analysis to test those ideas. They honed the cost and the design of the systems during the proposal preparation, incorporating the advice of the subcontractors into the design. "The early competition said a lot about what the building would be." (Manfredi 1989) Syska and Hennessy found this process very useful.

On a traditional job, we design something and if someone questions it, we say we have had 60 years of experience, and we know that is the way the system should be designed. On this job, the sub gets to make suggestions, and we have learned from that (Manfredi 1989).

After the contract award, instead of having Syska and Hennessy prepare a full set of working drawings and specifications for the systems, with the subsequent preparation of more detailed shop drawings by the subcontractors and their suppliers, the consulting engineers would take the documents to "a logical conclusion, defining the major systems, the arterial runs, but not the branch ducts and the circulation. The design/build subcontractors would do that through shop drawings." The engineers gave the subs design performance criteria, such as standards for air velocity and friction through the ducts. The subcontractors would then design distribution lines that met these criteria. Syska and Hennessy would check the shop drawings. This approach was written into HSI's contract with DCPO.

There were several problems in implementation: difficulties coordinating the trades, difficulties in inspection faced by DCPO's resident engineers, and financial failure on the part of one of the subcontractors.

According to John Messervy (1989)

The design sequence should work like this: The sheet metal goes in first. Its big, and it can't shift up and down. The contractor produces shop drawings, and he gives these to the plumber. The plumber has to make sure his pipes have the right slope. He puts together his drawings and gives them to the electrician. His conduits can go anywhere. Then the sprinkler system goes in. It has to be below the electrical, at the ceiling.

Coordination in the jail was a problem because the spaces in which the systems had to fit were constrained and the foreman for each of the trades decided where his system would go with limited overall direction. The floor to floor height barely accommodated the necessary systems between floor and ceiling, and the requirements for secure construction in the housing units made routing of the systems in the walls difficult at best. Problems were most acute at the lower levels of the building, where the biggest ducts and pipes had to be fit into the space with the lowest ceiling height.

Again, according to John Messervy:
They tried to work it out, but rather than having an engineer figure the whole thing out, it left the foreman of four or five subcontractors to get together and try to figure it out... It became a case of 'I was here first, so my system goes here...We have actually had brawls between the HVAC and the plumbing subcontractors. One group comes in and wants the other group to rip out the work it has just installed.

Syska and Hennessy reviewed shop drawings, but they were only on site, where the installation was taking place, once a week. Hyman managed design/build purchasing off site and provided coordination from its on site office, but Messervy felt it remained up to DCPO to make sure that everything was being done right.

During the project, EMDE, the mechanical subcontractor had financial difficulties and went out of business. The firm had been involved in advising the engineers on the mechanical and plumbing work. Hyman had in effect "bought their expertise", and when the firm went under, Hyman did not have its own staff to pick up the slack. Some of the sub-sub contractors were retained, allowing continuity on the project, and EMDE's bonding company brought in another subcontractor, but the firm was not as highly qualified as EMDE. This contributed to the field conflicts, and the event delayed the work for about 6 weeks.

A related problem was the difficulty DCPO's resident engineers had with the new design documentation. The resident engineers were accustomed to monitoring traditional state projects with traditional construction documents. For this project, the installations were not described on a single clear set of documents. To figure out what was supposed to go where, the resident engineers had to refer to 60 to 70 percent complete design documents showing the major components at one scale, and a series of larger scale shop drawings filled with distracting fabrication details. Also, since the actual installation locations were determined at the time of installation, what was in place did not necessarily conform to the drawings.

The conflicts over the installation of the systems in the lower levels of the building made the residents suspicious that there other problems with other design/build elements. The residents resorted to what the architect and the subcontractors regarded as intrusive tactics, measuring installations to verify that the state got what it paid for. The HSI team began to view the residents as "bean counters...trained to suspect, to question things" who could not see the "whole picture" and who drove people in the field crazy responding to request for more data. According to Shook, "down in the trenches, the state does not know how to administer a design/build contract."

A final problem for Hyman, who bore the construction price risk, involved ambiguities in bidding by subcontractors. The subcontractors were accustomed to bidding on complete documents. On this project, Hyman asked subcontractors to confirm prices for the phase II proposals (20 percent design completion) and then at the level of design development (30 to 35
percent completion). According to Manfredi of Syska and Hennessy, subcontractors typically were reluctant to confirm prices at this level of detail, preferring to wait until the design more complete. In some cases, the subcontractors compensated for the uncertainty of the design and their final prices were consistent with the estimates. Other subcontractors treated the pricing differently, estimating only what was shown on the documents. As details were added, the price went up.
D. The Participants and Subsequent Projects

HSI was set up as a temporary partnership between TSA and Hyman. Characteristic of project organizations in the industry, the partners would disband and create new teams for future projects. The directions the HSI partners took and those of their competitors tells us something about the lessons they learned from the DCPO design/build projects. All three HSI partners, TSA, Hyman, and VMA, chose to participate in new design/build type contracts. WAN, which had developed a particular specialization in DCPO work and entered and then withdrew from two design/build competitions, chose to continue to provide services to DCPO under traditional contracts.

1. HSI: A Repeat Performance

Hamner Recommends Eliminating Design Competition

May 13, 1988 was "official" completion date of the design phase of the Suffolk County jail project, and Jack Carlson invited participants including John Messervy, Alan Burne, Easley Hamner, and Wilson Shook to celebrate the event at Carlson's office at One Ashburton Place. Carlson and Hamner talked about how the design/build process had worked, and Hamner had several ideas about changing procedures in the future. Carlson asked Hamner to put his ideas on paper, and the following week Hamner responded with his "Evaluation and Reactions" (1988) to the project. Hamner focused on several elements of the DCPO design/build procurement method: the use of a prototype design, selection through a design competition, and reliance on a lump sum bids rather than a guaranteed maximum price.

Hamner connected DCPO's requirements to the state's desire to provide accountability, and he suggested that public agencies used such formalized measures because of an underlying distrust between public and private sectors: the controls were supposed to protect the state from the professional.

Design professionals are frustrated because they believe that "bureaucrats can't make decisions" and public agency staff feel that their job is to watch the professionals "like hawks" in order to protect the public interest. (Hamner 1988)

Hamner found the state's approach to be part of the problem.

An essential aspect of design and construction is a need to create an environment in which teamwork can exist. Teamwork cannot function in a framework of mutual distrust. (Hamner 1988)
Hamner proposed three modifications of the procurement method: shorten pre-design by eliminating the non-program related parts of the RFP, most importantly, eliminate the prototype design; select design/builders on merit, not on the basis of a "seductive" design competition decided by an "ambiguous" jury evaluation process; use a guaranteed maximum price rather than a lump sum.

Hamner proposed that DCPO focus on the design aspects of design/build, choose a qualified team and then work closely with that team. "We believe a client must actively participate in the discussions during the design process." Similarly, the team should work with DCPO on an open book basis -- all data, proposals, contracts, etc. would be available for review and approval. Costs could be controlled by reducing the project scopes, negotiation, re-design, and re-bidding. Savings would be returned to the Commonwealth at completion of construction.

Hamner delivered his recommendations to Carlson after DCPO and the IG had agreed to new procedures for the next project. However, the state had already decided to strengthen the RFP, develop the study prototype design into a schematic design, and to require more detailed proposal submissions from competitors. DCPO had left the question of the bid price open, over the objection of the inspector general.

*TSA and the House*

Before DCPO formally advertised the Suffolk County House project for design/build, Hyman's Shook and VMA's Brodeur suggested that HSI enter the competition. Easley Hamner in turn approached Alan Burne, director of DCPO's Corrections Special Unit, to ask whether it was likely that DCPO would award a second major design/build contract to the same team. Burne's reply was that "it would be hard for us to give you another job", and Hamner and Shook decided not to compete for the project. After the weak response to the advertisement--only three teams had applied--Hamner called DCPO and asked if the firm should submit a "courtesy" proposal--they would expect to be eliminated. DCPO replied that they would be delighted if HSI submitted, but that they would regard the proposal as serious. At this point, HSI decided to compete. Brodeur had already formed a team with Dimeo Construction, so Monacelli was not included in the new HSI team.

TSA's strategy for the house was similar to that of the jail. Although the RFP stated that competitors should follow the prototype design, TSA felt the design had major flaws and decided to challenge the concept. TSA used its experience with the jail in the design; avoided masonry where possible, used precast elements for the building skin, and used a steel structure. The prototype had small basements, but the site had been a dump site for years, and
with a fluctuating water table, HSI was concerned about the potential for contaminated material below grade. TSA designed the house with no basements: the structure was supported on piles driven through "whatever was there".

DCPO had decided to use a cost plus contract for the house, with guaranteed maximum for the first phase only. Just before the presentation to the DBSB, Bill Shook told Hamner he felt very comfortable with the conceptual price, especially in light of his experience with the jail project, and that he would even prefer it if the price were a lump sum. In the presentation, Hamner repeated the conversation. "I thought it was a throw away line, but everyone wrote it down." Later, the John Messervy contacted Shook and asked if he were serious; the IG preferred a guaranteed price. Shook agreed to guarantee the price and return to DCPO 75 percent of the savings.

2. VMA: New Forms of Design/Build

*Monacelli and Dimeo Construction Compete for House*

Just as he had followed the jail project, Bob Brodeur of VMA, now Monacelli Associates\(^3\), followed other DCPO corrections projects. When it became apparent that DCPO intended to advertise the Suffolk County House, Brodeur approached his partners at HSI. Brodeur also talked to Alan Burne, who repeated to him what he had told Hamner. Brodeur wanted to participate in the competition, so he "scrambled for a new team."

Brodeur spoke to both Perini Construction and Dimeo Construction. Perini did not want to participate, and Monacelli formed a team with Dimeo. Later, when DCPO extended the proposal deadline to invite more firms to compete, Jack Carlson invited Perini to participate, and they decided to form a team with TAC of Cambridge. Brodeur was upset. He had introduced TSA and Hyman to corrections work and to DCPO, and he had had conversations with Perini about the competition. Now, DCPO had changed the rules, and the these firms were coming in as competitors to Monacelli’s team.

Monacelli and Dimeo submitted qualifications for the house and, along with the other two competitors, submitted a proposal in October of 1988. Two weeks before the bids were due, Dimeo's bonding company, which had promised to provide a bond for the project, was acquired by another company that was reluctant to provide bonds for design/build projects. There was no time to look for another bonding company, however, the team continued in the competition.

\(^3\) In 1988, Monacelli and Voinovich ended their association. Monacelli continued to compete for DCPO contracts, focusing on corrections projects.
Brodeur found the design guidelines in DCPO's RFP to be "quite explicit; DCPO and the penal commissioner were very happy with the study schematic and teams were expected to adhere to that scheme, improving and enhancing it only." The Monacelli-Dimeo design did that, as did the TAC-Perini design. The HSI design differed significantly from the prototype, and when the DBSB awarded the project to HSI, Brodeur felt cheated. "If you don't intend to follow the rules, don't promulgate them" (Brodeur 1989). Bill Lindemulder of Sert Jackson was also discouraged by the DBSB's action. The design the firm had prepared had been abandoned, and the project could no longer "go up on the wall". Lindemulder no longer wanted to be associated with the project. It was his "worst hour".

Jack Carlson saw the process entirely differently. When the award for the house to HSI was announced, Carlson told Lindemulder it was his "best day in state government." Before the design/build projects, people said you could not do a design/build jail. There were no firms out there, and it was too complicated. Through this process, that group had been created. Jack's goal was achieved.

**Monacelli Teams with Perini to Design Modules**

Shortly after the competition for the house contract, DCPO advertised the modular contracts, starting with the Worcester County Jail project. There would be four contracts: housing units using concrete modules, wood and steel housing modules, pre-engineered administrative buildings, and site work.

Monacelli teamed with Perini to compete for the contract for concrete modules. They then looked for a modular manufacturer. According to several bidders, while there were manufacturers for the wood and steel modules and pre-engineered buildings, there were no manufacturers of modular concrete prison cells at the time DCPO advertised the project. The company that had provided the modules for the Charles Street jail, on which DCPO had based its specifications, had gone out of business. Monacelli and Perini solved that problem. They found Rotundo, a company in southern Massachusetts that made concrete boxes for the telephone company, and Monacelli designed a prison cell that Rotundo could make by adapting is telephone company product.

Perini won two of the four contracts for the Worcester project, for the concrete modules (with Monacelli and Rotundo), and for the wood and steel modules (with PBS of New Jersey). The contracts totalled $30.9 million. Butler Buildings won the contract for pre-engineered administrative and program space (at $4 million), and a local contractor, Zoppo, won the site contract award (at $4 million).
3. WAN, Maintaining Tradition

The 1985 Prison Construction Bill that funded the three design/build prisons and the Nashua Street jail also funded a correctional facility for Bristol County, southeast of Boston. The Bristol project was to be a major regional facility and thus was a high priority project for the state. Design and construction was undertaken under traditional state procurement laws. In May of 1986, the Designer Selection Board chose the Boston firm of Whitney Atwood Norcross (WAN) to do the design.

WAN was a firm of 10 to 12 professionals, and 95 percent of the firm's work was with public sector clients. At the time, DCPO was the firm's major client; the firm had designed six correctional facilities for the state since the 1970s. Because Bristol was a high priority project, in addition to the $1.7 million fee, DCPO offered WAN a bonus of $300,000, one third for meeting each of three targets: a design schedule of 48 weeks exclusive of DCPO reviews, a bid price of $26 million, and change orders due to document errors of less than one percent.

WAN specialized in the production of construction documents, working in association with "concept designers" who undertook design through schematic drawings. For the Bristol project, WAN's associate was Silver and Ziskind of New York, and WAN agreed to give Silver and Ziskind 35 percent of the fee. WAN would keep 65 percent for its production drawings and contract administration. The purpose of splitting the final design into two phases and using different firms for each, according WAN principal Bernie Feldstein, was to focus necessary time and resources on the preparation of construction documents. With a lump sum fee, he saw a danger of an architectural firm spending more fee time than it should in the schematic design stage, leaving too little fee resources for documentation. By allocating fees to and specializing in production, Feldstein sought to produce highly accurate bid and construction documents, thus improving the quality of bidding and reducing document errors and omissions in construction, often a major source of change orders.

Because DCPO and WAN had a long working relationship with DCPO, WAN agreed to begin design in September of 1986, two months before the contract was signed. At the same time, WAN, also in association with Silver and Ziskind, submitted a statement of qualifications with Peabody Construction for the Suffolk County Jail design/build contract. WAN later withdrew from that competition.

The study for the Bristol projects proved to be a poor regulator of final design. The 1986 study, prepared by the Vitetta Group of Philadelphia, anticipated a 372 bed facility in a 132,000 square foot building. The cost would be $26 million. The final building contained 180,000 square feet, 46 percent more than the original program. The variation was well in
excess of the 10 percent limit called for in Chapter 579. The 1988 bid was $32 million, 22 percent above the DSB estimate. The mismatches reflected several inherent problems with this kind of design regulation. First, according to Feldstein, the total building area in the program was a "gross area", estimated without knowing a final building footprint. Second, there were two clients in the Bristol project, the sheriff and the state Department of Correction. During the later stages of design, the DOC decided to enforce a new policy about the design of housing areas, increasing the net area.

The Bristol project illustrates some of the schedule related problems with traditional procurement and traditional design. Overall, the project took four years and three months from the time the DSB advertised for a final designer (March of 1986) to completion (July 1990). This was about nine months faster than DCPO's average. DCPO's internal processing took longer than usual, however, and DCPO made up the time by providing bonuses to both the designer and the contractor, and by shortening the construction schedule required in the construction bids. Because the DOC required redesign lengthened the design schedule, WAN lost the $100,000 schedule bonus.

Feldstein projected a 33 week construction schedule, but to make up for the slippage in the design schedule, DCPO decided to accelerate the construction schedule, first reducing it to 27 weeks and then to 22 weeks. DCPO then offered the general contractor a bonus of up to $600,000 for early completion.

In its specialization in the production phase of design, WAN had developed a strategy for anticipating construction controversies. First was document accuracy. The firm also used principals rather than junior staff to attend job meetings and review shop drawings; the architect and the engineers thus interacted directly with the builder and the subcontractors at the site. Information about construction issues derived from previous projects also had been fed into the design process for the Bristol project.

The Bristol project was advertised in April of 1988, and in June bids were submitted by eight general contractors, including the George Hyman Construction Company, Daniel O'Connell, Peabody Construction, and Dimeo Construction, all of which had bid on the design/build projects. Dimeo Construction of Providence RI submitted the low bid of $31.9 million. Dimeo's previous work included projects for private clients plus several public projects in Rhode Island. This was the second project in Massachusetts.

The six low bidders were within $1 million of each other. Dimeo's construction manager attributed to the quality of the construction drawings a the broad interest among

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4 The DSB estimate had inflated the cost of construction estimated in the study to be $21 million to $26 million, to reflect inflation to the mid-point of construction.
contractors, close bidding (indicating accurate pricing), and a smooth construction process on the project.

Table 5
Characteristics of DCPO Corrections Projects

<table>
<thead>
<tr>
<th>Project Characteristics</th>
<th>Nashua Street Jail</th>
<th>Suffolk County House</th>
<th>Bristol County Jail &amp; House</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Area (Square Feet)</td>
<td>248,555</td>
<td>392,966</td>
<td>180,005</td>
</tr>
<tr>
<td>Number of Beds</td>
<td>453</td>
<td>823</td>
<td>377</td>
</tr>
<tr>
<td>Square Feet per Bed</td>
<td>548</td>
<td>477</td>
<td>477</td>
</tr>
</tbody>
</table>

Building Cost ($000s)*

<table>
<thead>
<tr>
<th>Description</th>
<th>Study</th>
<th>Honorarium</th>
<th>Final Design</th>
<th>DESIGN TOTAL</th>
<th>CONSTRUCTION (Contract)</th>
<th>TOTAL Design &amp; Construction</th>
<th>1987 $ per Square Foot</th>
<th>1987 Total $ per Square Foot b</th>
<th>1987 Construction $ per SF</th>
<th>1987 $ Per Bed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study</td>
<td>409</td>
<td>500</td>
<td>2,868</td>
<td>3,777</td>
<td>49,507</td>
<td>53,284</td>
<td>214.38</td>
<td>214.38</td>
<td>199.18</td>
<td>109,287</td>
</tr>
<tr>
<td>Honorarium</td>
<td>832</td>
<td>600</td>
<td>3,500</td>
<td>4,932</td>
<td>88,780</td>
<td>99,352</td>
<td>238.47</td>
<td>219.63</td>
<td>208.07</td>
<td>99,352</td>
</tr>
<tr>
<td>Final Design</td>
<td>125</td>
<td>n/a</td>
<td>2,011</td>
<td>2,136</td>
<td>31,983</td>
<td>34,119</td>
<td>189.54</td>
<td>173.05</td>
<td>162.22</td>
<td>77,455</td>
</tr>
</tbody>
</table>

Schedule

<table>
<thead>
<tr>
<th>Event</th>
<th>Nashua Street Jail</th>
<th>Suffolk County House</th>
<th>Bristol County Jail &amp; House</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start Design or Proposal</td>
<td>Oct 1986</td>
<td>July 1988</td>
<td>Sept 1988c</td>
</tr>
<tr>
<td>Bid Date</td>
<td>April 1987</td>
<td>Nov 1988</td>
<td>July 1988</td>
</tr>
<tr>
<td>Advertisement to Const. Start</td>
<td>13 mo.</td>
<td>10 mo.</td>
<td>29 mo.</td>
</tr>
<tr>
<td>Construction Time</td>
<td>30 mo.</td>
<td>29 mo.</td>
<td>22 mo.</td>
</tr>
<tr>
<td>Advertisement to Completion</td>
<td>43 mo.</td>
<td>39 mo.</td>
<td>51 mo.</td>
</tr>
</tbody>
</table>

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*a Current Dollars, from DCPO "Total Project Cost", fees and expenses only.

*b Constant Dollars as of April 1987, using index by Marshall and Swift.

*c Contract not executed until late November 1986.
4. The George Hyman Construction Company

As part of its strategy to establish itself in the Boston market, Hyman bid on other DCPO projects as well as the design/build projects. When the Bristol project was advertised in the April of 1988, the firm placed a bid. At that time, HSI had decided not to enter the Suffolk County House of Correction competition. In February of 1990, Hyman and Keyes Associates, one of the design firms that had competed for the Suffolk County Jail, decided to compete for one of DCPO's modular projects, a medium security prison in Shirley.

In May of 1989, Engineering News Record reported that 3 construction firms nationwide had secured general building contracts of over $1 billion the previous year. Two, Turner Construction Company and Centrex General Construction Company, had been part of this elite group for several years.

The only other builder to break the billion dollar barrier was the Clark Construction Group. This was a goal the company set for itself five years ago. "Our success can be attributed to a major penetration into the Boston and Philadelphia markets as well a gaining market share in our traditional Washington and Baltimore markets," says Lawrence C. Nussdorf, vice president and chief financial officer. "In addition, we were able to move beyond the office building [market] with significant increases in hospital and prison work," he says. (ENR. May 25, 1989, 75.)

Hyman has since competed for other design/build projects for public owners and was chosen to do a design/build project in the Washington area for the Postal Service.
E. Summary

The DCPO design/build projects were the target of a particular segment of the local industry design and construction industry, firms seeking public contracts for at least a portion of their work. Architectural and general contracting firms were willing to come together in various combinations to match DCPO's offerings. On one project, a group might define itself as a design/builder; on another separate firms would compete traditionally; on a third, combinations of the same group of firms would define themselves as modular builders.

The study of HSI reveals how much of an image the "design/build entity" was and how strong traditional practices remained. In the jail project, the architect drove the flow of information, as would occur in a traditional project, and the builder defined costs and planned construction after the architect completed drawings. Builders were most comfortable with traditional relationships and traditional projects such as Bristol, particularly when they involved architectural firms such as WAN that had developed public construction oriented practices over multiple projects. Even internal innovations, such as the design/building of the systems for the jail, caused conflicts within the team as well as discomfort with DCPO.

What made the industry nervous was that DCPO kept changing its mind. The client changed its mind on how it would buy services, first offering design/build, then traditional, then contracts for modules. Within the "new procurement", the client changed the rules in the middle of the game. This made the new "games" very risky, but to secure the work, firms played the games as best they could.

In adapting to the rules, firms faced a range of questions for which answers were not immediately apparent. How were teams to interpret the program in the RFP? How could they get specific information and feedback from DCPO on design proposals without tipping their hands? What "requirements" in the RFP were really negotiable? Price? Program? Bond? Prototype design? What kind of team image was DCPO looking for? An equal partners? The contractor as the lead? Could teams play and win two games in a row?

Participants also had to make decisions about how to structure their own internal partnerships. Because of the single contract, firms had to operate as single legal entities. In most cases, they had never done this before, despite DCPO's requirement that firms have "worked together" previously. That meant redistributing traditional design, supervision, cost estimating responsibilities and risks. Firms tried to fit traditional relationships and practices into the new framework, but in the case of the jail, this was not always possible nor even desirable, yet firms had little experience with other ways of interacting. If design/build was stressful for DCPO staff, it was equally stressful to other participants.
VII. Negotiating Change: Ideas in Conflict

The challenge to the participants in the DCPO case was to implement a new way of developing public buildings. In meeting that challenge, each participant faced conflicts between old ways of working, which were deeply imbedded in each organization and reinforced across organizations, and the requirements of the new process. In resolving the conflicts, each participant reached some kind of internal compromise in practices and the new approaches became the subject for negotiation with other participants. The result did not look like the traditional linear public process, although certain features persisted, nor did it look like the "model" we defined as the integrated firm, although some features were present. Design/build as implemented by DCPO and HSI was a hybrid, exhibiting the organizational and procedural characteristics of a system in change and displaying the tensions associated with such change. At the end of the project, the participants had not become partners, but nor were they adversaries as is often the case at the conclusion of a large complex public project. They had become skilled negotiators, with respect for each other.

The innovation, framed by DCPO as a change in its procurement process, required changes in the way almost every project participant worked, affecting the entire range of activities in the development process from design and construction to insurance. Counting agencies of the state and its consultants, competitors, their consultants, major subcontractors and insurers, at least 50 organizations and hundreds of individuals were asked to change the way they worked. The change rippled through the entire business system for building the project.

Specific impacts began with programming and architectural design. The new status of the study document changed the relative importance of early design decision-making. Schematic design became a competitive process undertaken in isolation from the owner and with limited input from the builder. Design development was done in an environment of contract negotiations. The impact on design extended to the work of the engineers. The mechanical and electrical engineers interacted for the first time with subcontractors in design.

For Hyman the change affected the way the firm priced documents—putting the firm in the position of pricing drawings "in process" rather than on completion. In turn, through its participation in specifying materials, Hyman acquired more control over the details of work packages. The change also influenced the supervision of construction, and the change in documentation by subcontractors in turn affected the job of DCPO's resident engineers.

With the elimination of the filed sub-bid requirements, certain subcontractors became part of the builder's team for the first time. These subcontractors acquired new control over the
design of certain components they were to install and new responsibilities for coordinating work in the field. Suppliers were able to advise subcontractors.

The change extended to the insurers. The requirements of Hyman's bonding company and TSA's liability insurer pushed the firms to use the particular joint venture form of organization, and the bonding company for one of HSI's competitors for the house simply would not provide coverage for design/build.

The change impacted individual organizations and the media through which they communicated with each other--the project documents. The traditional documentation sequence: the program, schematic design, design development, working drawings, bid, shop drawings, was replaced by a new sequence: RFP, proposal, bid, contract, (including design development drawings) and work packages with two versions of working drawings. Traditional working sessions between the owner and the architect during schematic design were replaced with rule based "interactive workshops". During design development these became contract negotiations. New potential communication opened between the contracting firm and its team of subcontractors and the architectural firm and its team of consultants during design and through construction.

Conflicts accompanied these changes because the project was undertaken within the traditional business system, by a line government building agency which bought services from traditional firms in the commercial and institutional sector of the industry. It was not a new process drawn out on a clean slate--it imposed a new framework on the traditional operating system of individuals and organizations. The linear public process was the model for public building, dictating the typical project organization, management procedures, design and construction processes, procedures to protect the public interest, contracting, bidding, and bonding rules. Design/build challenged all of those elements.

In response, participants crafted hybrid strategies to allow them to fit their traditional ways of doing business into the new framework. The resulting inconsistencies limited achievement of certain project results. For example, an important problem for overall project performance arose from the state's application of traditional mechanisms to safeguard the public interest in contracting, i.e requiring a detailed program, competitive selection and lump sum bids, to design/ build. In the new context, these safeguards became roadblocks.

Complicating the ability of individuals and organizations to initiate and respond to the requirements of the new process were the conditions of "urgency" and "visibility" imposed on the project. Whatever intentions were, as Wilson Shook put it: "the train was moving too fast." These conditions were not peculiar to the DCPO case. In most of the other attempts to use the public buying power to change production, the innovations were both necessitated and made possible by the urgency of some problem that visibly affected a number of people.
There was specific success. DCPO was able to change and control the procurement schedule in such a way that the jail project was delivered about 1 1/2 years sooner than would have occurred under the sequential process. The quality of the architectural design and of construction was high; the building was a source of pride for the sheriff, DCPO, TSA and Hyman. The building was also expensive—among the most expensive jails built in the United States over the last 10 years, the construction process was labor intensive and the builder had to double shift to meet the completion deadline, and the process required intensive management by all parties.

This chapter explains how project performance was a function of conflicts between old practices and the new design/build process. The focus is on three areas of change in the system: the rules of public procurement, the organization of the project, and the process of design.
A. Changing Procurement Rules

DCPO initiated the design/build process by changing the way the state purchased design and construction services. The agency wanted to speed the procurement process by untangling the cumbersome web of regulations dictated by Chapter 579 and previous legislation. The new process was crafted from ideas held by Tunney Lee and Jack Carlson about design/build and turnkey methods and the experience of other public agencies, tempered by the state's recent examination of corruption in building practices and subsequent administrative reform.

In implementation, design/build procurement turned out to be fundamentally different from the traditional linear public process, and the juxtaposition of traditional and innovative concepts produced conflicts and unintended consequences. The imposition of traditional mechanisms to "safeguard" the public interest in honest, equitable and economical purchases, most important DCPO's maintenance of an arm's length relationship between itself and the industry during procurement, had the effect of limiting competition, preventing the industry from understanding the state's priorities, and mystifying costs.

1. Procurement and the Market

DCPO design/build involved several specific innovations. The state purchased design and construction services in a single package rather than in two sequential steps. Requirements for filed sub-bids did not apply under the single contract. The selection process for the new single contractor combined the selection process for architects and the bidding process for general contractors through competitive proposals judged by an independent Design/Build Selection Board. Meanwhile, the state retained procedures originated by the Ward Commission to safeguard the traditional linear process from "waste, fraud and abuse, and DCPO relied on standard media, formal advertising of projects, public workshops, and written documents, to communicate the state's requirements for the building project and the new design/build process to designers and builders in the industry.

DCPO Targets Traditional Firms

DCPO wanted to attract new firms, i.e. large national design/build firms, or at least large national architectural and general contracting firms, to undertake the state's design/build projects. For the jail, DCPO advertised in national trade journals, and it contacted 285 firms directly to let them know about these projects. Jack Carlson and other DCPO staff used personal contacts in the industry to let firms know about the project. These outreach efforts
were successful in that 30 firms, 18 architectural firms and 12 general contractors, joined forces in 10 teams to compete for the jail contract. According to the DCPO contracts office, the agency would only expect to receive 5 bids for a project the size of the jail, so the outreach actually doubled the pool of bidders.

DCPO's eligibility requirements dictated the "team" characteristics of the competing "entities". Design/build firms did not apply, in part because the stepped competition and bidding process was inconsistent with the way design/builders contracted for work. The consolidation of requirements for architect selection and bidding translated under the new process into a "design component" and a "build component" of design/build teams, and references to subconsultants and other team members made the point clear. Traditional architectural firms and general contractors were expected to apply.

DCPO's emphasis on prior experience with public projects, (experience with corrections projects was required), also targeted firms that customarily provided services to public clients. This had the secondary effect of targeting firms used to the traditional linear public process and competitive bidding. Every team had at least one team member with prior DCPO experience. Of the 30 firms, 7 designers and 4 general contractors had done projects for DCPO.

DCPO also attracted national firms to the state: all of the general contractors and their design partners on seven of the ten teams were on ENR's list of the largest designers and contractors in the U.S. Two of these general contractors had design/build experience: Hyman had become involved in a design/build project for the U.S. Postal Service after the initial contractor ran into trouble, and another competitor had done a number of design/build projects as a firm; for the DCPO project the firm teamed with a traditional architectural firm. None of the architectural firms had any design/build experience, although several had experience with fast-track projects under construction managers.

The Choices For Firms

By presenting its design/build innovation to the traditional market for public projects, DCPO posed a dilemma for firms. Firms that specialized in serving public clients had invested in understanding the "public process". For most of these firms, the DCPO projects, although substantial, represented only a part of a firm's workload, potentially putting the firm in the position of doing design/build for the DCPO jail but doing other public projects using the traditional linear process. Through the AIA, architectural firms had historically opposed the practice of design/build, and the AGC, of which most general contractors doing public work were members, was committed to open competitive bidding for public construction. On the other hand, there was evidence that other public agencies were experimenting with
design/build, and experience with a public design/build project could prove useful in the future. What should firms do?

As an example, Sert Jackson was a small firm with no experience with correctional facilities, but the firm had done studies for institutional clients, and it had done two design/build dormitory projects for MIT in the early 1980s. Because of its inexperience with corrections work, the firm would not compete for the final design for the jail, but it could add a "corrections consultant" to its programming team and compete for the study. DCPO called them, and the firm decided to apply for the jail study. The firm also applied for and was chosen by the DSB to prepare studies for the Suffolk County House of Correction, and a correctional facility for Essex County.

WAN was a local firm and specialized in DCPO corrections design, but Feldstein had enough traditional work to keep the small firm busy without taking on the substantial uncertainties associated with design/build. For example, design work for the Bristol County project began in the fall of 1986, during the jail competition. The firm entered two design/build competitions, but withdrew from both.

Several other local firms also specialized in the design of correctional facilities or buildings for public agencies including DCPO. The question for VMA, for example, was whether it should compete for a project similar in type but larger than ones the firm had done before for DCPO. Could the firm assemble a team of larger firms that would meet DCPO's requirements, thus allowing VMA to compete for the bigger project? VMA decided to compete, for the final design (fee of $2.5 million), but not the study (fee of $100,000). VMA also entered the competition for the Suffolk County House and later for the modular projects.

The Stubbins Associates was approached by VMA on the jail project. The firm did not do much public sector work, most of its work was for private and institutional clients, and 90 percent of that was under construction managers. The firm had just completed a major public project in Boston, and TSA principal Easley Hamner saw design/build as the public version of construction management. The firm was interested in gaining inside experience with the method, so TSA looked for partners, finally inviting the George Hyman Construction Company to join it in competition for the project.

Firms that did not provide services to public and institutional clients faced a different problem. For example, DCPO invited the Austin Company to compete. The company was an integrated design/build firm, but its product specialties did not included corrections facilities, nor were many of its clients government agencies. The "Austin Method" did not fit traditional public procurement practices, so those public clients Austin served, like the postal service (really a quasi-government organization) had developed procurement procedures compatible with Austin's method. When it considered the new product type (a jail), a process which
differed from the specific practice of the company, and as a client, a state with a "political" reputation, the governor of which was about to run for president, Austin concluded it should not to compete. DCPO was similarly unsuccessful in luring Brown and Root, a Texas design/build firm, to bid on the Suffolk County House of Correction.

Despite the fact that DCPO was able to attract 10 competing teams for the jail, the competition turned out to be quite narrow. This too was a function of the hybrid DCPO method. DCPO's strategy of layering threshold requirements, using three rounds of competition, and relying on a costly design competition, narrowed the pool more quickly than the agency anticipated. Without recognizing how its own rules limited the competition, DCPO compounded the problem by running the competitions for the three prisons and the jail at the same time. In the end, the winner was the only survivor of the process.

2. Old Safeguards Become New Roadblocks

DCPO built two central traditional "safeguards" into its new design/build process. One was the careful regulation of all communication between DCPO and competitors from July 1, 1986, when the project was first advertised, to May of 1987, when the contract award was announced. The other was the use of an independent board to make the final award. Under the linear process, the mechanisms functioned to ensure honesty and fairness in the contract award. Under design/build, the practices created barriers to the communication of critical information between the sheriff and DCPO and the design/builder. They created a difficult conflict between design and procurement decision-making.

From Fair Process to Fair Game

Following the premises of procurement established by the Ward Commission, DCPO incorporated into its design/build method an explicit separation of the public agency and private contractors prior to contract award. During procurement, DCPO reduced the channels of communication to written public documents and open public meetings. It reasoned that if all communications were documented, no one could accuse the agency of corruption in its dealings with private contractors. Any written communication between bidders and DCPO was distributed to all competitors. DCPO followed meetings with written comments distributed on the same basis. Everyone had the same information, and the process was thus "fair".

For the bidders, this ritualistic form of communication turned a fair process into a high stakes game. Players paid, out of pocket after the DCPO honorarium, between $100,000 and $350,000 in the preparation of proposals. The payoffs were the fees -- estimated at the start of the game at $2.5 million in design and $5 million in construction. Winning depended on how well the team predicted the relative importance of the various criteria specified in the documents.
and at the public meetings. Since direct one-to-one communication between the competitors and the state was not allowed, the competitors developed informal means of communication to get state officials to reveal their preferences. In the end, the winning team was the one that best identified and appealed to the most important decision makers. Hammer described the underlying problem to be a "breach of confidence between the private and public sectors. Government has set up a whole bureaucracy to make sure the private sector does what it is supposed to do. If firms were selected on the basis of qualifications, that should not exist" (1987).

After the first four projects, DCPO recognized that maintaining the arm's length relationship during design had compromised the responsiveness of design proposals. DCPO decided to open up the process through structured "interactive workshops". This allowed the development of a pool of acceptable proposals for the Suffolk County House, but the final decision still was driven by initial assumptions made by teams and by the DBSB.

Changing the Rules

During the competition, DCPO realized that some parts of the design/build method were problematic, and the agency tried to solve the problems by modifying the process as it went along. During the 10 months it was formally isolated from the market DCPO switched from a single step to a two step competition, increased the level of the honoraria, changed the schedule for submissions, made adherence to the Sert Jackson design non-binding, and changed the budget three times. In the RFP, DCPO estimated the project cost to be from $30 to $35 million. In the RFP, DCPO capped the cost at $42.5 million. DCPO later lowered the cap to $40 million, then removed the cap entirely for the second phase price submission. At the same time the agency made similar adjustments in the concurrent competition for the three prisons.

Although these were unilateral decisions, not negotiated with competitors, DCPO believed the changes to be responsive to the needs and interests of the competitors and the state. They demonstrated the state's willingness to be flexible, to work cooperatively with its future team-mates. Competing firms saw the issue differently. It was hard enough for firms to understand DCPO's new rules. Changing the rules made the new game more risky.

Local architectural, engineering, and general contracting firms doing business with public clients were few in number, individuals knew each other through industry associations and through previous projects. Individuals in the market often had moved from firm to firm. There was at least one on each team, and they talked on a regular basis about upcoming projects. Communication along the informal networks was as lively as the formal communication with the state was restrained.
Individuals interested in the DCPO projects did not talk to each other about the specifics of proposals each would submit, but they did talk about DCPO's process. It was new, and participants needed to define the rules. During the competition for the three prisons, competitors got together to petition DCPO to change the proposal requirements. Various participants also followed DCPO’s implementation of the rules, and they interpreted many of the 'adjustments' DCPO made in the process as "changing the rules in the middle of the game." One firm that withdrew from the jail competition cited DCPO's rule changing as one reason, as did a competitor for the Suffolk County House of Correction.

Only three teams applied for the third contract, the Suffolk County House of Correction. Although this could have been a function of the scale of the project--at $90 million, few firms could provide a bond for such a project--some participants saw in this evidence that the industry had begun to distrust DCPO's rules. This impression was reinforced when the agency changed the rules for the house to encourage more firms to apply and then selected as the winner the only team that had not followed the "required" prototype design.

**The Inspector General Versus DCPO**

The Inspector General and his staff saw the rule changing as evidence of a failure of public control, proof that design/build was not suited to the public context. The struggle between the IG and DCPO over DCPO discretion pitted procurement against management decision-making. From the IG's point of view, there was great danger in the way DCPO was re-writing the laws on public building. The Ward Commission had demonstrated that discretion, in the wrong hands, led very quickly to corruption. While the IG felt that the current DCPO employees would not abuse their positions -- he praised the "integrity, dedication, and professionalism " of the DCPO staff -- Barresi could not be sure that dishonest people would not take over in the future.

One source of management discretion was the choice of the design for the jail. Since the choice of design was tied to the choice of designer, DCPO staff could not make this decision. Using the Ward Commission's framework for the selection of designers, DCPO had shifted that responsibility to the DBSB, a board made up entirely of private individuals. The DBSB alone selected the final design/build team and thus the final design. The deputy commissioner could overrule the award, but only for cause. Thus, although DCPO staff and consultants undertook exhaustive reviews of the design/build proposals, they could not make the decision nor, argued the inspector general, could staff make specific recommendations to the DBSB or try to influence the decision in any way. Instead, the DBSB was to review written material prepared by the staff, interview the teams, and make its decision independently. The deliberations of the DBSB were scrutinized by a representative from the
office of the inspector general, to ensure that not even informal guidance was given to the
DBSB by staff. Later, in his negotiations with Jack Carlson about extending the experiment,
Barresi requested that DCPO include in written procedures for new projects the requirement
that "DCPO officials refrain from expressing their summary judgements or preferences with
respect to competing teams or proposals" (Barresi 1987).

Jack Carlson and his staff felt that DCPO had a legitimate interest in which proposal
was selected—the proposal dictated the characteristics of the final building, which the state
would pay for and which would serve state agencies. DCPO would also enter into a close
working relationship with the design/builder. The DBSB had no such stake in the projects; the
board's detachment from the project after award was complete. As one member put it "Once
we made the selection, my role was ended. The next thing I did was to go to the ground-
breaking" (Forbes 1989).

The staff also felt the effect of the IG's scrutiny during the project. From the start, the
IG's eyes were trained on DCPO (the Ward Commission had intended the IG to watch the
legislature as well as administrative agencies like DCPO, but the legislature had failed to extend
the jurisdiction of the IG's office to itself), and the IG's gaze intensified on the design/build
projects. He regularly requested copies of documents, and during the negotiations over the
extension of the experiment, Barresi submitted several long lists of "questions" about the
projects, to which DCPO responded in writing.

The staff interpreted this attention as an attempt to find something wrong. They
reasoned that the job of the the IG and his staff was to find fraud, waste, and abuse. If they
could not find the real thing, they could find the "potential for" the real thing, and keep the IG's
name in front of the legislature and the public. If the IG was wrong, and everything worked,
he could say he was just doing his job. If something did go wrong, he could say he had
foreseen that very kind of problem (Garrity 1988).

The distrust between the office of the IG and DCPO compromised project performance
in several ways. The two agencies were not able to come to a mutual agreement about public
protections which might not be accompanied by tension and adversity. The constant sense by
DCPO staff of having someone looking over their shoulders, during an experiment when no
one really knew what might happen, made DCPO staff feel at risk and protective of the
innovation. There was a schism between what staff thought they were accomplishing (great
new innovative things) and a sense that those accomplishments were being publicly criticized,
through the IG's reports to the legislature. "Objective" evaluation of the experiment became
impossible.

186
The Mystification of Costs

DCPO incorporated specific provisions in the process to make sure the state got what it paid for. The study included a cost estimate, done by an independent firm. The estimate became the basis for the budget cap in the RFP. DCPO made competitors swear that they could build the project within the budget cap, and firms had to submit lump sum competitive bids with the final proposals. In spite of this attention to cost, DCPO never knew what the true costs were and price became an important subject for negotiations.

The underlying problem was that DCPO called for a minimum program which, according to the bidders, would cost more to provide than the maximum price allowed. Bidders responded to the conflict by making both quality and cost variable. As a result, DCPO had no uniform comparison on which to determine true costs. When the state wanted to modify the proposals, reducing the prices, DCPO resorted to an independent cost estimator to determine whether the bids were "fair". It is not clear how "real" the estimates were: the independent cost estimator did not have access to the detailed assumptions held by the competing teams about specific building characteristics. In subsequent negotiations over design modifications, DCPO had to guess whether the contractor was taking advantage of the state, and by how much. When the design/build team priced the design modifications, DCPO similarly turned to hired cost estimators to check on the revisions proposed by the design/build.

The state remained uncertain about costs, with questions lingering into design and construction about whether DCPO had "lost" or "won" at the contract negotiations. The state's resident engineers, used to taking an adversarial position with contractors on traditional projects, retained suspicions that the builder was inherently motivated to take advantage of the state. HSI's treatment of David Tenney's "refinements" to the hardware and door schedules as change orders fueled these suspicions and doubts. To make sure that the design/build would not win in the field, the state inspectors became "bean counters", checking on every move of the contractor and tradesmen, requiring documentation whenever they felt the design/build was using too much discretion in construction. DCPO's staff and the contractor's staff struggled over these issues in the field. For example, in describing conflicts with DCPO resident engineers over inspections, Shook talked about the "unending suspicion by the state that you are trying to take advantage of them" (1989).
B. Restructuring the Organization

Through its new single contract procurement process, DCPO recognized that the use of a single entity to design and build the jail meant reframing the traditional three party project organization to a two party relationship between DCPO and the design/builder. Corresponding to the unification of design and construction in the private entity, DCPO set up a single staff unit to provide unified management within DCPO. This internal re-organization would simplify management by consolidating functions, pulling the entire segmented and disperse system together.

In practice, a network of organizations implemented DCPO design/build. The "master builder" proved to be elusive. Since this organizational version occurred in other public projects, I give it a name: "multiple firm design/build", to distinguish its characteristics from those of the prototype integrated firm.

The HSI organization, like most design/build entities undertaking public work, was an umbrella sheltering two traditional firms which in turn held contracts with other firms. Firm claims on profits were written into the joint venture through fixed price contracts for design and construction services. Although the each firm owned stock in the parent, the parent organization retained only enough in fees to cover legal and other administrative costs, and the only profit sharing pertained to the sharing of leftover fees at the conclusion of the project.

Instead of a single "entity" responsible for design and construction, many individual firms participated in the design the jail. The participants were widely separated in the phases of design. The study was done by an independent consulting firm. Concept designs were prepared by the study consultant and by the design teams of four design/build teams. Schematic designs were completed by two design/build competitors, and design development drawings were prepared by a single final designer entity. The design process was further subdivided in that construction drawings, in the form of shop drawings, were prepared by subcontractors working with equipment suppliers for some project components and by the final designer in other instances. Since TSA subcontracted the engineering and corrections design to other firms, four additional design firms participated in the final design: Voinovich Monacelli Associates, Haley and Aldrich, Syska and Hennessy, and KKBNA. Counting the four pre-teamed subcontractors, nine firms participated in the TSA design in addition to the 17 firms involved in preparing the study and competing proposals. At least 26 primary design firms participated in the design of a project intended to demonstrate the advantages of integrating the entire production sequence in one organization.

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1 Counting five firms per design competitor and two firms preparing the study.
With so many designers, coupled with the redistribution to the builder and subcontractors of certain design related functions, the design responsibility of the architect was more limited than on other public projects. The builder provided cost estimating services. Subcontractors and suppliers designed the final distribution systems for mechanical and other systems. The general contractor assumed some contract administration functions provided by architects on other public projects, such as the Bristol project.

Participants continued to respond to firm goals, and they had to balance their new accountability for the total project performance against firm agendas. TSA's conflict was between its traditional allegiance to the user/owner and its new loyalties divided among the sheriff, DCPO and Hyman. When the firm decided to identify the user as the primary client, TSA created conflicts between itself and the general contractor. Shook described the relationship between TSA and Hyman as one of "constant friction and compromise as both corporate images seek equilibrium." As the TSA project architect described the situation: "We are two separate businesses with separate goals" (Pedersen 1989). Had TSA chosen to identify Hyman as the primary client, undoubtedly the sheriff and DCPO would have felt frustrated. Meanwhile DCPO's isolation from the production entity allowed it to broker conflicts between the architect and the builder as the two juggled material specifications.

Hyman was used to working with traditional public bid contracts, treating changes in design as change orders that modified the bid price. Under the new arrangement, such changes were subject to intense negotiations with DCPO and with TSA. Another change, for Massachusetts work, was in the relationship between the general contractors and subcontractors. Under the filed sub-bid law, "the prevalent general contractor attitude [is] that the filed sub trades work for DCPO and that the GC has little if any responsibility for subcontractors' performance." Shook found the elimination of the required filed sub-bids and his ability to assemble his own team a very positive feature of design/build.

DCPO's staff consolidation was effective in centralizing administrative responsibility for the project. The program manager during the study and proposal stages, John Messervy, was retained as project manager during design and construction, and he worked closely with the special unit director Alan Burne and Carlson throughout the process. This consolidation did not address a more fundamental problem for public projects, the separation of accountability and responsibility for expenditure decisions among administrative agencies of the state and the state legislature.

Design/build as an organizational model centralizes, among other things, cost accountability and responsibility in one place. In this case, these functions were anything but

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centralized. The sheriff was the user. DCPO was the owner, acting on behalf of the sheriff and the eventual formal owner, the Public Facilities Department of the City of Boston. Sert Jackson and TSA responded to one or more of these as the "client", but Hyman paid the subcontractors for work, and the legislature paid the overall bill. The result was ineffective cost control.

The legislature had promised the sheriff "a jail", and the sheriff lobbied for the most elaborate and high technology jail he could get. DCPO did not challenge the sheriff seriously--his position was bolstered by the court order mandating the completion of a "constitutional jail" by March 1, 1990. DCPO's interests also coincided somewhat with those of the sheriff--Carlson wanted to prove that the state could achieve, using design/build, the same high architectural quality sought by the Ward Commission for traditional linear projects. DCPO did not have to make trade-offs between the jail and other projects - each project was budgeted separately by the legislature--and when the price exceeded the appropriation, twice DCPO asked for and received additional funds.

The participants found the entire process intense and stressful, but they retained a high degree of respect for their counterparts in the project. Those interviewed were quite clear that all parties were committed to making the concept of design/build work. Shook termed the DCPO people "top notch. I've never dealt with public sector people as qualified as Alan Burne and John Messervy." Hamner echoed these sentiments, characterizing the participants as "an extraordinary group of people to work with." In turn, Shook termed TSA a "top shelf" design firm, and TSA in turn pointed to Hyman's "wonderful reputation for high quality."
C. Reforming the Process of Design

Designers and builders in this study had a common understanding of the building design process. Design is hierarchical, beginning with a space program and building through "bubble diagrams", a design concept, schematic design, design development, working drawings, specifications, and finally shop drawings. Each step creates a framework for the next step, guiding the process from idea to detail and locking in a set of previous decisions. Associated with each step is a level of product specification. Costs are applied to design based on the level of design documentation, with estimating methodology proceeding from generalized aggregated data, applied to concept designs, to detailed field specific data applied to more detailed designs.

The consolidation of design and construction responsibility is supposed to produce greater integration of construction knowledge into design, leading to a more cost effective design. In the implementation of the DCPO method, specific constraints limited this integration. DCPO's procurement rules imposed two limits. By retaining an independent consultant to undertake a detailed pre-design process, up to the development of a concept design, DCPO isolated the design/builder from early design decision making, preventing the integration of construction knowledge into design at this stage. When DCPO removed itself from the design process during the development of proposals, the agency prevented the design/builder from checking its decisions against the state's priorities. The design process itself limited the integration of field construction knowledge into design. That the designer and the builder remained separate organizations with sometimes competing agendas posed a further constraint. Shook noted that it was "pretty difficult trying to get someone into Stubbins office" (1990).

1. DCPO's Method and Design

DCPO's method tended to reinforce the usual process of locking in early design decisions. The change in purpose of certain design activities and new points of transition in the process created greater than usual rigidity in transition from step to step. A sequence of "precedents" increasingly shaped the design and locked into place decisions made up to that point: first the program, then the technical requirements, then the concept, then the proposals, then the bid. It also locked in early errors and miscalculations, and after the award, certain decisions had to be reconsidered. The participants had to re-define a number of elements before anyone was prepared to enter into a legal agreement, i.e sign the contract.
In the design examples studied, a natural transition appeared between "preliminary" and "final" design. Preliminary design established the architectural concept for the project, final design detailed the bid and construction documents. In both the "Austin Method," and the Bristol project as organized by WAN, different designers with different specialties and expertise participated in each step. Some analysts, observing this break in the design sequence, have recommended reorganizing the profession of architecture to reflect the differing specialties (Irwig 1977).

DCPO's design/build method altered the natural transitions in the design process. DCPO defined design in the following phases: RFP, competitive schematic design, negotiated design development, and working drawings, with three major transitions between phases. Shifting gears during the transitions was difficult. TSA was able to engineer a shift from the study concept to the proposal. Another shift could have occurred near the end of schematic design, when the structure cost problem surfaced. Because TSA was by then committed to both a design concept, based on the first phase of the competition, and a deadline for submitting its final proposal, and because it could not communicate with DCPO at that point about its priorities, a change at that point became impossible.

Preliminary Design: From Regulatory Guide to Legal Precedent

Under its traditional procedures, DCPO used the program to regulate final design, as required by Chapter 579. The study did this by establishing a maximum building size of 110 percent of the gross square footage in the "certified program". Even for traditional projects, however, the study did not serve its regulatory function in that it was a poor measure of the final building area. In the Bristol example, the final building area was 146 percent of the initial program.

Architects in the study pointed out the difficulties of using a program as a regulatory device. First, programmed building areas do not reflect actual designs. Second, the design process is itself a learning and decision making process for the client and the architect. The client learns to participate in the design process as the design emerges into something real, a drawing on paper. Prior to the development of the design, the client doesn't "see" anything, and thus cannot react to anything. It is during the development of the design that the client begins to have opinions, make decisions to shape the space, and suggest changes.

With its roots as a regulatory document, DCPO's RFP was prepared independently of final design. However, in its new role as a contract document, the program became important in its detail. For a facility like the Nashua Street Jail, the details reflected the many embedded unresolved policy and design issues. Resolved and unresolved issues were then described in a written document that was given to the final designers, without further explanation.
Knowledge developed about the project and the needs of the client that was not written into the final document was lost to the final designers. The document became the first precedent of a series of legal documents, to be followed by the design/builder's proposal, the bid, and the contract.

The use of the concept design to control the competition violated the design process as understood by most practitioners. Sert Jackson had worked closely with DCPO and the sheriff during the development of the RFP, and the resulting concept, rather than testing the program as was the traditional function of the study concept, was to guide the design competition. To propose alternative solutions, which is an important purpose of this first phase of design, designers had to first wean the client from old ideas. For example, Hamner found that the clients, DCPO, the sheriff's department, Rothman, and others were heavily invested in the Sert Jackson scheme because the study consultant had taken the client "too far" into the design process. To introduce a new idea, "Stubbins not only had to come up with a better scheme, it had to unlock the clients minds about all of the time they spent getting to that point" (Hamner 1989).

TSA had recommended that DCPO not use a prototype design in future competitions, and after the competition for the third contract, DCPO agreed.

*From Schematic Design to Contract Document*

DCPO also changed the function of the schematic design and created a new transition between it and the "concept" design. The schematic, in the form of the winning proposal would become the next step in the precedence of documents and the basis for the contract. To protect the integrity of the procurement process, DCPO did not communicate with designers during the competition.

According to most architects in this study, interaction between the owner and the designer is most crucial during schematic design. As we have described, it is at this point that the client begins to "see" the building, and in so doing develops more clarity about its own ideas. DCPO's procurement, premised on the separation of the decision to award from management, mandated that the owner isolate itself from designers during the competition, i.e during schematic design. That meant that the winning design for the jail, as the basis of the contract, could easily and did contain features that DCPO or the sheriff might want to change.

A purpose of design competitions is to generate new ideas and innovation in design, but the restrictions on the DCPO process generated a competition of poorly grounded concepts. Of the five conceptual designs for the jail, one, the Sert Jackson concept, was developed without access to construction knowledge, the other four without access to the owner. The
four proposals were "judged" in comparison to the Sert Jackson scheme by an independent jury, the DBSB.

The process created a ratchet effect in the schematic design phase, this time occurring within the TSA/Hyman team. TSA saw the competition as a design competition, and once selected, the firm felt committed to deliver the building as proposed. The plan irregularities that made a concrete structural system expensive made the spatial arrangements work. When bids came in for the structure, the team had only a few days before the final proposal had to be submitted to DCPO, and TSA felt that even if a spatial redesign were possible, that would violate the rules of the competition. The team elected to use a structural system that would fit the architectural design and could be built at a lower cost. The solution, a combined masonry, steel and concrete system, was labor intensive and lengthened the construction schedule, conflicting with the expressed priority of DCPO for building completion as soon as possible.

DCPO expected to sign a contract on the basis of the winning proposal, but none of the participants was prepared to do that. The design did not represent a sufficient level of detail, and the state had been accumulating a list of "issues" it had identified and been unable to address during the proposal period. The owner wanted several changes.

Design changes during design development were not unusual—in both the Bristol and Nashua Street jail projects, important design changes were made during design development. For the jail, these were due to earlier constraints on owner/user participation in design. In the Bristol case, the change was due to a policy decision made by the DOC, a secondary user. Although changes became more difficult as design proceeded, the linear process accounted for such changes.

In the design of the jail, the changes were an unexpected surprise, brought about by the sudden opening of communication among parties after the contract award. Although documents were only 20 percent complete at this point, the "entity" had committed to both a price and a schedule, based on its own interpretation of the owner's requirements. The owner, the designer, and the builder made the design changes in an environment of contract negotiations. The resulting documents, termed "early" design development by the participants, were attached to and became part of the contract, the next document precedent.

The combination of fast track design and construction with a preliminary design process which isolated the user from decisions created a disconnected decision making sequence. The door and hardware change order is an example of the consequences. Because these design features were not reviewed by the state and the sheriff's planner earlier in the design sequence, the sheriff's planner made changes during the development of working documents. This resulted in expensive delays in work related to the doors and hardware and several other work elements, including masonry.
3. The Design Integration and HSI

Through its partnership, TSA and Hyman reversed the usual one way flow of information from the designer to the builder at several points. At the start of the project, Hyman's estimates provided square foot constructions costs for TSA's designers to use in planning, and the two firms jointly determined the type of structure and foundations systems to be used in the design. The builder provided cost estimates for TSA's designs at key points, and Hyman's subcontractors gave advice to TSA's engineers about systems design. The subcontractors and material suppliers prepared the final system distribution designs. TSA and Hyman negotiated over material specifications throughout the project.

Despite these efforts, the characteristics of the design process itself made the integration of construction knowledge into design difficult, especially during the early stages of the process. Cost had been a consequence of design from the beginning. Sert Jackson prepared the program independent of field cost information and gave the documents to the cost estimator near the end of the process. The consultants considered cost issues, particularly in the discussion over management, but as Lindemulder pointed out "there was no way of costing all of the alternatives. The only way you can check yourself was by using gross measures" (Lindemulder 1989). Cost predictions at the programmatic phase were also quite imprecise, because of the use of aggregated published data rather than current material and labor costs and because the estimate was not based on a specific design, i.e. there were no measurable quantities.

Hyman had access to detailed field cost data about the relative prices of labor, materials and products, but this could not be applied until the design was sufficiently detailed to permit the measurement of these factors. By then, the design was "locked in". This created a double bind for TSA and Hyman. To be able to use field cost data to inform design, the architect needed the information up front, but at that point the contractor could only provide aggregated data. The contractor could not generate specific factor prices until the drawings were done and priced by subcontractors. By that time it was too late to redesign, beyond the component directly affected, even for a significant new piece of cost information such as a doubling of the cost for the structure.

During TSA's development of contract packages, Hyman tested the budgets with "dummy contract packages". The data were accurate but costs followed design. In phase one of the proposal, Hyman received the design documents from TSA at the same time DCPO did. During design development, design and estimating followed separate tracks. The builder wanted to tie down the prices prior to signing the contract -- and wanted the design to proceed
in construction packages that could be priced by subcontractors. At the same time the designer, responding to the users, modified the design. In doing so, the designer worked ahead of rather than with the builder, putting the builder in the position of providing price accuracy for elements based on obsolete drawings. The discrepancies were not resolved until final bid packages were prepared, and the resolution of pricing problems took the form of material modifications.

This process differed from the practice of an integrated firm like the Austin Company, which used several mechanisms intended to introduce field specific construction knowledge into design. By pricing and providing milestone schedules for alternative concepts, Austin made cost and time components of the concept selection process. Similar mechanisms were in place during preliminary design. Costs were derived from a proprietary data bank, specific to projects the company had built, and the schedules were prepared by the field management staff group. The accuracy of the information was enhanced by the company's product specialization: the types of facilities documented in the data bank had similar characteristics to new projects. The firm was motivated to provide accurate estimates for both time and cost, since at the end of the preliminary design, the company offered to guarantee both to the client.

One goal of design/build is to break through the organizational and practical barriers to the contractor's knowledge base. In this case, although the builder was the prime participant in the joint venture, with 95 percent of the stock, and was most at risk, accountable for 95 percent of the contract, the builder's influence on design was limited; the architects remained in control of the process. Cost and constructibility remained a consequence of design in design/build. The state achieved the design standards it sought and a "state of the art" (by the sheriff's standards) jail. The state also paid the bill, with a final contract 35 percent above the cap specified in the RFP.
D. Measuring Project Performance

Design/Build is claimed to produce efficiencies in building design, development time, project costs, and project management. In this section, I evaluate production characteristics of the Nashua Street Jail in comparison to those of similar corrections projects developed nationally and by DCPO. I ask how the characteristics of the jail differed from other projects, and how those differences might be connected to the use of the design/build method.

1. Top of the Line Design: DCPO Built a Monumental Jail

The Nashua Street Jail was a "monument" by definition of the owners and the designers. It was substantially larger per inmate than similar projects in Massachusetts and elsewhere, and it used the stones of monuments, marble and granite, in its public spaces. The final building was designed to house 453 inmates in a 248,555 square foot high rise maximum security facility. The 1987 contract price for design and construction was $52.375 million.

Rather than trying to measure design quality, aesthetics, or other characteristics on which tastes differ, this analysis considers design in terms of how space in the jail was distributed. The facility was designed for occupancy by one inmate per cell. Using the aggregate number of inmate rooms in the facility as a base, we can measure the facility in terms of square footage per inmate. Compared to other large single occupancy facilities, the Nashua Street Jail, at 548 square feet per inmate, was 20 percent larger than similar facilities average nationally, 453 square feet per inmate. Although remote supervision facilities such the Nashua Street Jail nationally are smaller than direct supervision facilities, Nashua Street was 15 percent larger than, for example, the Contra Costa detention center, the prototype "high amenity" direct supervision jail. (See Appendix D, Table D-1.)

The Nashua Street Jail was also large by DCPO standards. For example, the net building area per inmate was 17 percent larger than the Bristol County facility. Interestingly, the net building area of the jail was also 37 percent greater than that of the jail as designed for the city of Boston by HOK and Stull Associates in 1985.

From 1985 to 1986, during the DCPO study, the net area of the jail grew by almost 20 percent, while the number of inmates remained constant. The growth was not uniform. For example, the amount of space devoted to housing inmates remained almost the same, as did the amount of space devoted to inmate programs and services (i.e. education, counselling, recreation). The area devoted to administrative offices, intake and processing and building support services grew 80 percent. The medical and psychiatric unit almost doubled. These increases were recommended by the sheriff's staff, the primary participants on the DCPO study.
group, and in the interests of maintaining the abbreviated schedule and harmony on the group, DCPO included almost all of the sheriff's requests in the final program.

From 1986 to 1987 the jail grew another 15 percent. This time, the increases were due to TSA's interpretation of the program and its offer to DCPO to add 18 cells to the facility, an offer DCPO accepted.

### Table 6
Spatial Changes in Nashua Street Jail Program

<table>
<thead>
<tr>
<th>Designer Capacity</th>
<th>1985 Stull 433</th>
<th>1986 Sert Jackson 435</th>
<th>1987 TSA 453</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Category</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inmate Housing</td>
<td>65,619</td>
<td>65,030</td>
<td>73,815</td>
</tr>
<tr>
<td>Medical</td>
<td>3,751</td>
<td>7,345</td>
<td>7,760</td>
</tr>
<tr>
<td>Inmate Program/ Services</td>
<td>16,549</td>
<td>16,000</td>
<td>17,460</td>
</tr>
<tr>
<td>Inmate Control/ Processing</td>
<td>4,233</td>
<td>7,105</td>
<td>7,560</td>
</tr>
<tr>
<td>Building Support</td>
<td>9,779</td>
<td>21,555</td>
<td>24,840</td>
</tr>
<tr>
<td>Administration</td>
<td>10,281</td>
<td>14,970</td>
<td>19,416</td>
</tr>
<tr>
<td>Total Net Building Area</td>
<td>110,212</td>
<td>131,150</td>
<td>150,845</td>
</tr>
</tbody>
</table>

Sources: Sert Jackson Feasibility and Technical Study, September 1986 Proposal Area Summary prepared by TSA, November 17, 1986, Updated

The design process focused on tailoring the facility to the specific needs of the user--first Sheriff Kearney in 1985 and then Sheriff Rufo in 1987. The design also responded to DCPO's mandate for a high level of architectural quality. A problem with such a process is that it created a long-life facility suited to the circumstances of a single point in time, and circumstances changed. The characteristics of the jail defined in 1985 and 1986 were already out of line with the circumstances of 1990 when the facility opened. In 1986, the state was awash in tax revenues, and its governor was about to take the "Massachusetts Miracle" to the nation in a presidential campaign. A top quality public monument fit such a situation. By 1990, the state faced a critical budget crisis, expensive housing for people awaiting trial looked
looked different, and even more people were being committed to jail than planners originally anticipated. Just before the opening, Sheriff Rufo petitioned the court to permit him to put two inmates into room designed for one in certain areas, allowing him to house 650 inmates in the 453 bed facility. The court refused the petition, and the old jail will remain open for at least one year, to house the overflow.

2. Cost: The Top Shelf

The 37 percent increase in size of the jail over the facility designed by HOK and Stull for the city of Boston alone would account for a significant increase in the estimated construction price. The cost per square foot of building area for the jail was also high by both DCPO and national standards. Construction costs were driven by the physical features of the building, the site and the schedule. Design costs were driven by the design/build process, particularly the use of a design competition.

Construction Costs

To compare the costs of the jail to similar projects, I used a measure of cost per square foot. Since construction prices vary over time, I converted current costs to their equivalent as of April 1987, when HSI submitted its price for the jail to DCPO. Costs were indexed to Boston MA using indices published by Marshall and Swift. Compared to other large single occupancy facilities nationally, construction costs for the jail were 19 percent higher on a square foot basis than other large maximum and medium security single occupancy facilities. The cost of the jail, at $210.72 per square foot, was almost identical to the adjusted cost of the Contra Costa jail, the prototype third generation jail built in California in the late 1970s. Based on facilities in the National Institute of Justice data bank, the square foot costs were in the top 5 percent of all correctional facilities built in the last 10 years. (See Appendix D.)

Construction costs were also 22 percent higher than those of DCPO’s Bristol County facility. The Bristol project was comparable to the Nashua Street Jail project in its general scale, category as a county corrections facility, and the time frame for development.
Table 7
Program Comparison: Bristol Project and Nashua Street Jail

<table>
<thead>
<tr>
<th>Program Area</th>
<th>Square Feet Bristol Study</th>
<th>Actual</th>
<th>Square Feet Per Inmate Bristol</th>
<th>Nashua St</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inmate Housing</td>
<td>45,526</td>
<td>62,045*</td>
<td>164</td>
<td>163</td>
</tr>
<tr>
<td>Inmate Program/ Services</td>
<td>2,895</td>
<td>2,895</td>
<td>56</td>
<td>39</td>
</tr>
<tr>
<td>Inmate Control/ Processing</td>
<td>6,260</td>
<td>6,630</td>
<td>18</td>
<td>17</td>
</tr>
<tr>
<td>Building Support</td>
<td>13,652</td>
<td>11,739</td>
<td>31</td>
<td>55</td>
</tr>
<tr>
<td>Administration</td>
<td>5,960</td>
<td>8,268</td>
<td>22</td>
<td>43</td>
</tr>
<tr>
<td>Courtroom</td>
<td>na</td>
<td>1,302</td>
<td>3</td>
<td>na</td>
</tr>
<tr>
<td><strong>Total Net Building Area</strong></td>
<td><strong>95,207</strong></td>
<td>104,382</td>
<td>302</td>
<td>334</td>
</tr>
</tbody>
</table>

* Includes imputed area added due to redesign for DOC.

The differences reflected specific design features of the jail which made it inherently more costly, based on national data, than the Bristol facility. These "cost drivers" included the maximum security design, the function of the jail as a short term holding facility (versus long term housing), and the combination of remote supervision hardware and direct supervision amenities. Also, the Nashua Street project was a high rise facility developed on an urban site. The urban location represented additional costs because the constraints of the site made moving equipment around more difficult. The site was also on fill, and the building had to be supported on piles driven through to bedrock. (The Bristol facility was built in a rural location, in a former corn field.) Finally, DCPO's concern about the urban design characteristics of the downtown project led it to require certain high quality, high cost finishes such as brick, marble and granite. (The Bristol facility was faced with ground concrete masonry units that simultaneously formed the walls.)

The Bristol project was substantially less expensive on a per bed basis, due to less programmed administrative and support space per inmate than in the Nashua Street jail.

3 The Nashua Street Jail project was designed as a 100 percent maximum security facility. Bristol has 30 percent of the bed, as maximum security, the balance in direct supervision medium and minimum security beds.
Design Costs

DCPO chose to use design competitions and to compensate teams for at least part of the cost. The effect of this was to increase the relative expenditure of design dollars through design development.

Table 8
Design Cost Comparison: Bristol and Nashua Street Jail

|                  | Bristol |               | Nashua |               | Jail |  | Ratio |
|------------------|---------|---------------|--------|---------------|------| | DB    | to     |
|                  | Fee $000s | % of Design | Fee $000s | % of Design | Fee if Trad* |  | TRAD |
| Program Schematic Design/Design Development | 125 | 6 | 409 | 9 | 199 | 2.1 |
| Total Thru Design Dev. | 704 | 33 | 1,857** | 47 | 1,095 | 1.7 |
| Working Documents | 829 | 39 | 2,266 | 56 | 1,293 | 1.8 |
| Total Design | 1307 | 61 | 1960 | 44 | 2023 | 1.0 |
| Construction Cost | 2,136 | 100 | 4,227 | 100 | 3,317 | 1.3 |
| Design as % of Const. | 31,983 | 6.7% | 49,507 | 8.5% | 6.7% | 1.3 |

Note: * Applying the % fee for the Bristol project to the Nashua Street Jail
** Includes cost to teams to prepare proposals and fees paid to TSA for design development.
Sources: DCPO "TPC" sheets and Nashua Street Jail Contract 9/8/87

Sert Jackson and four competing firms spent a total of $2.3 million in developing the design through the design development level: $1.5 million compensated by DCPO and $0.8 million absorbed by the teams. This total was almost twice the cost of a traditional DCPO schematic design (See Table 8). The increase was not offset by measurable savings in design dollars spent on construction documents, despite Hyman's purchase of a smaller package of services during construction. The result was a net increase of 27 percent in the total cost of design.

The design competition under design/build contributed to increased costs. For example, restrictions on communication during the competition left the state with a list of design modifications to be made later, when such modifications are generally most expensive.

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4 TSA later received compensation for its costs in the contract award,
5 Based on percentage of construction.
Once the contract was signed, HSI imposed effective cost controls. Participants claimed that economizing on design documentation reduced design costs at the end of the process. The consulting engineers reported economies in system design based on the advice of subcontractors. Finally, the builder controlled costs by controlling materials. Cost projections as of March 1990 showed the design and construction costs to be under the contract amount, by a small percent, and under the total budget by almost $3 million. This is a reversal of the state’s experience with change orders, which usually add 3 to 5 percent to contract construction costs.

Management

The level of DCPO management resources invested in running the competition made design/build administratively more expensive than the traditional process, for example, as used for the Bristol project. After the start of construction, however, the jail contract was less expensive to administer than the Bristol contract, measured by the relative project management time allocated to the project and by the cost of project management services per dollar of construction contract. Contract administration represented 0.35 percent of contract construction for the Nashua Street jail. Contract administration for Bristol represented 1.1 percent.

3. Schedule: Design/build Saves Processing Time

DCPO completed the jail 42 months after the agency advertised for design/builders. It met the court ordered deadline, substantially completing the facility by by March 1, 1990. Three months before the court deadline for completion, HSI turned over one housing unit to the sheriff’s office for staff training. The completion time was almost 1 1/2 years less than the DCPO average, according to CAPICS.

<table>
<thead>
<tr>
<th></th>
<th>CAPICS</th>
<th>Actual Jail Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designer Selection, Design and Bid</td>
<td>24</td>
<td>13</td>
</tr>
<tr>
<td>Construction</td>
<td>36</td>
<td>30</td>
</tr>
<tr>
<td>TOTAL</td>
<td>60 months</td>
<td>43 months</td>
</tr>
</tbody>
</table>

Source: Designer Selection of 4.5 months plus design and bid of 19.5 months for projects of $20 million or more. from DCPO "CAPIC Milestones" July 22, 1985
The most significant saving occurred in the procurement process. The time from the advertisement of design until the start of construction was 13 months versus 24 months for CAPICS, a savings on average of almost one year. In contrast, the Bristol project took 29 months from the time the final design contract was advertised until the start of construction.

There was no measurable saving in actual design time for the jail. Design took was 19 months, from October 1986 when the RFP was issued, to May 13, 1988, the formal start of phase two of the contract, although the last printing of the working drawings was not done until October, 1988, 24 months after the RFP was issued. DCPO's CAPICS program projected a design time for a comparable project to be 21 months. Design for the Bristol project took about 20 months. The saving in design time was in net time, made possible by the fast-tracking of design and construction.

Given that the jail was a high rise detention facility on a constrained urban site, the construction time of 30 months represented a major time saving, 30 percent based on the average for high rise correctional facilities in the NIJ data base and 25 percent under the DCPO's average shown by CAPICS. (See Appendix D.) The schedule performance was achieved in part through DCPO's consistent efforts to accelerate the process where it could, including the payment of acceleration payments to HSI to compensate for the slow progress of the masonry.
E. Issues Raised by Case

Design/build created changes in the way participants throughout the business system worked, but the compartmentalization of the system made the coordination of this change difficult. The change occurred in the traditional sector of the industry, creating a collision between the old practices and the new process. Like a wave, the change rippled through the system, sometimes catching participants off guard. Each crafted a unilateral response, a hybrid practice that allowed the continuation of old ways of doing business in the new context. The conflicts in practice created tensions in implementation and prevented the achievement of promised efficiencies.

- In procurement, the imposition of mechanisms to ensure honesty and accountability in the traditional linear process compromised design; the arms length relationship between the state and the design/builder prevented essential communication. Layers of threshold requirements narrowed the competition. The use of a lump sum bid left DCPO with no clear way to evaluate costs. Neither did the safeguards achieve the goals of open competition, fairness, equity and economy. DCPO went to great lengths to protect the integrity of the contract award, but with one final bidder, the jail competition cannot be termed competitive. With the need for extended design negotiations after award, the process of project design cannot be termed a success. It took the unrelenting efforts of the participants to make process "work".

- The result of the reorganization of design and construction was a multi-firm version of design/build, in sharp contrast to the idea of a unified process in a single organization. Overall design responsibility was widely dispersed.

- In the design process, procurement rules, including the development of a detailed program in isolation from the design/builder and the isolation of DCPO from the process of schematic design, cut critical elements out of the design/build process. Within the "entity", the traditional design process limited the integration of construction knowledge into design.

To create a context in which public design/build might be effective, we need new concepts in three areas:

1. Public accountability
2. The organization of the design/build entity
3. The process of design.

These are addressed in the next chapter.
VIII. Implications of Research

Public owners like the Massachusetts Division of Capital Planning and Operations face a dilemma in their efforts to innovate in building. These owners are in a good strategic position to bring about change, since they initiate projects. However, as owners, they are outside the industry that designs and builds and thus are least knowledgable about building and its technology. While private owners are in a similar position as public owners in being outside of the industry, the line between the public and private sectors is sharply drawn and separates public owners from private firms in the industry more definitively. This turns out to be a major impediment to innovation in public development, and this separation proved to be a significant problem for the implementation of public design/build.

For DCPO, the strict separation between the public and private sectors divided what was meant to be a partnership. This separation was intended to serve public goals in contracting and to allow the public owner to control the activities of private contractors. This control function ceased to be effective when the separation was imposed on an integrated building process. The imposition of bureaucratic controls early in the development process led to later cost escalations. In contrast, the control of cost, quality and schedule was most effective when the partners could negotiate with each other across organizational and sectoral lines.

The implementation of design/build was also conditioned by the institutional structure and associated rules of the building industry. Implementation occurred within the traditional system for commercial and institutional projects. Given the fundamental differences between the organizing premises of design/build and those of the traditional linear public process, participants, used to the compartmentalization of functions, faced unfamiliar requirements for their work. These created conflicts. To resolve the conflicts, participants crafted new versions of their old ways of working, and they created new procedural frameworks such as design documentation and the contract.

Design/build required a host of compromises. Some resulted in hybrid practices that worked at cross purposes. This created tension among project participants. In some instances, these tensions were beneficial; the participants at the upper levels of the DCPO, Stubbins, and Hyman organizations were highly qualified and evenly matched, and they were able to negotiate effective solutions. In other instances, the tensions became counter-productive, for example, in the field. The balance among participants was not always stable.
The DCPO experiment was one episode in a long history of public experiments with the building process. While no single experiment has achieved the results claimed by its champions, in the aggregate the process of public building is changing. The number of public design/build projects now underway is one form of evidence. Overall changes in industry practices, particularly the increasing diversification of firms, is another indication. Finally, participants in the DCPO case took their experience to other design/build type projects. Thus, despite the substantial barriers to implementation and impediments to learning, the innovations continue.

The Process of Experimentation and Change

On the surface, process innovation by building owners looks feasible: owners initiate projects and project teams are newly created every time. In practice, innovation is difficult. The institutional structure of the industry inhibits process changes. When a process innovation like design/build is implemented by traditional organizations, accustomed to linear procedures, participants have to invent new procedures and develop working relationships with their new partners. Participants face a steep learning curve for each project.

In developing new procedures for public projects, participants often do not recognize that other firms and owners may be in similar positions, crafting from old linear practices ways of work that are compatible with new integrated processes. Because what they are doing is new, and because they function in a political environment, public owners are highly protective of their process innovations. The combination of new organizations for each project and highly protective attitudes about innovation inhibit learning about new processes by the public innovators and prevent the transfer of new knowledge to other innovators.

Thus we see a pattern in public building innovation. Public owners initiate change in the building process when they face sudden changes in the demand for particular types of buildings. The vehicle for change is the procurement process, since that is the vehicle for defining the project organization and assembling the project team. The innovative ideas come from the personal experiences of innovators rather than analyses of other experiments. Innovators look to their peers who are developing current projects. During implementation, the public agency protects the innovation from political criticism. Evaluation is therefore limited. When they are undertaken, evaluations are done after the demand crisis is over and the experimental projects are completed. Most often, there is no evaluation. Meanwhile, the innovators move on to other projects in other contexts, where they often participate in new experiments.

The pattern repeated itself in the DCPO case. First, DCPO perceived that it was starting from scratch. Its models were the process innovations undertaken by the two heads of the
agency when they held other positions: Tunney Lee's experience with turnkey projects and, and Jack Carlson's experience with his own firm. Using these models, DCPO crafted its own "unique" process. Faced with its most important obstacles in the regulatory environment dictated by Chapter 579 and the Inspector General, DCPO focused on procedures to safeguard the line between the public and private sectors while developing its new method. The same approach was taken by almost every agency studied. Each innovation was a hybrid of other innovations and traditional methods, and most retained a sharp division between public and private sectors.

Second, to the extent DCPO did research, it focused on other public agencies, not the industry, the designers and general contractors who would do the projects. In fact, it consciously avoided anything that would make it appear that the agency was getting too close to any individuals in the industry. The only practitioners consulted were developers, who were not expected to participate in the actual projects. The only source of design/build practice based advice came from Jack Carlson, and his firm had done few public projects.

Third, DCPO declined to undertake a formal evaluation of the experiment, for fear that the Inspector General or others with political motives would take the opportunity to kill the experiment. Thus DCPO could not learn well from itself, nor could it provide fully informed advice to others about its experience.

A fully integrated design and construction process was never implemented in the case. This research found that adherence to old practices undermined implementation of the new. However, because the participants lacked a systematic analysis of the experience, they could not say whether it was the design/build method, or adherence to old ways, that caused the difficulties. Advocates said that design/build was a new process, and they just had to work out the procedures. Critics said the design/build was a bad idea for public building. Thus, the barriers to evaluation become part of the problem. Agencies and practitioners can not identify the factors that prevent innovations like design/build from achieving claimed anticipated performance. This in turn makes it more difficult for owners and the industry to make the changes necessary to achieve the kind of cost effective building that both seek.

Finally, the participants in the jail project carried the design/build innovations to new projects. By the time the jail was completed, Hyman-Stubbins Inc. partners Brodeur, Shook, and Hamner had become involved in other design/build type projects: Shook and Hamner competed for and won the award for the Suffolk County House, Brodeur, with new partner Perini, won the award for the development of modular prison units for DCPO in Worcester. Easley Hamner later participated in a design jury for a GSA turnkey project in New York. The George Hyman Construction Company won an award from the U.S. Postal Service to design/build a project in the Washington area.
In summary, this research found a long and rich history of innovation by public owners. However, evaluation and learning was limited. As a result, many good ideas may have been discarded for the wrong reasons. Public owners and firms in the industry that provide services to these owners clearly need better ways to learn from their own experiences, better ways to transfer knowledge within projects while they are in process, and better ways to disseminate the results to others.
What Does the Evidence Show? What Worked?

1. Negotiations and Risk Sharing, versus Control

Under DCPO's multi-firm version of design/build, participants did not become close partners, as the theory of design/build suggests. This is characteristic of the public version of the method. Participants instead became skilled negotiators trying to balance their individual and sometimes conflicting interests against the overall requirements of the project.

Participants were least successful in addressing these conflicts prior to the contract award. During the programming and schematic design, major dilemmas arose. As key actors were isolated in the decision-making process -- the firm responsible for design/building did not participate in the programming process and DCPO isolated itself from bidding firms -- design conflicts could not be successfully resolved.

Only after the project award could participants negotiate with each other. In the four month period after the award but prior to the actual signing of the contract, key participants were able to create working relationships which they described as crucial for future problem solving. While they could not undo some of the earlier programming and design decisions, they were nevertheless able jointly to bring the project to completion under the contract price and within the scheduled time.

Hence we see how DCPO's efforts to control the project through traditional public regulatory practices backfired in the case of design/build. For instance, after the first experience the state believed that a more detailed RFP and the development of a more detailed prototype design would ensure a pool of more acceptable proposals and prevent the long period of negotiations that occurred on the first project. In practice, in the next project the prototype design had to be abandoned, and the period of negotiation on the house was longer than for the jail. On the other hand, when the state relaxed the process, when it moved from completely formalized communication to interactive workshops, when it moved from lump sum price to open books, when it allowed the designer to abandon the prototype and re-think the design, things worked "better". This suggests that we need to define a different kind of control system, that allows negotiation focused on final performance.

Open books contracts were typical for the integrated firm model of design/build, and negotiated contracts are increasingly the model for other commercial and institutional work. Nevertheless, sharing information about costs and sharing risks with the design/builder was a last resort effort for DCPO. DCPO first used the guaranteed maximum price with open books on the three prisons project, when it faced a series of unexpected change orders. The agency then proposed essentially a cost plus contract for the house, later switching to a guaranteed
maximum price under pressure from the Inspector General. It was difficult for DCPO to let go of the idea of the lump sum bid, but the agency found that the practice simply did not work under its design/build method.

2. Innovations in Design

Despite limitations on the design process, participants nevertheless tried innovations in design. Two examples give us insight about the potential for the integration of construction knowledge into design. First, at the start of its partnership, The Stubbins Associates and Hyman collaboratively determined the overall parameters of the jail design. The form of the building reflected the architect and general contractor's mutual knowledge of the site conditions and the requirements for moving equipment and materials around in building. The decision to use a concrete structure did not, however, reflect a good understanding of the Boston precasting market. As a result, the structure had to be redesigned at the last minute.

In the second instance, the systems engineers and the mechanical subcontractors devised new "design/build subcontracts". DCPO's resident engineers found this approach to design very difficult to inspect, and they prevented its use on the subsequent Suffolk County house project. Nevertheless, Syska and Hennessy and TSA found the approach beneficial for the project.

Integration of construction knowledge into design that most benefitted the project thus occurred between those designers and contractors with the most specific understanding of the technology of the system they were designing and of the local market. Communication about design between the mechanical engineers and the mechanical subcontractors was more effective than that between the architect, who managed the design and the design consultants, and the general contractor, who managed the subcontracts.

3. Repeat Relationships

Traditional public rules for selecting architects and general contractors have distributive goals: one intent is to parcel out work among firms. DCPO's rules for selecting architects, mandated by the Ward Commission, sought to distribute work relatively evenly and to prevent relationships that were "too cosy" between architects and the state. Construction bidding laws have a similar intent: any reasonably qualified firm can win a public contract by being the low bidder.

There are costs to this policy. Architects and contractors have to learn about the client for each new project. At the end of each project, the lessons are lost unless by chance the same team members come together again. For design/build projects, which depend on the
development of a close working partnership among participants, the costs of the distributive policy are higher.

The benefits of repeat relationships have long been recognized by private owners. They use their ability to award repeat contracts as an incentive to encourage good performance. There is also evidence of such benefits for public owners. In the case of DCPO, the Designer Selection Board evidently recognized the value of using design firms experienced with DCPO projects: it choose Sert Jackson for the study of the HOC after the firm had completed a comparable study for the jail. The DSB also choose Whitney Atwood Norcross for a series of prison projects. The Design Build Selection Board made a similar decision when it selected HSI for the second design build project.

The evidence also suggests that when firms have experience working with each other the project benefits. The smooth design process in the Bristol project was in part the result of WAN's long experience with public projects. When Hyman and TSA developed an initial concept for the HOC, they used their experience with the jail project to avoid repeating the design decisions that had led to production problems. Hyman found the long term relationships with certain subcontractors so valuable to project delivery that the firm included these subcontractors up-front as part of the construction team.
How Can We Resolve the Embedded Conflicts?

In Chapter 7, we identified a need to create new conceptual frameworks, to address embedded conflicts between design/build and the traditional linear public process. We focused on three areas:

- Public Accountability
- Organization of Multi-Firm Design/Build
- Design Process

1. Public Accountability

Public owners must recognize themselves as being part of the business system for the production of public buildings. This means authority and responsibility for project outcomes must be shared by government and private contractors. In design/build projects, systems of accountability that depended on the separation of sectors and the exercise of unilateral control by government proved to be inappropriate.

The conflicts in the case arose not because DCPO wanted to hold the design/builder accountable for services to the public but because of the way the state defined accountability. Drawing from the Ward Commission's work, and driven by pressure from the Inspector General to adhere to the specific ideas of the commission, the state drew a sharp line between itself and the private contractors. It then defined accountability as how well HSI and the other competitors followed the specific rules the state had set out. There was controversy within the state over this view of accountability. The Inspector General was a "strict constructionist" in his interpretation of Chapter 579. He considered each deviation from individual procedures to be a potential problem. He provided the legislature with 38 pages of noted exceptions to the "rules", yet he never asked whether the process produced a better project. DCPO, first through Lee and then Carlson, argued for a more flexible process in its operation, more openness, more ability to negotiate.

Public agencies have moved in the direction of negotiated relationships for projects and programs in which governments agencies share authority with private entities, for instance in the development of public/private partnerships for downtown development projects (Frieden and Sagalyn 1989) and in federal contracting with private third parties for programs (Kettl 1988). Kettl, in his study of program contracting, concludes that contracts are negotiated documents, and that accountability should be defined as a system of overall goals, using incentives and negotiation as tools to focus on those goals during implementation.
2. The Organization of Multi-Firm Teams

The overwhelming majority of public design/build projects are undertaken by temporary teams of traditional architectural and general contracting firms, in some instances under the leadership of a real estate developer, in other instances in direct contractual relationship with each other. In the DCPO case, the HSI partnership worked, in that the partners elected to compete for a second major design/build project for DCPO. The DBSB was confident enough in the team's performance on the first project to choose HSI for the next contract. TSA and Hyman are also open to future joint projects in the future. As partnerships such as HSI undertake this kind of repeat work, they should develop "routines" for working together, perhaps becoming "quasi-firms" in Eccles terminology.

The TSA and Hyman partnership was held together by a balance of strong personalities and corporate identities. This was balanced at DCPO by equally matched personalities and clear public goals. Together these individuals were effective negotiators and effective brokers for problem solving during the project. With less qualified or less equally matched participants, this might not be so. There are alternative forms of organization that provide a more central responsibility, mitigating the risks of an unstable partnership.

The turnkey model uses a real estate developer as the central point of responsibility, and the largest and most complex projects in the survey part of this research—the GSA projects in Washington and New York and the Chicago Public Library—were organized under this model. In these cases, the government agency dictated the team organization, through its RFP.

In the turnkey projects studied, developers brought management and financial resources to projects. As managers, developers held the team together at a central point, internally brokering conflicts between the designer and the builder. Access to developer financing opened a range of options for public financing, such as revenue based leases, bond backed leases, and lump sum purchases. The flexibility of financing was sometimes the primary criteria for choosing the turnkey contract.

The use of developers in packaging public projects is consistent with other roles developers have played for owners, in the development of housing, in industrial parks, shopping centers, and office buildings, and for public owners, including decades of development for the Postal Service, HUD, and the Department of Defense, and more recent development for state agencies and the GSA.

Another possibility is that the emerging separation between concept and production design in the practice of architecture, coupled with the expansion by traditional architectural and construction firms across the boundaries of design and construction, may lead to new
integrated firms in the future. A model is the organization of construction companies in Japan. There, construction companies provide full production design services, and these are integrated into the construction process. Certain "signature" designers remain independent. We can imagine such a system evolving in the United States. Production architects might feasibly join with general contractors specializing in the management of construction to form design/build partnerships. Concept architects could be retained as appropriate for specific projects, as are other specialty consultants.

An advantage of allying the production architects and contractors is that the cultures of the two are closer than between concept architects, the "poets" as Peter Forbes described them, and contractors. Irwig makes a similar argument in describing the different interpersonal characteristics of architects who design and architects who manage design, although he comes to a different organizational conclusion. Still, architects and contractors in new partnerships must confront and resolve old prejudices and learn new languages. This in most likely to occur between firms and individuals who get to know each other by working together over time.

3. The Design Process

Despite organizational alliances of architects and builders, without some modification in the process of design, the integration of construction knowledge into design will be limited. The prevailing tendency to customize building for a single user, as was done for the DCPO jail, as well as the architect's access to construction information during design, need to be addressed.

When an architect designs a customized building, the priority is first on meeting the needs of the individual owner. Once a design is developed that meets these special requirements, the design may be modified based on a value engineering or constructibility analysis. Economies are secondary. Yet as we have seen from the case, use requirements defined by individuals can change quickly, sometimes before a building is complete. On the other hand, when a designer designs repetitively for a similar use and a similar client, the design becomes both more "generic" and more open to significant economies and innovations in technology. In the process of design of factories, broadcasting studios, and other facility types, the Austin Company developed and profited from numerous patented innovations directly related to its growing knowledge of the general requirements of the specialized building.

We see a similar pattern in Japanese construction firms, which spend more on research and development than U.S. firms, leading to the development and patenting of more new products, which in turn generate profits to cover the investment. There is evidence that
investment in research and development by Japanese design/build firms has produced significant technical innovations: in tunneling methods, in earthquake protection, and in a variety of other areas. We also saw evidence of the seeds of such innovation with HSI -- its design for the HOC specifically avoided design features that led to production problems in the jail.

The criticism of this approach, of course, is that design excellence suffers and that generic designs do not win design awards. However, one might argue that if good designers put their talents to more generic and flexible designs, they can achieve excellence. Austin argues that its buildings do incorporate quality design, but design as excellent technology, not only excellent art.

The MIT Center for Construction Research and Education is pursuing another possibility--the use of computers to integrate construction knowledge in the design process. Following the model of integrating design and production in manufacturing, the center is testing the application in design of knowledge-based systems to explore the relationships among function, cost, design and construction in conceptual design and to test building constructibility while design is in process. The results of this research may provide architects with new tools to generate more technically sophisticated and economical design.
What are the Implications for Public Owners?

As participants in the business system that produces of public buildings, government agencies must engage with their partners in design and construction. Redefining government as a partner in the process allows us to re-frame public design/build. A new process might look like the following.

1. Pre-Design.

In the pre-design phase, studies should assess the generic characteristics of the specific project and the context of production in the design and construction industry. The agency should first look at comparable facilities built by other organizations and gather information about the industry. A study should set the general project in context. The study should not seek to establish rigid controls for later design.

1. Project Parameters. The owner or its consultants should identify similar built projects and establish their characteristics. For owners who undertake multiple projects, some data may be available internally from project data banks or files. In addition, owners should look outside of their own organization at the marketplace to establish "ball park" costs and rules of thumb about the relationships between costs and characteristics. At this point the owner may decide on the importance of a "custom" versus "generic" building, based on cost trade-offs.

2. Industry Context. Owners should also identify the firms that design, build, and develop projects of the particular type. What sector of the building industry specializes in such facilities? How do firms in this sector do business? Who are the industry leaders? What is the "best practice" of firms?

3. Procurement Practices. Procurement must be consistent with industry practices. If design/build will involve teams of traditional firms rather than integrated design/build firms, as in the DCPO case, the owner should tailor the procurement process to such teams.

4. Limiting Factors. The study should conclude by defining limiting factors, such as gross building areas based on similar projects and ball park budget estimates for appropriations. It is not appropriate at this stage to make finite detailed decisions about design or program, as this research suggests that many such decisions are premature and need to be undone later in the design process.
2. Procurement

The government agency should select the best qualified design/build team or firm for a project and then work with that entity, as it now does with traditional architects. The design/builder should be seen as a partner to the agency, effectively extending professional status from the designer to encompass the builder. Recognizing the status of the builder as a professional puts the three partners, the owner, the architect and the builder on more equal and appropriate footing and it would facilitate the development of an atmosphere of teamwork. The move also reflects more accurately the nature and complexity of the contractor's activities as the manager of a complex production process.

The most important element of a successful design/build project is the project team: The owner, the designer and the builder. Procurement criteria should focus on the owner's selection of the right partners. Prior experience with the owner's projects may be an appropriate criteria in practice, as it appears to be with the selection of designers.

Design should not be subject to competition unless there is a particular outside reason to undertake a design competition. In this case study, the elements of design, cost and team quality were too disparate to be useful in combination, and the decision came down to one of design. Yet by choosing design/build, the owner in effect had said that time and economy were important objectives.

By eliminating design competitions as the basis for selection, except in specific instances, public owners can open the selection process to firms that can demonstrate their ability to do the job but that may not be in a position to undertake a competition. This is consistent with public goals about fairness and equity. With an open and documented selection process, and with clear criteria for decision making, the process becomes transparent and auditable. Parties can be held accountable for their decisions.

3. Production

 Owners and their partners should open the books. If the owner has established a budget for a project, based on general project characteristics and potential special circumstances, and the appropriation reflects that budget, it becomes an effective maximum budget in an open book setting. The design/builder can then work with the owner to design to the budget. At an appropriate point in design, 35 percent completion according to most participants in this study, the design/builder can guarantee a price and the partners can share savings as they decide.

An open and documented selection process focusing only on team qualifications, with open books in production, makes for transparent and auditable transactions, facilitating the
public's interest in holding individuals accountable for what they do. With open books, public owners can make explicit choices about design based on explicit cost and quality trade-offs. This will de-mystify costs and lead to greater economy in production.

The Agenda For Future Research

1. The Organization of Public Projects

This research raises questions about the impact of the organizational characteristics of design/build entity on the integration of design and construction and on performance in public projects. The DCPO case was an example of a partnership version of multi-firm design/build. We need further case research on other models. For example, what about projects that may have been done by integrated firms for public clients—the Postal Service and the Department of Energy report such examples.

This research suggests that "pure" design/build and developer led turnkey organizations have quite different operating characteristics. Is this true in practice? How does DCPO's version of design/build differ from "turnkey" design/build by GSA? What happens when developers add short and long term financing to the package of services, or when the developer retains ownership of a project for a period of years and leases it to the government? How does the way developers manage production under design/build differ from the way public owners or other private owners manage design/build?

Finally, design/build and construction management constitute competitive alternatives for organizing building production. Decision matrix theories stress the owner's needs and priorities as critical factors in the choice of method. This research suggests that industrial structure and prevailing practices play as important a role in implementation; further research is needed into the comparative practices of these strategies. Is one strategy more appropriate for public work than another, or do the strategies indeed have parallel applications?

2. The Integration of Design and Construction

In addition to the information systems type research such as that going on at MIT, we should look to organizational models that purport to integrate design and construction. Design/build is the prevailing practice for building development in countries with a different professional tradition than in the United States. These firms are also increasingly competitors for work in the United States. For example, in 1988 Kajima International was the 73rd largest contractor in the US, and Ohbayashi America was 344th. Both are members of Japan's "big six" contractors. (No Japanese were included in Engineering News Record's top 400

218
contractors ten years earlier.) These models might provide resources about different ways to integrate construction knowledge into design in projects in this county.

Meanwhile, American architectural and construction firms are testing new joint ventures in construction in Japan. TSA is doing a project with Mitsubishi, and the Austin Company is undertaking its first Japanese project. What can we learn from these experiences?

Finally new cases of public sector projects need to be compared on a systematic basis with available cases about the organization of private projects.

3. Learning from Others

As this research shows, design/build requires that owners, designers and builders change not only the way they relate to each other but the way they do the business of designing and building. The scope of the change means that all parties have a lot to learn.

The impediments to evaluating experiments and learning parallel the impediments to implementation of an integrated process. Research is compartmentalized along the lines of the industry, and no entity has the resources nor the mandate to undertake research across organizational boundaries. These boundaries exist in academic institutions as well as in the industry, and they exist within organizations. Especially within public organizations, there is a protective attitude toward innovations that allows them to survive in what may be a hostile climate, but it limits evaluation and learning. In this case, Massachusetts let $170 million in design/build contracts yet was reluctant to sponsor an evaluation that crossed organizational lines. The evaluations that were done by DCPO and the Office of the Inspector General had strong ideological biases. Other agencies reported similar problems with evaluations. A planner for the GSA, which is undertaking hundreds of millions of dollars in design/build, acknowledged that a false step or a change in the political wind could kill the whole effort, and the agency was thus reluctant to open the process to premature scrutiny. The head of the Federal Construction Council of the Building Research Board confirmed that most federal agencies are very cautious about how they evaluate themselves, and there are few vehicles for outside research.

Meanwhile, this research reveals significant creativity and experimentation by public agencies in building. The next task is to create a framework for making the extensive available data useful, making the experiences of the agencies and their partners in the industry accessible to each other, and disseminating the results to other practitioners. It is hoped that this research can accomplish a piece of that goal by making DCPO’s experience accessible to the readers of this document.
Appendix A

Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>A&amp;F</td>
<td>Secretariat of Administration and Finance (Massachusetts)</td>
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<tr>
<td>AGC</td>
<td>Associated General Contractors (of America) (of Massachusetts)</td>
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<tr>
<td>AIA</td>
<td>American Institute of Architects</td>
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<tr>
<td>ASCE</td>
<td>American Society of Civil Engineers</td>
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<tr>
<td>BBC</td>
<td>Bureau of Building Construction (Massachusetts)</td>
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<tr>
<td>CAPICS</td>
<td>Computerized Accounting and Project Information Control System</td>
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<tr>
<td>CERL</td>
<td>Construction Engineering and Research Laboratory</td>
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<td>CM</td>
<td>Construction Management</td>
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<td>CITTP</td>
<td>Civilian Industrial Technology Program</td>
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<td>DBSB</td>
<td>Design/Build Selection Board</td>
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<td>DSB</td>
<td>Designer Selection Board</td>
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<td>DCPO</td>
<td>Division of Capital Planning and Operations</td>
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<td>DOC</td>
<td>Department of Correction</td>
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<td>DPW</td>
<td>Department of Public Works</td>
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<td>ENR</td>
<td>Engineering News Record</td>
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<td>GMP</td>
<td>Guaranteed Maximum Price</td>
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<td>GSA</td>
<td>U.S. General Services Administration</td>
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<td>HOC</td>
<td>House of Correction (Suffolk County Massachusetts)</td>
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<td>HSI</td>
<td>Hyman-Stubbins Incorporated</td>
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<td>HUD</td>
<td>U.S. Department of Housing and Urban Development</td>
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<tr>
<td>HVAC</td>
<td>Heating, Ventilating and Air Conditioning</td>
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<td>IG</td>
<td>Inspector General (Massachusetts)</td>
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<td>MCA</td>
<td>Military Construction Appropriation</td>
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<td>MGH</td>
<td>Massachusetts General Hospital</td>
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<td>MIT</td>
<td>Massachusetts Institute of Technology</td>
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<td>NASA</td>
<td>National Aeronautics and Space Administration</td>
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<tr>
<td>NAVFAC</td>
<td>Naval Facilities Engineering Command</td>
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<td>NJ</td>
<td>National Institute of Justice</td>
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<td>PFD</td>
<td>Public Facilities Department (Boston)</td>
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<tr>
<td>RFP</td>
<td>Request for Proposals</td>
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<td>RFQ</td>
<td>Request for Qualifications</td>
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<td>SCSD</td>
<td>School Component Systems Design</td>
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<td>SFSU</td>
<td>San Francisco State University</td>
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<td>TSA</td>
<td>The Stubbins Associates</td>
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<td>TSFA</td>
<td>Two Step Formal Advertising</td>
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<td>Voinovich Monacelli Architects</td>
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<td>WAN</td>
<td>Whitney Atwood Norcross</td>
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Appendix B
Experimental Public Building Projects

Public Building Using Industrialized Systems

School Component Systems Design

SCSD was the the first major attempt to industrialize public building in the U.S. and is recognized as the pioneer program in North America in the development of performance specifications. The program grew out of the demand for the volume production of school buildings generated as the post world war II baby boom generation began entering the public school systems in the early 1950s and a growing belief that the technological progress in the building industry depended on industrialization. The project began in 1961 when the Ford Foundation funded the Educational Facilities Laboratories (EFL) to develop the program.

The premise behind SCSD was that local school districts could reduce costs by using standardized building components produced using long production runs in factories. To create a market for such components, individual districts joined together as a purchasing group and established permanent long term relationships with suppliers. To accommodate the special requirements for competitive bidding on different proprietary systems, the SCSD program created a new design document, the performance specification.

Ezra Ehrenkrantz, project architect for EFL, created specifications for the performance of four building subsystems to be used in the construction of 22 schools in 13 school districts. Twenty six manufacturers competed for the four awards. Individual architects used the designated systems in the design of each individual school. The prototype, designed by Robinson Ward, was built in Palo Alto in 1965.

The program had limited success. As of 1968, schools in only 11 of the 13 districts were complete, and one manufacturer had discontinued operation by that time, due to insufficient volume. Several other school districts replicated the approach, including the Florida Schoolhouse Systems Program, the Study of Educational Facilities program in Toronto, and the Recherches en Amenagements Scolaires (RAS) program in Montreal.

Firms involved in these projects went on to market their systems to private clients under a design/build "package building" system. For example, one of the unsuccessful bidders for the SCSD award successfully marketed a new version of the systems as Butler Buildings, selling the packages through design/build contractors. The director of the Inland Steel

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1 The model for SCSD was CLASP (Consortium for Local Authority Special Program) initiated in England in 1948.
participation in SCSD went on to organize SYNCON, a firm specializing in packaging and managing systems building on a design/build basis for owners.

**Public Building Service Building Systems Program**

In 1967, based on the experience of SCSD and recommendations by John Eberhard then of the AIA Research Council, a presidential task force recommended that the federal government use its purchasing power to stimulate the development of new building technology. Eberhard had been involved in the SCSD projects, and following that model, he developed for the Public Building Service (PBS) specifications describing the requirements for the performance of the various subsystems in social security payment centers to be built by the PBS. The specifications, known as the "Peach Book", were completed in 1971. Construction of the centers began in 1972.

Procurement of the PBS Systems was in two steps. Competitors first submitted technical proposals. Competitors with proposals that met the performance requirements then submitted bids, and the award went to the low bidder.

**Army Corps of Engineers**

The combination of performance specifications with a two-step technical and price competition known as Two Step Formal Advertising (TSFA), patterned after the PBS Building Systems process, was used by the Army Corps of Engineers in the 1970s for the purchase of buildings incorporating industrialized systems. The Corps issued an RFP defining its requirements, and bidders described their technical approaches in proposals developed by their own designers. The Corps evaluated the responses and determined which systems met the performance specifications. Finalists submitted price proposals, and the Corps made the award to the low bidder.

TSFA differed from earlier systems approaches in that Corps sought available "second generation" building systems and subsystems rather than the development of new ones for its projects. The purposes of TSFA were procurement efficiency and innovation and economy in building associated with industrialized production. In addition, although the method focused on the purchase of industrialized systems, in practice it "allowed industrialized building to compete with conventional construction" (Napier and Golish 1982). Competitions were open to general contractors proposing conventional methods and contractors selling products under manufacturers licenses or franchises.

In 1980, the Corps decided to "verify the effectiveness" of industrialized building systems in military construction (Napier and Lierman 1985), and it chose 3 projects for evaluation by the Construction Engineering Research Laboratory (CERL), a battalion
headquarters and classroom building at Fort Drum, NY, a physical fitness center at Fort Benjamin Harrison, IN, and a fire station at Fort Stewart, GA. Ehrenkrantz' firm had prepared the Request for Technical Proposals (RFTP) for the first project. In all three cases, bidders included conventional and building system franchise contractors, and the low bidder for one of the three projects proposed conventional steel frame and masonry construction. In the other two cases, the low bidder proposed the use of a pre-engineered metal building systems.

The CERL evaluation reported significant cost savings, ranging from 28 to 32 percent based on government estimates of traditional procurement and construction, for all three projects. Two projects demonstrated substantial time savings, from 50 to 75 percent based on the contract schedule. The third project was completed on time. In all three cases, CERL found quality to be equivalent to conventional construction.

CERL reported that the "savings in project cost are attributed to the "design/ build" feature of the two step procurement" (Napier and Lierman 1985). CERL found the process produced diversity in design, advantages in cost, time and construction administration due to the integration of design and construction, and easier phasing of work due to this integration.

Although the charge to CERL was to evaluate the effectiveness of industrialized building systems, the CERL test did not address this question directly. However, there is evidence from the case documents to suggest that pre-engineered metal buildings were inherently less expensive than conventional construction and that these savings were independent of the design/ build procurement process. In the two bids won by contractors using systems, the low systems bid was 10 to 20 percent below the low conventional bid. In the case of the third bid, a competition between two bidders, the supplier of the systems product indicated that he did not understand the second phase of the competition was on a price only basis - that he had proposed a system which exceeded the performance specifications, thinking to get credit for the higher quality.

The more interesting outcome of the CERL test is the transition it represents between the adaptation of procurement policies to promote a specific technological development, the production of building systems in the factory, to the use of the resultant procurement policy to achieve a change in the building process - the integration of design and construction. According to CERL, the benefits of this integration flowed to conventional as well as industrialized production.
Turnkey Projects

Turnkey Public Housing

During the late 1960s, officials at the federal Public Housing Authority (PHA - later Housing and Urban Development or HUD) decided to use private developers to expand the capacity of local public authorities to develop public housing. Public policy makers decided that residential developers, who had become sophisticated large capacity producers and managers during the post world war housing expansion, should develop public housing. The idea was that if they developed public projects as they developed private projects, turnkey developers could process and produce faster than could public agencies using conventional methods. Turnkey lower costs at the same time it increased program activity. There was no explicit agenda to promote specific technologies or innovation.

The initial experiments with the purchase of public housing directly from developers began in 1965. After tests in courts, the program moved into production in 1970s. By the late 1970s, turnkey became the preferred method of purchase. One of the largest users of turnkey, the New York Housing Authority, completed 87 projects under the method from 1965 to 1988. Between 1970 and 1980 over half of all federal public housing was being built under turnkey procedures (USRE 1982).

Strategies for selecting developers for public projects and the assignment of management functions to these private entities are mirrored in current design/build methods. Turnkey developers were asked to submit proposals meeting the minimum standards and a price for a package of services including land, building design and construction. Local authorities then chose developers based on factors including the quality of the design and the reputation of the A/E firm, cost, time, and other factors. Although there was a single team and a package of services, there were two contracts, one for design and the second for construction. Local authorities negotiated the terms of each contract with the developers. Upon completion, the authorities made lump sum payments for completed projects.

There was little formal evaluation of this program. One study done for HUD in 1982, examined 55 turnkey projects and 53 conventional projects completed from 1975 to 1979. The study reported the turnkey units were comparable in price to conventional public housing units, but that the construction type was inherently less expensive, incorporating less durable materials than conventional construction (USRE 1982).

Military Housing

The Department of Defense began using turnkey contracts for military housing in 1970, following a report by the Government Accounting Office (GAO) critical of housing produced
under traditional military procurement. The military family housing program was modelled after HUD turnkey, except that the military provided land and procured directly rather than through local agents. The specific procedure was know as One Step Competitive Negotiations. Under the strategy, the Naval Facilities Engineering Command or the Army Corps of Engineers issued Requests for Proposals based on performance specifications. Proposals included both price and design elements in one package. The proposal evaluation process weighed design, technical, and price elements and based the award on the resultant "quality point value."

In 1972, the military turnkey strategy survived a challenge by GAO, which questioned the use of a basis other than low bid for awards. The Department of Defense then moved into production under the program, and by FY '87, most of family housing developed by the Department of Defense was done using the one-step method.

Design/Build

New York State Dormitory Authority

In 1971, the Dormitory Authority for the state of New York, an independent construction and financing authority for the state university system, decided to test the use of design/build. The authority wanted to bring the borrowing costs of new student housing in line with revenues, which meant a 25 percent reduction in per bed construction costs. The authority hired architect Philip Bobrow of Montreal to develop the procurement procedures and project RFPs. Bobrow defined the process as a revised version of turnkey in subsequent descriptions of his experience with this project.

The Industrialization Forum, a journal published by the University of Montreal in the mid 1970s published articles about the projects by Bobrow, by the authority's director of design and construction Douglas Hasbrouck, and by Jonathan King of CRS, architect for the design/build team that developed one of the first projects. In 1977 Hasbrouck reported that the seven projects produced a savings in capital costs of 5 to 45 percent. For projects under schedule pressures, such as the St. John Smithtown Hospital, the development time was reduced to three years from a typical seven years. The Brockport project won several design awards, including a presidential award.

Between 1971 and 1976, the authority completed 7 design/build projects, five high rise buildings (two dormitories for the State University of New York, faculty housing for Rockefeller University and a hospital) and two parking garages. The first housing project, a

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2 From 1958 to 1970, King had been vice president of Educational Facilities Laboratories and involved in the SCSD and other school systems programs.
dormitory at the Brockport campus, was awarded to CRS, which proposed using an industrialized building system. The authority had not intended design/build for the specific purchase of industrialized systems, but as architect Jonathan King noted, the process allowed industrialized building systems to compete fairly with conventional construction.

In his evaluation, Hasbrouck noted the critical importance and relationship of two elements of the process, the RFP and the ability to fix the cost. The RFP itself became the "single most important device distinguishing the process from traditional." If price were specified, the RFP should be oriented toward performance criteria, and the competition would occur on the basis of quality. If the price were a variable, the RFP would become both a minimum and maximum set of requirements, and thus provide prescriptive criteria. Competition would occur on the basis of price.

Currently, according to Ronald McDowell, director of SUNY and Related Institutions for the authority, the authority uses design/build for all SUNY dormitories and parking structures. The authority continues to specify the price, to encourage competition on the basis of the program, and to pay honoraria to participants.

**Department of Defense**

The Department of Defense first used a one step process parallel to design/build in the mid 1970s, for revenue financed projects outside of the formal congressional Military Construction Appropriation (MCA). One of the first projects was for a 250 man Bachelor Officers' Quarters for the Army at Fort Knox, Kentucky. Caudill, Rowlett, Scott (CRS)\(^3\), under the supervision of senior vice president in charge of systems Jonathan King, developed the RFP. Since then, single contract procurement has been used by the Corps, Naval Facilities Engineering Command, and the Marines for other self funding projects.

In 1983 Congress authorized the Army to test the use of one step design/build for non-housing projects in the MCA budget. The Corps selected two physical fitness centers for test, and CERL undertook the evaluation. CERL reported project costs on one project to be 28 percent under the government's estimate for conventional construction, with all price bids below the estimate. There were no responses to the initial RFP for the second project. That RFP included a definitive design as well as an "artificially low cost ceiling" (Napier et al 1988). A second RFP was issued without the definitive design, and three firms bid. CERL reported final project costs to be 16 percent below the government's estimate.

In 1986, Congress authorized the Department of Defense to use one step design/build for 3 projects per service per year through 1990.

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\(^3\) CRS principals Caudill and Pena were also leading innovators in the area of architectural programming.
Appendix C

Public Building Agencies Using Design/Build Contracts
Summary of 1989 Survey

Federal Agencies

All federal agencies must follow the Federal Acquisition Regulations (FAR) in the purchase of products and services. The following standards are most relevant to building.

The Brooks Act of 1972 forbids agencies from using competitive bidding for design services. This was consistent with the AIA code of ethics at the time, that prohibited members from bidding services. In 1978 the courts found the AIA restriction to violate anti-trust laws and the provision was eliminated from the AIA code.

Traditional requirements mandate the use of Sealed Bidding for construction (FAR Part 14). This can take two forms. One form is consistent with traditional design prior to construction, with bidding based on a detailed set of construction drawings and prescriptive specifications. The second form, known as Two Step Formal Advertising (TSFA), was developed in the 1970s for the purchase of industrialized building systems. In this form, the agency uses performance specifications to solicit proposals for competing proprietary systems. In the second step, the agency awards the contract to the bidder proposing the lowest price for a qualifying system.

An alternative is Contracting by Negotiation (FAR Part 15). This process, also known as One Step Competitive Negotiation or Source Selection, was first used for the purchase of family housing for Department of Defense agencies. Most family housing for DOD agencies is currently acquired under this section. In 1985 Congress authorized the Department of Defense agencies to use this process for selected non-housing projects, on a test basis.¹

Department of Defense

Army Corps of Engineers.

The Army Corps of Engineers is responsible for the design and construction of most building for the Army and for the Air Force. Procedures are developed by the central office for use by field operations. Procedures must meet Federal Acquisition Regulations, described above.

¹ Congress authorized three non housing MCA projects per service per year through 1990 using Source Selection.
The Corps reported using both TSFA and One Step Competitive Negotiations, defining both as versions of design/build. The TSFA had been in use since the 1970s. Since 1984 the Corps has undertaken about fifteen design/build projects, each ranging from $2 to $6 million. In 1988 the Construction Engineering Research Laboratory developed a matrix for field use in deciding when and which version of design/build to use for projects with particular characteristics.

The Air Force has developed its own version of design/build, involving the development of detailed specifications and design guidelines during an extensive pre-design process. The agency had used this process for projects of $15 to $20 million. These were defined as One Step Competitive Negotiations projects and were included in the 1985 congressional test.

*Naval Facilities Engineering Command*

NAVFAc is responsible for the design and construction of building projects for the Navy and the Marines. NAVFAc defined three versions of design/build. Two Step Sealed Bidding, equivalent to the Corps' TSFA, was used when detailed prescriptive specifications were not appropriate, for example, in the purchase of proprietary systems. NAVAC used source selection for technically complex projects which were large enough to attract firms willing to invest in the preparation of proposals. These projects were included in the congressional test. The third version, known as Newport Design/Build, was used for small projects. In this version, NAVAC used an outside A/E firm to develop a partial design and specification, for bid as a design/build competition.

Although the Marines had not completed design/build projects as part of the congressional test, the Marines reported using design/build for projects outside of the MCA, those financed by user fees and thus not covered by the FAR. Projects included commissaries, exchanges, and bowling alleys.

*Department of Energy*

The Department of Energy reported use of design/build projects on an ongoing basis. Each of the eight field offices did two or three projects projects, generally under $1 million each, per year. Design/build represented under 3 percent of annual volume. Design/build was used for the purchase of pre-engineered buildings or for the development of projects for which an industry standard exists, i.e. standard office buildings or warehouses.
Department of State

Because its work is often in countries where building practices differ, the Department of State is exempt from FAR if they conflict with local conditions and the exemption is in the best interest of the government. The Department of State has used design/build for the development of three embassies outside the United States. The department varied its design/build procedures in the three projects, using both single and two stage competitions, and using detailed criteria and minimal criteria in defining project requirements.

National Aeronautics and Space Administration

NASA has used design/build for three projects at the Kennedy Space Center. Projects scale ranged from a $500,000 to $17 million in construction.

Postal Service

As an independent agency, the Postal Service is not subject to FAR. The service finances its facility development using revenues and bond sales, with no government funds. The service has used design/build since the early 1980s, completing four projects in that time. In some cases, developers undertook projects on a turnkey basis, in other cases project packages included only design and construction.
State and Local Agencies

Alaska

Department of Transportation and Public Facilities

The department used design/build for the development of two small correctional facilities in the 1980s. In both cases, the motivation was overcrowding in existing facilities, defined by the Department of Correction as an emergency situation. The process has not been repeated.

California

California State University

Chancellor's Office of Physical Planning and Development undertakes design and construction for the various campuses. The university has used design/build for seven low rise dormitories since 1983. In 1987 the university decided to use the method for a high rise $17 million apartment building and guest center. (See mini-case at the end of this appendix.)

Santa Clara County

In 1985 the Santa Clara County Board of Supervisors used design/build for the addition of housing to the Elmwood Detention Center. The project was motivated by a court order mandating an immediate solution to overcrowding at the facility. No other design/build projects have been undertaken.

Connecticut

The Connecticut Department of Public Works

The DPW builds for all state agencies, and it has been using variations of design/build for ten years. One version involves the purchase of facilities using long term leases. The state has recently expanded this concept for the development of a health center and state purchase on completion using a lump sum payment. The agency also uses design/build to purchase pre-engineered temporary buildings, such modular offices. The DPW also expanded two correctional facilities using modular construction purchased under design/build contracts in the mid 1980s.
District of Columbia

The District of Columbia Department of Public Works has used design/build for several corrections projects, for the purchase of building modules and for conventional construction. Design/build has been used for large projects, $18 to $28 million, and the DFW plans to use the method for a $75 million correctional health treatment center.

Maryland

Design and construction is the responsibility of the Maryland Department of General Services. The agency has been using design/build since the early 1980s, primarily for the development of dormitories and parking garages for the state university system. Design/build has been used for increasingly complex projects. The first project was a poultry facility. The agency currently plans to use the method for a $20 million state office complex. The state has done one design/build leaseback project.

Missouri

The Missouri Office of Administration, Division of Design and Construction used a design/build turnkey contract to acquire a $55 million state correctional facility in the mid 1980s. The state prepared detailed technical requirements for the facility and will use lease payments over a 40 year period for acquisition.

New Jersey

The New Jersey Division of Building and Construction used an A/E-CM contract, which it defined as design/build, to develop a medium security prison in Newark in the early 1980s. In 1989 the division advertised a design/build contract for the development of prisons at six sites across the state. For the second project, the division developed a prototype design and asked competitors to submit bids. Award was on the basis of low bid.
New York

Dormitory Authority

The authority began using design/build for dormitories and parking garages for the State University of New York in 1971. Since the early 1980s the authority has used the method for the development of two dormitories and a parking garage, the largest project was $5.7 million. At the time of the survey there were two more projects ready for advertisement, the largest valued at $8 million. All SUNY dormitories are developed using design/build.

NYC General Services Administration

The city of New York uses design/build primarily to purchase modular units for correctional facilities, the largest projects, and for smaller libraries and court facilities. Most projects are considered temporary.

Texas

The Texas Department of Corrections has used two versions of design/build contracts for correctional facilities. In the early 1980s the department developed facilities using pre-engineered buildings under design/build type contracts. At the time of the survey the department was undertaking four projects under a "privatization" program. A private developer built the facilities to the state's specifications. The state has countersigned the bond financing to the developer, will provide payments on a per/man basis, and may acquire the facilities at some time in the future.

Vermont

The Vermont Division of State Buildings developed three design/build projects in the early to mid 1970s, including a state office building, a correctional center, and a dormitory at Johnson State College. At the time of the survey, the agency was considering the use of a lease purchase arrangement for the a state office building.

Virginia

The state of Virginia Department of General Services has used design/build since it was authorized in 1980. Projects have included facilities for the University of Virginia, and a baseball stadium in the city of Richmond.
An Example: Apartments at San Francisco State University

The California State University has been using single contract procurement for the design and construction of dormitories since 1983. In 1986 the Chancellor's office decided to use design/build for a high rise dormitory and guest center to be built at the San Francisco Campus. As a high rise project and over 230,000 square feet of gross area, the project would be the most complex undertaken at the time using design/build. The decision was in part motivated by analysis of square foot costs for thirteen dormitory projects, six bid conventionally and seven using single contract procurement. The average cost under traditional methods was 14 percent higher than under design/build.

The project included apartments for 576 students in a 17 story tower plus housing for 110 guests in a six to seven story wing. The university set as the maximum price $17 million, which was effectively the bid by all four finalists. The general contracting firm of Perini Corporation, with Bodrell Joer’dan Smith as the architectural design subcontractor, won the award.

The program was prepared for the university by the San Francisco architectural firm of Anshen and Allen, which had prepared the master plan for SFSU campus. A&A were to prepare the program in two months, between October and December of 1986, with an additional three months for review and revision by the university and the chancellor's office. This schedule was delayed by three months, when soils tests revealed problem conditions at the original project site. The university selected an alternative site and issued the RFP in July of 1987. The award was made two months later, on August 28.

The RFP specified the building area, described space requirements and design criteria, and specified building performance. The RFP was in four sections and, according to the architect, "was the size of the New York City phone book"(Smith 1988). Bidders were pre-qualified through the chancellor's office based on the financial condition of the general contractor and the experience of both the general contractor and the architect with high rise buildings of comparable scale.

Competitors submitted a two part proposal: a technical proposal including a design, outline specifications "detailed enough to secure bona fide bids"(SFSU RFP 1987), a schedule, and a price proposal not to exceed the cap of $17 million. Seven bidders, all but one general contractors with architectural subcontractors, submitted proposals, and four were chosen as finalists. The one design/build firm that bid, Pankow, was a finalist; that firm included as a subcontractor a traditional architectural firm. The three losing finalists received honoraria of $50,000. Firms estimated their costs to be $85 to $100,000.
A twelve member board with representatives from the chancellor's office, SFSU, Anshen and Allen, and a professor of architecture from California Polytechnic Institute evaluated proposals and selected the Perini team for the award. It was the first design/build contract won by the San Francisco office of Perini.

According to Perini's vice president for pre-construction, Perini entered the competition in an effort to expand its market. A moratorium on commercial construction in San Francisco had shrunk Perini's usual market. To win the award, the firm invested in design. The firm had determined that the evaluators were not technical people, and that the quality of the renderings was critical to winning the award.

The combination of the maximum price and minimum program was "very limiting". According to the project architect,

the RFP contained three elements: the program, the budget, and technical requirements. The team decided to use good reasoning and ignore the technical requirements. We responded to the program and the budget, and we prepared our own technical requirements (Smith 1988).

The university anticipated signing a contract within a month of the award. In practice, Perini and the owner spent three months in negotiations over the technical requirements, disagreeing over items such as insulation, door frames, doors, partitions, painting, window glazing, plumbing fixtures, light fixtures, and the number of elevators. Doherty termed Perini's modifications necessary "value engineering". The university's project manager termed the negotiations "haggling, an agonizing process for everyone involved" (Hays 1988).

On Perini's team, the architect, the civil engineer, and the subcontractors reported to the general contractor. Mechanical and electrical engineers reported to the subcontractors, effectively creating "design/build subcontracts".

During implementation, an important problem developed in the design of the structure, a design initially proposed by the concrete subcontractor. The subcontractor had proposed a method known as "tunnel form" construction, a way to rapidly pour and cure successive levels. During the competition, new earthquake requirements were imposed, which would have required Perini to modify the tunnel form structure, at a cost of $2 million. With the price set at $17 million, Perini saw "value engineering" as the only solution. Because of this problem, the design was 90 percent complete before the structural problem was resolved.

Construction will be completed in February, 1990, 4 1/2 years after the program was initiated and 3 1/2 years after selection of Perini. According to Hayes, if the team had not run into the problem with seismic design, the design and construction schedule would have been somewhat faster than a conventional schedule, but that this was due to the overlapping of design and construction and the design work done during the preparation of proposals. He
suggested that equally rapid construction would have been possible with "rapid mobilization based on a complete set of documents". He indicated that at $75 per square foot, costs for the project would be below the average for comparable projects in the area.

All actors cited negotiating constraints between the owner and the design/builder as a major problem. The general contractor indicated that under the process, there was no opportunity to sit down with the owner and work out the design issues. There was no flexibility, and the state wanted a fixed price. The architect indicated that, because the team could only communicate in writing, they acted strategically to get the bid, postponing many decisions until after the award. The project manager for the SFSU, whose prior experience was with design/build projects for Bechtel, found that "grey areas" were inevitable in the documents; this led to extensive haggling on the project.
Appendix D

Characteristics of Corrections Projects

The special characteristics of corrections facilities impact cost and time performance. Corrections facilities can be "hardware intensive", incorporating specialized and often expensive fixtures and equipment and special often time consuming methods to produce walls and ceiling which constitute "security envelopes". Alternatively, these facilities can be similar in design and construction to other institutional housing, such as college dormitories. These characteristics affect building production.

Policy decisions about the management of inmates in prisons and jails in turn drive project characteristics. The first section summarized the major management issues. In the case, a controversy over management policy, between advocates of direct supervision and remote supervision of inmates, became an important factor in the programming of the Suffolk County Jail. Next, I describe characteristics of recently built corrections facilities, using cross sectional data developed by the National Institute of Justice. Finally, I present a "mini" case study of the development of the Contra Costa Detention facility in California, the first direct supervision urban jail built in the United States. The facility was a model for the programming of the Suffolk County Jail.

Designing Correctional Facilities

Correctional Facilities: End Point of the Criminal Justice System

Correctional facilities are part of the criminal justice system, which also includes local, state, and federal police and courts. Correctional facilities house persons accused or convicted of crimes. The term "correction" derives from the idea that the criminals' behavior can be treated and corrected during their incarceration.

The local county and state systems are interconnected. In metropolitan areas, police bring persons accused of violating state or local laws to jails or detention centers, where the formal processing begins. Accused persons are "booked" and transferred to court for arraignment, where a judge determines the most appropriate way to assure that the person appears later for trial. Many are released at that point, posting a bond or making a personal promise to appear for trial. Those who cannot post a bond or those whose word is considered unreliable are housed in jail pending trial.

Upon subsequent conviction, persons are committed to longer term facilities to serve their sentences. Those serving short term sentences, one to two and one half years, go to
county houses of correction, or jails in some states. Those serving longer term sentences for more serious offenses enter the state prison system.

The Federal system is separate. Persons accused of violations of federal crimes are held in regional detention centers and, upon commitment, are assigned to prisons, all under the jurisdiction of the Federal Bureau of Prisons.

The role of the facilities in the system influences design. Long term facilities with a mission to treat or rehabilitate prisoners include areas for recreation, education, counselling, employment in prison "industries" as well as inmate housing. Prior to assignment to a facility, prisoners are grouped according to behavior characteristics, security risks, and treatment needs. Most long term facilities are specialized by security classification, generally defined as "maximum" 1, "medium" 2, "minimum" 3, or "special" 4.

Detention centers hold persons for short terms, generally between arrest and trial. These facilities are geographically central, usually in metropolitan areas and close to courts. Spaces are provided for activities following arrest (booking, emergency medical and related services) and in preparation for trial, (including court transfer areas, a law library, and rooms for meeting with attorneys). Because they are short term, these facilities generally do not provide extensive employment or educational programming. Some counties combine the functions of detention, courts, the police, and sometimes confinement of convicted persons in a single complex.

Because the corrections facility is at the end of the system, the number and type of persons committed to the system depends on a series of decisions made in other parts of the system and by legislators. Policy dictates who is incarcerated (incarceration rates vary widely), relative use of probation, community corrections, prisons, and conditions of incarceration (absent court intervention - which has occurred in many states).

The Overcrowding Crisis: Populations and Sentencing Policy

Since about 1978, there has been an unprecedented expansion in the number of persons committed to correctional facilities. Populations have severely overcrowded existing facilities. Coupled with changing public attitudes about crime and criminals, this overcrowding has

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1 Inmates that are most dangerous or exhibit the most violent behavior.
2 Most inmates are classified as medium security, although the facility implications differ from jurisdiction to jurisdiction. In the south, many medium security inmates are housed in dormitory facilities. In Massachusetts, recent DOC policy has been to provide maximum security housing for medium security inmates.
3 Minimum security inmates are the least dangerous and often are housed in facilities free of physical barriers such as outside walls and fences. Security is maintained by close supervision. Minimum security inmates may work in the community under work release type programs.
4 These include inmates separated from the general population for administrative or disciplinary reasons, or for their own protection.
motivated policy makers and public builders to increase and accelerate the production of new facilities.

According to the Bureau of Justice Statistics, which collects data on crime and the criminal justice system for the U.S. Department of Justice, the national prison population increased 68 percent between 1977 and 1985, growing at an accelerating rate. As of 1985, most states were operating above capacity. For example, the Massachusetts Department of Correction reported operating at 167 percent of its rated capacity.

The national growth in the prison population of the 1970s and 1980s has been generally attributed to social policy decisions, i.e. changes in sentencing practices, as opposed to increases in either crime rates or in the "at risk" population. The growth rate of population of young males, ages 18 to 29, which had increased from 1966 to 1976, declined in the late 1970s, however the ratio of persons committed to prison to serious crimes committed increased dramatically, by 56 percent between 1980 and 1983.

The explosion in inmate populations followed a period of "reform" in the 1960s and early 1970s, during which advocates of "community corrections" had successfully argued that the solution to crime was not hardware - the incarceration of criminals, but software - economic and social programs aimed at the causes of crime. This meant that few new facilities were built during the period of rapid growth in the at risk population. By the early 1980s, growth in incarceration rates and lack of prior investment in facilities combined to create an overcrowding "crisis". This was exacerbated in the 1980s by increasing drug related crime, "get tough on crime" and "get tough on the criminal" attitudes, and mandatory sentencing policies which increased the time inmates spent in the system.

*Facility Design and Method of Supervision*  
Prison design over time has reflected underlying philosophies about the causes and solutions to crime and criminal behavior. In the nineteenth century, social scientists saw criminals as social deviants, common victims of social disorder who might be rehabilitated through the well ordered routine of an institution. Prisons isolated inmates as a group from the civilian population and imposed a rigid daily regime on their activities.

In the early part of the twentieth century, the progressives believed the sources of the behavior of individual criminals could be identified and thus treated through scientific and rational analysis. The progressives introduced a medical model for the treatment of behavior, including a diagnosis of behavior based on past history, the concept of individual treatment programs based on individual needs for education, training, psychological counselling. One

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5 See Rothman 1971 and 1980 for a detailed discussion of the progressive movement and prison development and management in the U.S.
element of the "treatment" involved progressive changes in the degrees of personal freedom ranging from none (isolation and confinement to cells) through daily freedom of movement for recreation and employment, to the extensive discretion under parole. Prisoners were housed in groups according to steps of treatment. Physically, the architecture reflected the factoring of people and activities. Women, men, and children were each separated. Activities occurred in specialized areas.

The failure of the medical treatment model to achieve its promises led prison managers to establish more rigid control over the prison populations. In the housing areas, the space occupied by inmates was separated from the space allocated to guards by physical barriers. Over time, the control mechanisms have become technically sophisticated. In current high security remote supervision facilities, inmates are housed in individual cells that open onto a central "day room". Within rooms are "indestructible" steel plumbing fixtures and concrete or steel beds. Access to cells is often provided by sliding steel doors electronically controlled by guards stationed in secure "control rooms", from which guards can observe inmate activities. Access to the housing "pod" is through an electronically controlled "sallyport". Similar physical barriers and "security envelopes" channel inmate movement through other parts of the facility, to dining areas, recreation areas, work areas, and counseling and program spaces.

During the reform era of the 1960s and 1970s, the focus of facility managers returned to inmate treatment, i.e. rehabilitation, and building design reflected these concerns. Reformers argued that many offenders could be treated in community based programs, and that incarceration should be reserved for the most difficult cases.

An important new model for the design of prisons came from planners at the Federal Bureau Prisons. Observing the level of tension and violence in traditional prisons, and the negative effects on both staff and inmates, these planners identified the physical separations of guards from inmates, ostensibly a protection for guards, as itself a cause of tension and violence. The barriers amounted to the definition of turf, over which the two groups then competed. The solution was the development of barrier free facilities, secured from outside escape, but open within to movement of both guards and inmates. Control rooms were eliminated, and guards stationed within each housing unit where they supervised inmates "directly", hence the name. Environments were normalized. Staff provided necessary counseling within the unit.

Also known as "unit management", this approach was first tried in long term facilities. In the early 1970s, the FBP built a series of metropolitan correctional centers on this "third

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6 See Rothman's account of the development of MCI Norfolk in Massachusetts, superintendent Howard Gill's experimentation with the medical treatment model.
generation model”. Then, in 1980, the first county jail using the model was opened in Contra Costa County California, outside of San Francisco. Despite advocacy by the FBP and officials at Contra Costa, third generation jails and prisons have been opposed by guards and corrections officers used to second generation remote supervision models.

During the 1980s, the overcrowding crisis shifted the emphasis to questions of how to house the most for the least, and building design concerns similarly changed. In some cases, the two views collided, producing conflicts over management and facility design.

Facility Characteristics and Project Performance: NIJ Data

One of the questions central to a study of design/build is: does the method save time and money? A potential way to answer this question is to identify projects with like characteristics, group as design/build and non-design/build projects, and compare performance. Another way is to create a group of projects with characteristics similar to the subject design/build project, and compare performance. This research used correctional facilities as the constant facility type, but the analysis found performance measures to be highly dependent on what happens during project development.

The data used for this research were compiled by the National Institute of Justice, which surveyed architects specializing in corrections construction and administrators of those facilities. In 1988, the NIJ published project profiles of 262 projects built between 1978 and 1988. Using those profiles, I created pools of 168 projects with characteristics generally similar to the DCPO projects. Building costs were indexed to costs in Boston in April of 1987, the bid date of the Suffolk County Jail.7

There were eleven design/build projects in the pool, and these projects averaged lower construction costs ($125.52 versus $141.60 per square foot) and were constructed faster (15 months versus 23.4 months) than the non-design/build projects. A closer look revealed that eight of the eleven design/build projects were assemblies of pre-manufactured packages, half of those made of wood and metal, while almost all of the remaining 157 projects were built of concrete and masonry. The cost and time performance of the design/build projects thus reflected the use of different materials, and there were so few non-design/build projects with comparable characteristics (two of wood and two of metal), that a cross-sectional comparison was meaningless.

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7 Cost comparisons proved to be highly dependent on the index, and the leading publishers of indices, Means, Dodge/McGraw Hill and Marshall and Swift differed due to the use of different packages of costs. The NIJ data proposes the use of the Marshall and Swift index for cost conversions, and this study found that the cost package for that index most complete for newly constructed corrections buildings.
The next analysis involved creating a pool of projects with characteristics similar to the DCPO case. That meant eliminating projects, for example, using inmate labor instead of contract labor, small projects in general (I used a threshold of 140,000 gross square feet), and projects which housed inmates in dormitories or other multiple occupancy units. The pool of projects was now much smaller, 41. At this point, reducing the pool further, by selecting, for example, only high rise detention facilities designed for maximum security cells, would have reduced the pool to three projects, and these in Alabama, Texas, and Missouri. (Costs for these ranged widely, from $132.80 to $214.33 per square foot and construction time from 30 to 56 months.) Given these caveats, I include here average parameters of 41 large single occupancy projects in the NIJ data bank.

Table D-1

Summary Characteristics of U. S. Correctional Facilities
(Large Projects for Single Occupancy)

<table>
<thead>
<tr>
<th>Projects (Number in Group)</th>
<th>Square Feet per Inmate</th>
<th>Construction Time (months)</th>
<th>Construction Cost 1987 $ Boston</th>
</tr>
</thead>
<tbody>
<tr>
<td>All (41)</td>
<td>453</td>
<td>31.5</td>
<td>149.20</td>
</tr>
<tr>
<td>Detention Facilities (19)</td>
<td>432</td>
<td>35.0</td>
<td>160.00</td>
</tr>
<tr>
<td>High Rise (10)</td>
<td>465</td>
<td>43.2</td>
<td>154.76</td>
</tr>
<tr>
<td>Non High Rise (31)</td>
<td>415</td>
<td>27.8</td>
<td>147.41</td>
</tr>
<tr>
<td>Max/Med (13)</td>
<td>456</td>
<td>29.6</td>
<td>167.38</td>
</tr>
<tr>
<td>Med/Min (28)</td>
<td>452</td>
<td>32.5</td>
<td>140.76</td>
</tr>
<tr>
<td>Direct Supervision (11)</td>
<td>489</td>
<td>28.6</td>
<td>151.78</td>
</tr>
<tr>
<td>Remote Supervision (21)</td>
<td>452</td>
<td>32.8</td>
<td>147.24</td>
</tr>
</tbody>
</table>


Characteristics of 41 projects larger than 140,000 gross square feet, designed for single occupancy.
Example: Contra Costa Detention Facility, Martinez CA

In the mid 1970s, the Board of Supervisors in Contra Costa County CA decided to build a new county jail modelled after the Federal Metropolitan Correctional Centers. The new jail would replace an obsolete and overcrowded facility originally built in 1901. The new facility was opened in 1980, becoming the first county jail designed for direct supervision management and in the process the model for other "third generation" jails. Kaplan/McLaughlin/ Diaz (KMD) of San Francisco prepared the design. Turner Construction Company built the project, using construction management fast track methods.

The building was designed to house 386 inmates in a 181,240 square foot low rise building, for an average of 469 square feet per inmate. The building contains inmate housing as well as county offices and courts. Visiting, counseling, dining, and outdoor recreation are decentralized to the housing modules, which each contain 46 single occupancy cells. Floors in the housing units are carpeted, baffled metal cell doors swing open, plumbing fixtures in each room are of china, and the furniture is wood. Housing units are air conditioned.

The project responded to a 1971 lawsuit over conditions at the old jail and a subsequent court order. The county originally planned to build a six story 500 bed remote supervision maximum security facility in downtown Martinez, but community opposition to the design and the siting resulted in the abandonment of that plan in 1976. In May of 1976, the county appointed a programming consultant, an architectural firm, and a construction management firm, to develop a "new generation" facility, and it set a budget of $20 million for all project costs (See Frazier 1985).

Facilities Sciences Corp. prepared the program in four parts: a location study, a bed capacity forecast, a service program, and an architectural program. The program was completed in seven months.

The architects completed schematic design shortly after the completion of the program, in January, 1976. According to project architect John Kibre(1988), there was a lot of communication between the programmer and the architect and between the architect and the county and the sheriff's office. For example, KMD prepared information and concept drawings for the programmer. Turner, the construction manager, estimated costs, and KMD hired its own estimator to check Turner's estimates.

Schematic designs were reviewed by the sheriff, the National Clearinghouse for Criminal Justice Planning, the Contra Costa jail advisory committee, the county administrator, and after a public hearing, by the Board of Supervisors. Approvals were final by February, 1987, and design development drawings were complete in April. At that time, KMD began
preparing the 45 bid packages which were part of the fast track process. Ground breaking took place in that June.

Weak soil conditions and the need to reinforce the structure for earthquake protection complicated construction and necessitated the addition of shear wall reinforcement to the structure. This in turn required the re-routing and re-design of mechanical duct work. Coordination problems with the trades also slowed the project, and construction, that was supposed to take 24 months ended up taking 39 months.

Cost over-runs were another problem. According to Kibre, the low bids for most each work packages were over the estimates, and incrementally pushed the price above the $20 million budget. The final cost was $24.7 million, $23.7 million in design and construction plus $1.0 million in land and county costs.\textsuperscript{8} Square foot costs for design and construction, in 1987 Boston dollars, were $210.54. Because of cost overruns and coordination problems, the county decided not to use construction management fast track on future corrections projects.

\textsuperscript{8} From "Construction and Operating Costs, Staffing & Brief History of the Contra Costa County Detention Facility." 1982, updated 1985. Because the fast-track contracts were let over time, costs were escalated based on expenditures by year.
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