Toward a Theory of Organizational Elements

by

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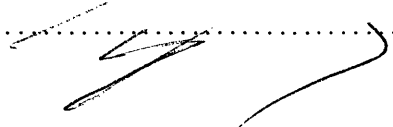in partial fulfillment of the requirements for the degree of
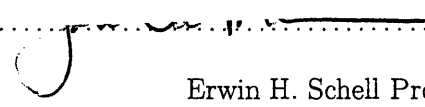
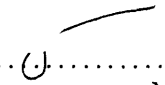Master of Science in Management

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Toward a Theory of Organizational Elements

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Abstract

Businesses are complex organizations with seemingly limitless interconnectedness and functionality. Organizational Charts are the limit to which many organizations consider their internal structure, while others build workflow models to identify and codify every keystroke and communiqué. In order to provide a middle ground between superficial Organizational Charts and elaborate workflow models, this thesis develops a simple and broadly applicable method of modeling organizations. In particular, ideas from computer program structuring are transplanted into organizational design.

Initially, a theory of Organizational Elements is defined. Then characteristics common to the elements of the framework are explored and a small set of example elements is identified and developed. Finally, the framework is applied to two example organizations and recommendations for further work are presented.

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Chapter 1

Introduction

In the two jobs I held prior to attending business school, I was involved in organizations which had problems for which I had no diagnosis or description. Divisions, managers and workers tripped over each other while going about their jobs; assignments did not get completed because it was not clear who or what was in charge of the assignment; reorganizations were undertaken with little effect on the functioning of the company. The water cooler buzzed with talk of what was *really* wrong with the company and what should be done to fix the problems, but the proposed diagnoses and solutions were myopically focused on the vocal employee's particular concern and not on the problems of the larger organization.

At the same time, I was reading a book about patterns that arise repeatedly in computer programming. Computer programs are made by designing the interactions between complex organizations of functions or objects. The book I was reading suggested that, although every program is unique, most of the basic functions and objects that it used were minor variants on a small set of basic computer programming patterns.

I wondered whether some of the troubles were due to unseen patterns of interaction underlying the organization. The exploration and development of this idea that *Organizational Elements* pervade human organizations is the subject of this thesis.
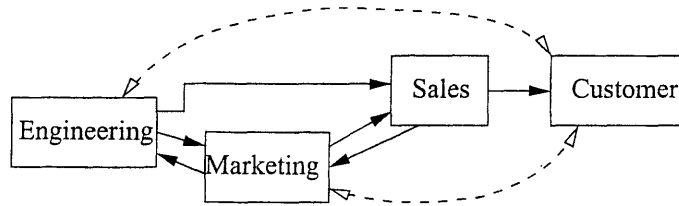
Figure 1-1: Patterns of Information Flow

1.1 The Organizations

In the first of the two jobs, I was a sales engineer, responsible for coordinating the technical support efforts for a large territory. Key to this job was intimate knowledge of my customers' needs and of the company's potential responses to those needs. This can be represented as in Figure 1.1, which shows how a fairly straightforward task with an obvious pattern of behavior and responsibility might be represented: information flows from Engineering and Marketing through Sales and out to a customer; Marketing also provides the return path through which information reaches Engineering.

However, as also shown in the figure, some information passed directly from Engineering and Marketing to the customer without touching Sales. Not informing Sales about every interaction with a customer is not necessarily a problem. For example, a customer-specific design might best be handled directly by Marketing and Engineering. In my case, the Sales organization expected to be involved in all customer communications, so, from Sales' perspective, the figure shows a set of interactions that does not represent the intended interactions. The Organization Chart did not give any guidance on how management intended for Engineering, Marketing and Sales to interact, and different managers felt that the groups should interact in different ways, so we repeatedly ran up against this problem.

In the second of the two jobs, I was a manager in engineering. Over a year period, our 200 person office saw 2 major reorganizations and 3 reductions-in-force (RIFs). Politics was an obvious factor in the reorganizations because those with the most political influence gained power with each reorganization and new people became Managers, Directors and Vice Presidents or were fired in the new organiza-

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tional structure. The interactions between people and groups within the organization, however, changed little.

1.2 Design Patterns

At the same time I watched my workplace flutter through structural changes, I began to read *Design Patterns*[1], a book which provides the rational for and develops a small set of computer programming patterns which now provide the basic functionality of much software. Some of the ideas presented in that book are crucial to the rational behind this thesis, so they will be quickly reviewed here.[1]

Until recently, computer software was developed without knowledge of these patterns and, while many successful programs were developed without design patterns, software components differed substantially between software providers and programmers. With the publishing of *Design Patterns*, most object oriented software began to use design patterns in development or was *refactored* to use the design patterns.

The design patterns provided general guidance for implementing generic, but very common and useful, functionality. For example, computer users are familiar with *folders* and *menus*. Although they are very different in functionality, the two have a strong similarity: they're both *containers*.[2] A *container* design pattern provides well-defined access methods, such as NumElements, Get, Set, Add, Remove, etcetera, to a group of objects, so any object that *instantiates* a *container* design pattern will have NumElements, Get, Set, Add, Remove, etc.

1.2.1 Ease of Comprehension

How is this useful to computer programmers? Before *Design Patterns* and the notion of industry-wide standardization of computer software components, a Macintosh computer programmer interested in learning how to work with folders and menus on a Windows machine had to learn a whole new set of terms and ways of doing things

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[1]The examples and ideas presented here have been adapted to the needs of this thesis and so may not mirror perfectly the usage of design patterns in computer programming.

[2]In *Design Patterns*, this might be called a List.

in this new environment. Now, while a programmer has to learn many new things, she sees similarities: when she works on a list of files in a file folder, she works on a FileListContainer; when she works with the menu items, she works on a MenuItemContainer. Are these two *containers* identical? Absolutely not, but the methods used to get the number of elements and get, set, add, and remove components are identical.

The programmer can now make assumptions about the functionality of any component that is called a *container*. If she learns about a NiftyContainer, she already knows how to interact with the Container, so she has only to learn about how a NiftyContainer differs from a Container.

1.2.2 Ease of Extension

Another benefit of design patterns is the ease with which a program's functionality can be extended or modified. If a Container is well defined, then new design patterns which operate on a Container can be defined. Consider a Retriever[3] which is defined to retrieve items from a Container: Next and Previous cause the Retriever to retrieve the next and previous items from a Container. Because everyone designs and implements Containers in largely the same way, this Retriever will work on any Container.

How is that useful? This common understanding can be used extend the functionality of the system without requiring additional learning on the part of the programmer. Since everyone understand Container and Retrievers now, when a RandomRetriever or ReverseRetriever is introduced, their functionality can be grasped intuitively: a RandomRetriever probably returns a random element from the Container; a ReverseRetriever probably returns the elements from the Container in reverse order.

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[3]In Design Patterns, this is called an Iterator.

1.2.3 Requirements

The following sections detail the necessary, though not sufficient, conditions which make design patterns useful to computer programmers.

Language

If one program called something "Container" while other programs called it Iterator, List, Storer, Cup, Box, Trunk or ThatWhichHoldsThings, then programmers would spend more time learning and thinking about vocabulary than thinking productively about how to design the program. A common design pattern language allows for the rapid identification of the majority of a component's functionality.

Assumptions

If one company used a Container to hold any object while another used a Container to hold only files and a List to hold only numbers, then the task understanding different systems becomes substantially more difficult. The ability to *assume* evaporates and the programmer must learn each component of each system without making any assumptions about its functionality: a Retriever usually works on Containers, but this system uses Containers and Lists, so does this other system's Retriever operate on Containers, Lists, both or none?

Non-Overlapping and Modular

The functionality of individual design patterns should not overlap the functionality of other design patterns and design patterns should be modular. With these requirements, design patterns become building blocks which can be grossly segmented[4] and then bolted together to form interesting functions without duplicating functionality.

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[4] *Design Patterns* segments patterns into creational, structural and behavioral groups.

Minimal Set

If the purpose of design patterns is to provide programmers with a common set of guidelines with which to develop software components, it makes sense to keep the set of patterns as small as possible in order to ease memorization and understanding. The 80/20 rule applies: rather than develop a comprehensive set of patterns to guide the development of every program component, develop a small set which guides the development of 80% of program components. If a programmer needs to implement functionality not defined by a design pattern, he can implement it by building a composite of design patterns or by creating a custom component for that function.

1.3 This Thesis

My experiences with professional organizations suggested that:

> In principle, organizations have internal structures defining the relationships between and functions of its groups.

Design Patterns examined computer programs and programming, and found that:

> Computer programs have internal structures defining the relationships between and functions of its components. These structures, or design patterns, are few in number and invariant across programs, so they can be identified and cataloged in order to ease the understanding of the structure of complex programs.

Applying the ideas from *Design Patterns* to organizations yields the hypothesis for this thesis:

> Organizations have internal structures defining the relationships between and functions of its group. These structures, or *Organizational Elements*, are few in number and invariant across organizations, so they can be identified and cataloged in order to ease the understanding of the structure of complex organizations.

Therefore, this thesis takes a notion derived from a computing concept and transplants it into the management and organizational sciences domain. As this is an expansive topic, this thesis is an investigatory step in the process of attempting to develop a coherent theory of Organizational Elements.

1.3.1 Bias

My background is in computer science and electrical engineering and my work experience is in the development and sales of semiconductors, so this thesis is biased toward examples and explanations consistent with that background.

1.3.2 Method and Structure

Due to its exploratory and analytic nature, the method used to develop the thesis is reflected in its organization:

- *Chapter 2: Definition* - Related disciplines are explored; a definition of Organizational Elements is created.

- *Chapter 3: Characteristics* - characteristics common to all OEs are presented along with guidelines for modeling using OEs.

- *Chapter 4: Example Organizational Elements* - a set of example OEs is described.

- *Chapter 5: Case Studies* - the OEs described in Chapter 4 are applied to two cases studies.

- *Chapter 6: Conclusion* - based on the work of the previous chapters, further avenues of exploration for OEs are identified.

1.3.3 Human Organizations and Computer Programs

The fruit fly, *Drosophila melanogaster*, is used as a very high clock speed method of studying biology [2]: studying many generations of fruit fly can yield valuable insights

into the biologies of more complex creatures. Flies are not people and computer programs are not groups of people, but each is arguably similar enough to lend insight into the other.

In this thesis, computer programs are my *Drosophila melanogaster*: computer organizations are generally composed to undertake simple millisecond-, second- or minute-long tasks, whereas human organizations are composed to conduct complex month- , year- and even decade-long tasks; it is cheap to undertake many design-try-fail-design-try-fail-... cycles per day with computer organizations. But it is difficult and expensive to change the structure or function of human organizations.

Computer program organization is a well studied problem for a simple reason: nearly every part of the computer ecosystem, including software, doubles in power or speed or capacity every year or two, so reducing the complexity of computer program organization allows increasing complex programs to match the advances in hardware. How to organize complex computer programs was a good thing to know when computer programs used punch cards; however, now that computer programs run across servers scattered around the globe, use a variety of programming languages and depend on other peoples' or companies' computer programs, how to organize complex computer program is essential knowledge for every programmer.

Analogous to the historical evolution of computer program organization, the understanding of the structure of human organizations was a luxury when small, simple organizations gathered and stored grain; now that organizations are distributed, multinational enterprises with interlinked supply chains and complex interdependencies, understanding organizational structure is essential for every manager.

1.3.4 Politics, Culture and Structure

Although this contribution clearly fits into the "strategic design" camp of the organizational sciences and largely ignores the organizational effects of politics and culture, it is not intended to argue for the superiority of strategic design over cultural, enacted or political design. Organizational Elements are intended to make the job of strategic design easier, thereby easing the entire organizational design process.

Cultural and political factors exert strong forces on organizations and cannot be ignored in real life. The ideas presented in this thesis relate to cultural and political factors in the following two ways:

- Organizational Elements should provide a clearer picture of the *intended structure* of an organization, which might highlight areas of the organization in which political or cultural factors are pulling an organization out of its intended shape.

- Along with identifying the structural effects of Organizational Elements, it may be possible to identify common political or cultural attributes or side-effects to which they are susceptible, thereby easing the prediction or identification of political or cultural forces within a particular organization.

Chapter 2

Definition

Patterns exist in all things, and finding and categorizing the patterns can yield substantial benefit. As an example, simple letters and articles are often drafted using a pattern of Introduction-Argument-Conclusion. Without knowledge of this simple pattern, the writer's task becomes considerably more difficult because they must first discover how to structure a convincing argument while also developing the argument itself. As a reader without knowledge of writing patterns, every composition must be examined as a wholly unique entity before the ideas expressed within can be understood. On the other hand, if a writer uses a known writing pattern to structure the document, then the reader can easily follow the document's structure and concentrate instead on understanding the writer's ideas.

As a common knowledge of writing patterns eases the ability of readers and writers to communicate, Organizational Elements (OEs) are intended to provide a common set of components with which to model, understand and communicate the structural design of organizations. Given that every organization of people, companies or industries is at least partially unique, the ability to define common organizational elements would depend on whether or not there are structures or *elements* which are common to all organizations and industries.

In fact, informal organizational structure descriptors are hidden in plain view: titles, such as manager or engineer, and division names, such as sales or manufacturing, are commonly used to describe organizational structure. However, the structure

implied by these titles are poorly specified. How does the Sales organization in a semiconductor organization differ from a Sales organization in a retail clothing store? How are Segment Marketing, Marketing Communications and Product Marketing related? In each case, terminology ("sales" and "marketing") suggests a strong similarity between the organizations, even though the organizations are quite different.

Because the terminology used to describe organizations is imprecise, we depend on experience with an organization to inform us of the general function of any one piece of the organization. This thesis provides a framework by which commonalities in an organization can be identified and codified in order to yield a more precise language for describing organizations.

2.1 Related Concepts

Organizations have a substantial body of literature dedicated to their care and feeding. The notion that an organization's structure can be described and modeled is not new. Before discussing OEs, I will discuss concepts which are complementary to the idea of Organizational Elements and provide motivation for research into this new area of organizational design.

2.1.1 System Dynamics

System Dynamics[3] was developed to bring quantitative analysis and simulation to widely varied, difficult problems. Figure 2-1 shows an example model of a sales business process taken from an example diagram included with Vensim, an SD modeling tool[4]. This model includes a fairly comprehensive description of the problem, including flows ("pot. order creation"), stocks ("Potential Orders") and variables ("duration of negotiation"). The model also includes difficult to quantify variables such as "effect of advertising". Using this model, a modeler could infer real world effects by exploring how changing different variables affects the model ("The model is highly sensitive to the effectiveness of advertising, which suggests that using a better advertising company could increase our sales").
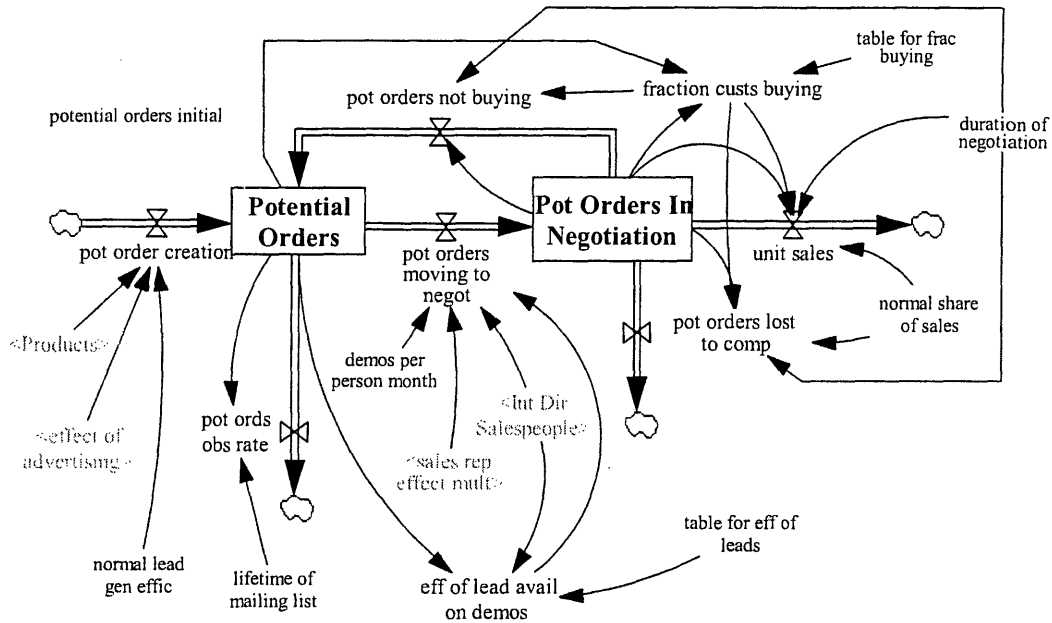
Figure 2-1: Vensim Sample SD Model of a Sales Business Process

One issue preventing the usage of System Dynamics for organizational modeling is that it focuses on modeling specific problems and not systems. This simplification is necessary because the number of variables necessary to fully describe a system is nearly infinite, while the number of variables necessary to describe a specific business problem is limited. Per John Sterman[5]:

> Beware the analyst who proposes to model an entire business or social system rather than the problem. ... For a model to be useful, it must address a specific problem and must simplify rather than attempt to mirror an entire system in detail.

Because System Dynamics is focused on dynamics, it models variables and does not directly consider organizational structures and boundaries. This is contradictory to the objectives of Organizational Elements, which focuses the model on the *structure* of an organization while not examining dynamics and variables.

Another issue preventing the usage of System Dynamics in organizational modeling is the steep learning curve: to the untrained, a SD model is not intuitive. Were SD used to model an organization, only the modeler and those knowledgeable in SD
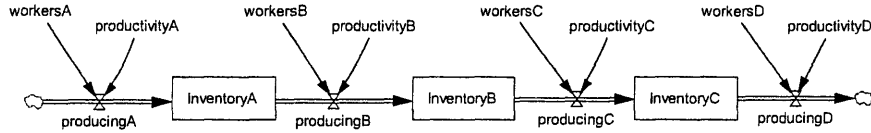
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Figure 2-2: Doing Work Cascade Molecule

would be able to understand and use the model, preventing the model from becoming a generally usable representation of the organization.

Molecules

Jim Hines, a professor at MIT Sloan School of Management, has undertaken to identify and catalog common patterns within the organization of SD models.[6] Professor Hines argues that Molecules provide a SD practitioner with simple model patterns, allowing the modeler to focus on the system under consideration rather than on how to model it.

As an example, consider a production line that converts an input to an output by processing it through multiple stages, each with its own workers and productivity. Other processes (e.g. population growth, product design cycles, etc.) might use a similar model structure, so the SD Molecule shown in Figure 2-2 provides a generic structure to be used in any model.

Organizational Elements are intended to provide a similar perspective to organizations as Molecules do to System Dynamics.

2.1.2 Workflow

Workflow systems focus on identifying and codifying the interactions between tasks, information and documents in an organization. These interactions can then be strung together in order to define a workflow. A simple issue management workflow is shown in Figure 2-3.[7] Workflow benefits claimed include[8]:

- Improved efficiency: automation of many business processes results in the elimination of many unnecessary steps.
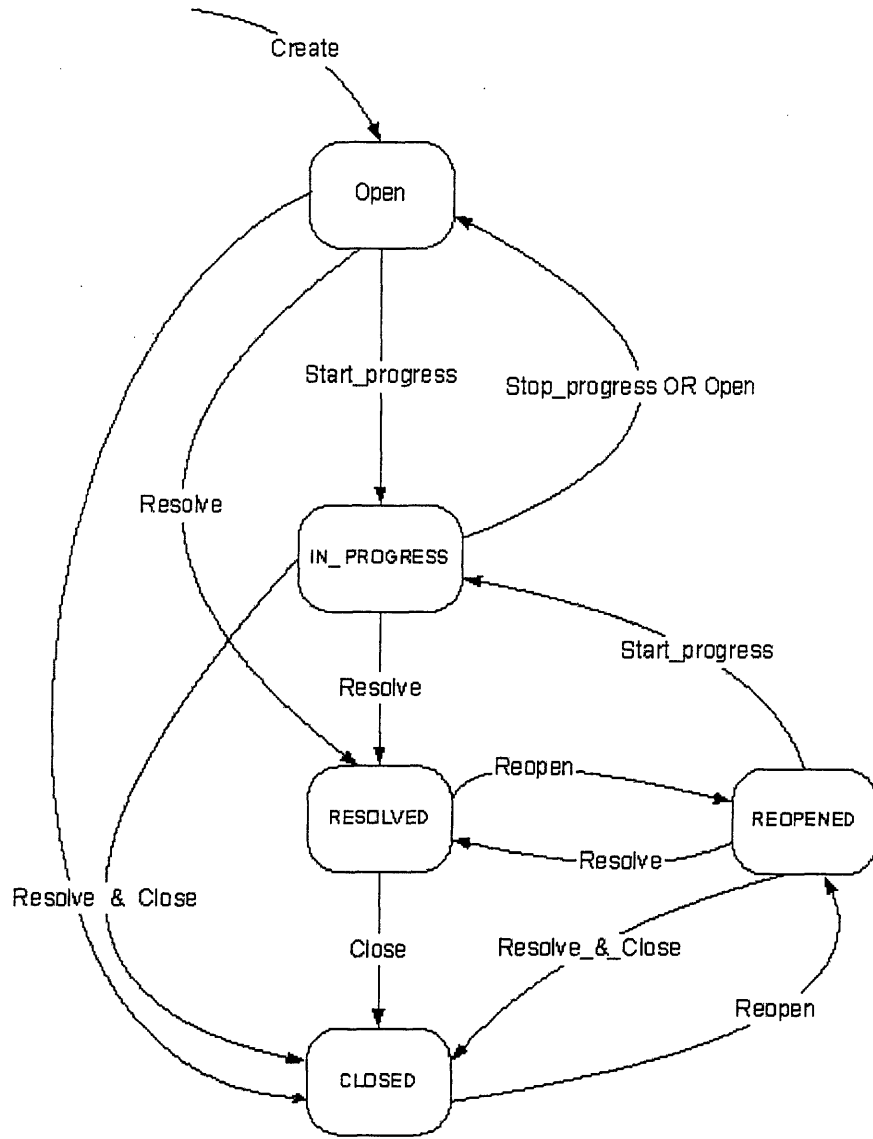
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Figure 2-3: A simple workflow example

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- Better process control: improved management of business processes achieved through standardizing working methods and the availability of audit trails.

- Improved customer service: consistency in the processes leads to greater predictability in levels of response to customers.

- Flexibility: software control over processes enables their re-design in line with changing business needs.

- Business process improvement: focus on business processes leads to their streamlining and simplification.

Workflow analysis shines in areas where a relatively fixed sequence must be followed by a number of different system components. Consider a computer support call center. Many different systems, including computer, human and communications, must be synchronized for the system to function. Workflow planning can help create an over-arching specification around which all of the system elements can be designed.

Work has been done on identifying workflow patterns, but the generated patterns are very specific to the types and timing of the interaction. For example, in one attempt to identify workflow patterns, the "Deferred Choice" pattern[9] specifies a workflow element which executes one of the two alternatives threads. These details are too specific for large granularity modeling of an organization and its intentional design.

Another example of an attempt to identify workflow patterns is the APQC Process Classification Framework (PCF)[10], a comprehensive list of sub-processes that was developed as an open standard to facilitate process management and benchmarking regardless of industry, size, or geography. However, the PCF includes hundreds of processes, some as "specific" as "Create Press Releases", "Promote Political Stability" and "Understand Ecological Concerns", thereby preventing memorization of the patterns and limiting itself to usage in detailed modeling projects by those who are experienced in using the framework.

		Asset Type			
		Financial	Physical	Intellectual	Human
Asset Right	Ownership-Significant Transformation	Entrepreneur	Manufacturer	Inventor	Human Creator
	Ownership-Limited Transformation	Financial Trader	Wholesaler/ Retailer	IP Trader	Human Distributor
	Use	Financial Landlord	Physical Landlord	Intellectual Landlord	Contractor
	Matching	Financial Broker	Physical Broker	IP Broker	HR Broker

Table 2.1: MIT Process Handbook business models

Although the theory of Organizational Elements provided in this thesis is closely related to the workflow patterns discussed above, the goal of OEs is to provide a more generic framework with which to quickly and easily model organizations' major characteristics.

MIT Process Handbook

The MIT Process Handbook[11] is a compendium of workflow processes which includes a top level categorization, shown in Table 2.1, by business model. These categories are useful for understanding a business as a complete entity, but they are not designed for identifying the multiple linked elements within an organization.

2.1.3 Organizational Patterns

Since the notion of Design Patterns is strong in the computer science community, some computer science professionals have begun to categorize software development tasks and behaviors into patterns. One effort, Organizational Patterns[12], has defined a large number of patterns focused on product development organizations. The complete chart of Organizational Patterns is shown in Figure 2-4[1]. Examples of

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[1]Much of this chart is too small to read. It is included in this form to show its complexity and number of elements. Important portions are magnified for readability.

Figure 2-4: Organizational Patterns and their relationships

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elements in the figure include:

- *Hallway Chatter*: Move team members physically as close to each other as possible. Be sure that people with outer roles are located close to the central roles.

- *Self-Selecting Team*: Create enthusiastic teams by empowering people to self-select their teams. Do limited screening on the basis of track record and broader interests.

- *Smoke-Filled Room*: Make the decision among power brokers as in the storied smoke-filled rooms stereotypically associated with tycoon businessmen.

As with Work Flow, the approach taken in Organizational Patterns generates an overwhelming number of components. And the loose approach to taxonomy of the patterns leads to patterns which, although very descriptive, are not suitable for describing one business function's relationship to another. As such, Organizational Patterns seem to function more as management recommendations or advice than as analytic tools for the structure of an organization.

2.2   Terminology

Throughout this thesis, the following terms, represented in Figure 2-5, are defined as:

- Organization: a group of business functions.

- Business Function: the specific function (e.g. marketing, sales, shipping) performed by a group of people within an organization. As shown in the lower portion of the figure, a business function can be composed of "nested" business functions, so it can also be an "organization".

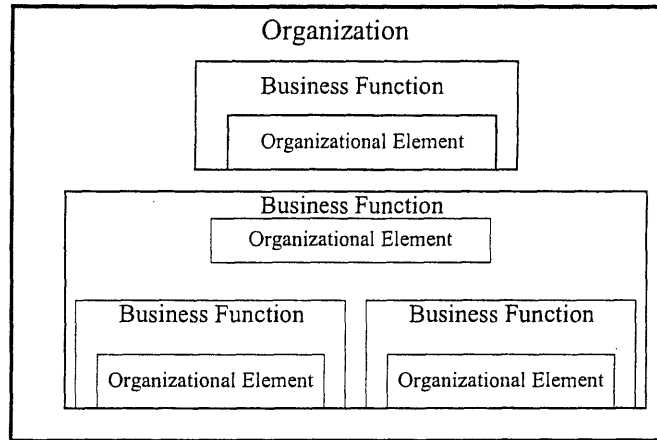- Organizational Element: a generic business function which is embellished to describe a specific business function.

Figure 2-5: The relationship between organization, business function and Organizational Elements

2.3 Thesis Objective

This thesis argues that organizations are composed of combinations of a limited set of fundamental Organizational Elements. If a theory can be developed that helps to discover these elements, then the elements can be characterized and used to model organizations, irrespective of the organization's industry or particular business model.

The objective of proposing Organizational Elements is to provide a small set of generally applicable elements and tools which are intended to simplify the design, comprehension and analysis of organizations. In order to do so, the concept of Organizational Elements must have a certain set of characteristics:

- Intention: OEs are incomplete descriptions of organizational structures, so they communicate a element's *intended function* and not a comprehensive description.

- Generic: OEs are used to model a wide range of large scale organizational interactions, not to model fine scale transactions, so OEs should be generic.

- Structural: OEs represent groups of people performing a function within an organization.

- Intuitive: people throughout an organization should be able quickly grasp the

organizational intention communicated by an OE model.

- Minimal: the set of OEs should be small to facilitate memorization and applicability.

2.3.1 Intention

Much as a corporation's mission statement provides general guidelines for its behavior, an organizational chart using OEs provides general guidelines as to the functioning of a firm's components. Mission statements are not designed to define precisely the actions that are taken in every situation and, likewise, OE charts are not designed to define precisely how organizational components are to interact.

OEs signal the *intention* of the organization by making explicit the assumptions and mental models that guide interaction within an organization. An understanding of the organization's intention can be gained from understanding the arrangement of the OEs in the organization.

2.3.2 Generic

Other approaches to characterizing business functions (see Section 2.1.2) focus on characterizing business functions *first* by the organization in which that business function is used. Such taxonomies might start with the organization (e.g. Market and Sell Products and Services), then break each of those into more specific functions (e.g. Develop and Manage Customer Strategy) and further into even more specific functions (e.g. Establish Customer Management Goals).

This thesis' approach to taxonomy taken in is markedly different: OEs are part of a generic taxonomy of organizational elements, each of which represents the core functionality of a business function without including attributes specific to a particular business or industry. Organizational Elements (Adaptors, Consolidators, etc.) are not unique to specific business functions (e.g. Sales, Marketing, etc.).

Because OEs are generic, they can be used to classify dissimilar organizational structures. For example, Table 2.2 shows an arbitrary set of organizational functions

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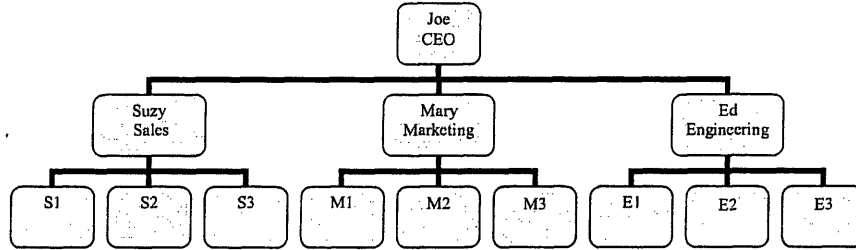| Business Functions	Sales	Shipping	PR	Accounting
Training			X	
Manufacturing		X		
Customer Service	X			
Inbound Marketing				X
	Adaptor	*Transformer*	*Distributor*	*Consolidator*
	Organizational Elements			

Table 2.2: Example OE Mapping

Figure 2-6: Basic Organizational Chart

[Training, Manufacturing, Customer Services, Inbound Marketing] mapped against another set of organizational functions [Sales, Shipping, PR, Accounting] and corresponding OEs [Adapter, Transformer, Distributor, Consolidator].

Unlikely as it may at first seem, there are substantial similarities between functions as different as Marketing and Accounting or PR and Training[2]. From the perspective of Organizational Elements (shown below the table), both Inbound Marketing and Accounting typically take a variety of inputs (financial or marketing data) and consolidate them into a single output (a financial report or a recommendation for future products). Likewise, PR and Training take an input (positioning materials and teaching material, respectively) and broadcast it to a range of receivers (media outlets and students, respectively).
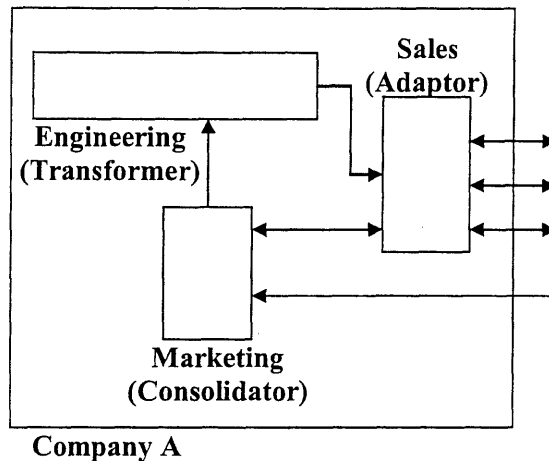
Figure 2-7: Simple Organizational Element Chart

2.3.3 Structural and Intuitive

Figure 2-6 shows an organizational chart. The hierarchy in this simple company is clear. The links between groups, however, are left to the imagination of people within an organization or, at best, are guided by "common knowledge". How is engineering linked to customers? Should marketing use information from sales in developing its forecasts? These questions are left unanswered by the organizational chart.

If the above organizational chart could be redrawn to show the relationships and interactions between groups, it could provide a clearer view of the manager's intention for interaction in the organization. Using functional blocks instead of reporting relationships, Figure 2-7 diagrams the same organization as in Figure 2-6. While the organization chart diagrams the hierarchy of the organization, the Organizational Elements chart shows a reasonably intuitive view of how groups within the organization are linked:

- Sales acts as a conduit between customers and the organization.

- Marketing takes inputs from the outside world and from Sales, and passes them

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[2]Characterizing two functions with the same OE (Traning=PR=*Distributor*) implies that the two have *common* functionality. It does not mean that they are identical business functions. This will be addressed in more detail in the following chapter.

into Engineering.

- Engineering works with Marketing to develop new products and with Sales to sell the products.

The Organizational Elements used in Figure 2-6 are not defined until Chapter 4, but the interpretation of the elements in the simplified figure is not complicated. Three of the five Organizational Elements defined in this thesis are used in the figure and describe the organization as follows:

- Sales acts as an "Adaptor", providing an interface between customers and the internal groups. Although Sales should equally weight the interests of both groups, but a common problem with Adaptors is a tendency to favor one group over another.

- Marketing acts as a "Consolidator", an element that takes a disparate set of inputs, consolidates them and presents them to the organization. Consolidators should pay equal attention to each of their inputs, however, managers must pay close attention that a consolidator does not favor or ignore any inputs.

- Engineering is a "Transformer", an element that takes an input and uses it to produce an output. In this case, Engineering is using information from Marketing to guide development of new products. Similar to the Consolidator, Transformers sometimes ignore guidance at their input in favor of producing their preferred output.

Combining the organization chart with the OE chart provides a view of the organization's hierarchy, structure and function. As mentioned in the previous chapter, absent are representations of political power, cultural power and size or strength of each business function. It might, however, be easier now to identify inter-business-function issues, such as how a breakdown in communication between Sales and Marketing might affect the organization's functioning.

2.3.4 Minimal

While it is possible to create a detailed pattern for each specific business function (see Section 2.1.2), a comprehensive taxonomy of specific business functions would become overwhelmingly large and, at the same time, less useful.

This thesis' approach to taxonomy focuses on identifying commonalities between business functions while ignoring specific business information and context. This allows the number of OEs in the taxonomy to be *reduced* while the number of functions encompassed by the set of OEs is increased. In the case of Table 2.2, this simplification allows eight different business functions to be categorized using only four of the five OEs.

Chapter 3

Characteristics

This chapter defines the characteristics common to all Organizational Elements. Chapter 4 will then use these characteristics to specify a set of Organizational Elements, or generic production functions, which can be used to represent the functional units of organizations.

3.1 Basic Characteristics

3.1.1 Generic

As discussed in the previous chapter, the key characteristic to Organizational Elements is that they are not specific to industries, geographies, functions, etc. OEs offer a a limited set of structural components with which to model organizations by
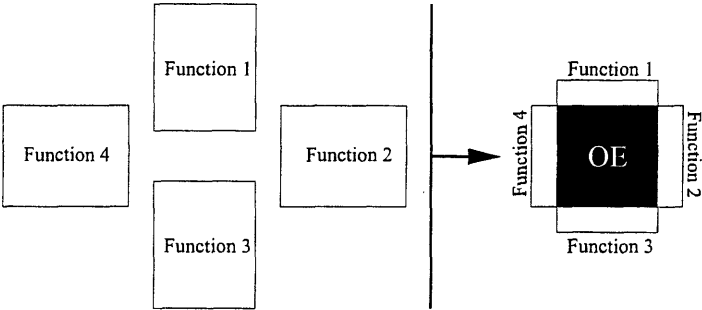

Figure 3-1: OEs Capture Commonality

capturing only commonalities between different business functions.

This can be represented as in Figure 3.1.1, in which Functions 1, 2, 3 and 4 are assumed to be different business functions which have substantial functional commonality. An OE captures the 80% of each function that is common across the functions, leaving 20% of each function to be tailored in the specific organization.

Whereas some efforts at characterizing business patterns capture specific business attributes, inputs or outputs[11], OEs do not capture the assets, income, employees or processes used by a specific business group. Instead, generic classifications, such as tangible or intangible, are used to define inputs and outputs. This way, OEs can be generic relative to any industry or business function.

3.1.2   Scale Invariance

OEs are scale invariant and can model organizations as small as a sales group or as large as a multi-billion dollar company. The scale invariance is due to the generic nature of OEs. By excluding specific business process information within an OE, one OE can be used to model a variety of different business functions. For example, a Consolidator (defined in Chapter 4) could be used to describe a small marketing group that gathers data on a target market, an accounting department that consolidates financial data from across a large business or an entire specialty retail company that sources goods from a variety of suppliers.

That OEs are scale invariant does not mean that an organization which changes its size should model the organization using the same set of OEs as it used before it grew. As an organization grows its mix of internal functions may change, thereby necessitating a change in the OE model. For example, consider the simple OE chart from the previous chapter (repeated in Figure 3-2). This company has modeled its sales function using an Adaptor because the sales function handles all types of sales accounts. As the company grows, the sales function may need to be broken into two separate function/OEs, one for large accounts and one for small accounts. instead of simply growing with the company.
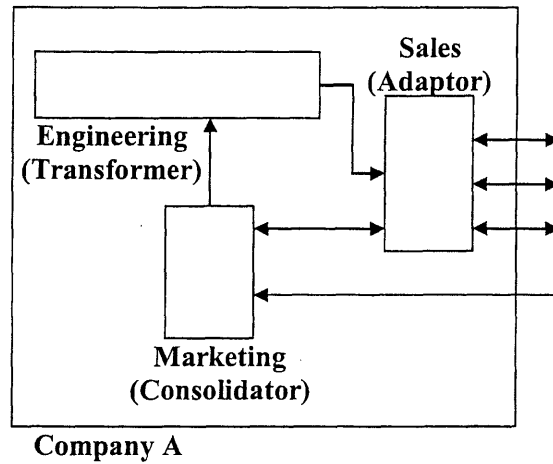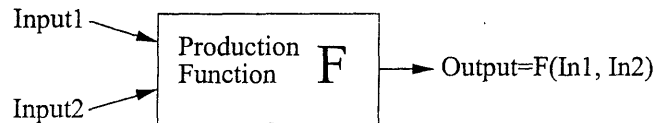
Figure 3-2: Simple Organizational Element Chart

Figure 3-3: The Economic Production Function

3.2 Inputs and Outputs Define OEs

The number and types of input and outputs along with the assumption that each OE represents a production function are the primary characteristics by which this thesis defines the individual Organizational Elements.

3.2.1 The Production Function

Economics represents "the relationship between the inputs to the production process and the resulting output [...] by a production function."[13] A production function that uses two inputs, *Input1* and *Input2*, to obtain *Output* using production function F can be diagrammed as shown in Figure 3-3.

This thesis adopts the production function as the abstract basis for the taxonomy of OEs and views production efficiency as the fundamental force working to define the structure of organizations. Although there may be many other forces operating

to define an organization's structure, the organization must produce or accomplish something useful by assembling widgets, thinking up clever new ideas, coordinating information flow, etc.

In theory, the exact functions converting inputs to outputs could be determined and used to guide evaluation of the business unit's performance. However, rather than focus on the quantitative aspects of the economic production function, OEs take a *qualitative* view, focusing on the organizational attributes of a small set of common production functions.

The term "production function" suggests a production line handling bits of metal or plastic as inputs and outputs. It is used with OEs, however, to mean "What input interactions and output interactions must an Organizational Element have in order to complete its intended function?" The interactions can be material, as with bits of metal in a production line, or immaterial, as with information provided by the sales organization to the marketing organization and requests handled by a company's Investor Relations organization. In each case, the intended "production function" cannot be completed without access to certain inputs and outputs.

3.2.2 Number

The number of inputs to and number of outputs from an OE are its primary characteristics. An OE may take *0, 1* or *n* inputs and may produce *1* or *n* outputs. (According to the taxonomy presented in this thesis, a *properly functioning* OE must create something of value to the organization, so OEs may not have *0* outputs.) This categorization is shown in Table 3.1 and detail on each OE may be found in Chapter 4.

The comprehensive sets of inputs and outputs to any organizational unit are more complicated than can be easily diagrammed. From a system modeling perspective, it would be interesting to determine exactly the function F from Figure 3-3, but, from an organization modeling perspective, it is enough to decipher which inputs and outputs are responsible for the majority of an organization's functioning. Does the inclusion or removal of an input or output change the function of an organization? If

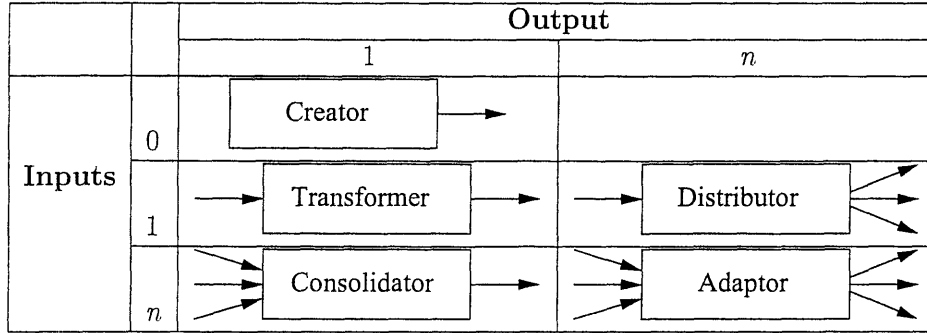|		Output	
		1	n
Inputs	0	Creator →	
	1	→ Transformer →	→ Distributor →
	n	→ Consolidator →	→ Adaptor →

Table 3.1: Taxonomy of Organizational Elements

so, that input should be included in the model.

For example, although an accounting department takes in a wide range of inputs (salaries, office supplies, etc), a single class of input, organization-wide accounting data, is the focus of the accounting department. The other inputs are important, but they do not affect the organizational purpose of the accounting department. Similarly, the accounting department provides a range of outputs (group employee evaluations, annual reports, etc), but a single class of output, processed accounting data, is measured to determine the performance of the accounting department. Therefore, OEs consider *classes* of inputs and outputs which are essential to the functioning of the OE.

3.2.3 Types

The type of each input and output is important to identify how a particular OE will behave.

If an input or output to an OE handles material goods, such as computer components or cargo, then the largest concern for that input or output is its ability to estimate correctly the flow of goods and to handle that flow. In the case of a warehouse modeled as a Transformer, this means that the warehouse must be concerned with its ability to handle the flow of goods to and from the warehouse along with the storage of goods.

If an input or output to an OE handles non-material goods, such as information,
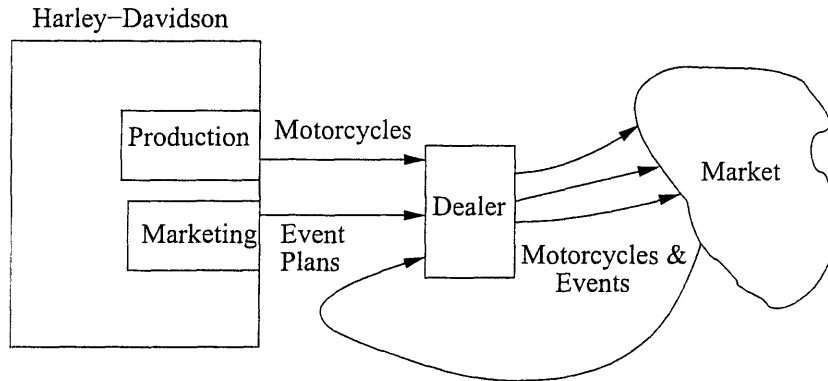
Harley–Davidson

Figure 3-4: A basic diagram of Harley Davidson's dealerships

then the largest concern for that input or output is to verify that the information is needed by and used in the OE. In the case of a market research group modeled as a Consolidator, this means that the market research group must verify that the market research information output accurately reflects the research conducted. Otherwise, it would be easy for market research group personnel to taint the market research information with their own opinions.

3.3 OE Selection

Modeling an organization using OEs requires careful selection and arrangement of the OEs. Because the model represents the organization's subjective intention, there are multiple correct way to model an organization. This section will outline guidelines for OE selection and modeling.

3.3.1 Scope

Scope refers to the set of inputs and outputs to and from the business function represented by an Organizational Element. The scope over which an OE is used should be broad enough to encompass the business function and narrow enough to limit the number of inputs and outputs to only those necessary to determine the business unit's function.
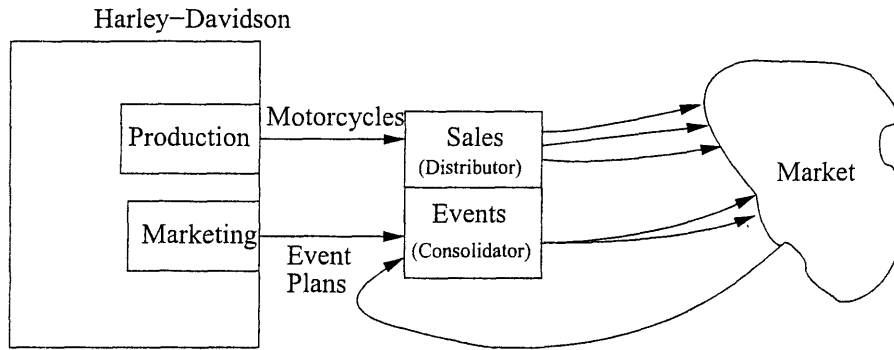
Harley–Davidson

Figure 3-5: An improved diagram of Harley Davidson's dealerships

As an example of scoping for OEs, consider Harley-Davidson relationship to its dealers. A first-pass model, as shown in Figure 3-4, suggests that a Harley-Davidson dealer:

- Takes input from Marketing (marketing information, promotional materials), Production (motorcycles) and the dealer's target market (market specific information);

- Has multiple outputs (motorcycles, bike trips, information) back to the market.

Clearly, the dealer takes a group of inputs and provides a group of outputs, but the figure is unclear about how inputs relate to and affect the outputs. The scope of the chosen OE is too broad, causing the OE to encompass inputs and outputs which are unrelated to each other.

If the above model is restructured to more closely represent the linkages between inputs and outputs, Figure 3-5 results. This figure suggests that a Harley-Davidson dealer:

- Has a sales function that acts as a Distributor OE in order to take delivery of motorcycles from Harley-Davidson and sell/distribute those motorcycles to the market.

- Has a events function that acts as a Consolidator OE, which takes input from Harley-Davidson's marketing group and dealer-specific knowledge of the local market, and produces events relevant to th dealer's market.

3.3.2 Information Back-Flow

Although inputs and outputs denote the direction of interaction, *information* also flows in the direction opposite to that of the interaction. By taking inputs from one OE, the consuming OE implicitly provides the sourcing OE with an information source.

Manufacturing production lines provide a clear example. Consider a product line segment that takes inputs from an upstream segment; the upstream segment clearly derives information to guide future widget production decisions from examining the input widget flows to its client OEs.

Less tangible examples are also available. If a product development team increases its usage of the patent law department of a corporation, information about the effectiveness of the interaction is provided to the product development team. If the product line gets information back-flow suggesting they are not submitting useful patents, they might increase its internal patent training. When a marketing department provides marketing information to the sales department, the marketing department should receive feedback on its marketing information. Engineering and market organizations use information passed back from the sales organization to guide future engineering and marketing efforts.

Information back-flow should be an expected part of the OE and separate OEs to capture the information back-flow do not necessarily need to be set up. However, when the information implicitly provided by an information back-flow is crucial to the functioning of the OE, it is advisable to model the contrary information flow as an input or output in order to explicitly capture the information and signal that OE should consider this input or output as crucial to the functioning of the OE (see Section 4.3.2 for an example). This is especially useful when the the information back-flow controlling business function might hoard information or might not consider the information important even though it's important to the larger organization. A very common method of addressing the aforementioned problem is to force the business function to generate reports encapsulating the information back-flow (e.g. weekly
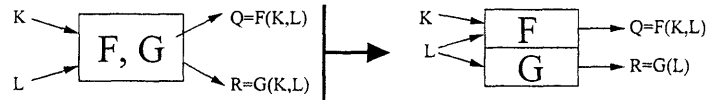
39

Figure 3-6: Splitting an OE

customer call reports for sales).

3.3.3 Confounding Factors

The left side of Figure 3-6 shows an OE with two outputs, each of which is dependent on both of the inputs. If some of the outputs are not dependent on all of the inputs, then diagramming the OE in this fashion could create *confounding factors*, in which inputs and outputs appear to be causally related but are not.

In order to avoid confounding factors, the single OE would be better represented by two separate, simpler OEs. This is shown in the right side of the figure. Now it is clear that, although one organization (or group of business functions) services both inputs and outputs, the organization is comprised of two separate OEs.

In the first Harley-Davidson figure above, the dealer took market information, motorcycles and event plans and provided motorcycles and event plans. It was not clear how the various inputs and outputs were related. In the second Harley-Davidson figure, splitting the function in two made it clear that motorcycles were handled by the Sales team, while events were generated by the Events team using input from the market and from Harley-Davidson.

3.3.4 Input/Output Triage

It is tempting to include every input and output to a business unit when choosing an OE representation. This will drive models to use Adaptor (a pattern which adapts a dissimilar group of inputs to a dissimilar group of outputs) to represent every business unit. Doing so clouds the model and provides little information about the intention of the organization: it is already known that, in reality, each business function is complicated and has a number of inputs and outputs. Inputs and outputs
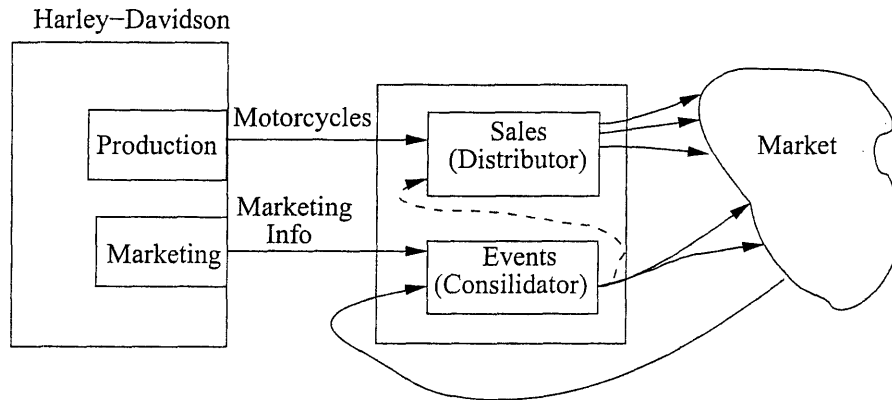
40

Figure 3-7: A Secondary Input to the Dealer's Sales Organization

to an OE should only be those required by the OE's intended function.

In the Harley-Davidson figure, the model is simple, but the organizational intention is clear. At the same time, "major" inputs and outputs are missing, including salaries, loans, personnel, office supplies, rent, etc. These inputs are important for the functioning of each business unit, but they do not represent the intention of each business unit.

3.3.5 Secondary Inputs and Outputs

In some cases, the organizational model would benefit from including inputs or outputs which are not of primary importance to the OEs in the model. Secondary inputs or outputs are those which are useful to model intention, but are not required. Figure 3-7 shows such a case, in which Sales receives input, in the form of marketing information and event schedules, from the Events organization. Sales benefits from the input from the Events organization, but Sales' basic function remains the same with or without the input from the Events organization.

3.4 Nested OEs

While an organization may have a top level representation of a single OE, the business functions within that organization may be represented by different OEs.
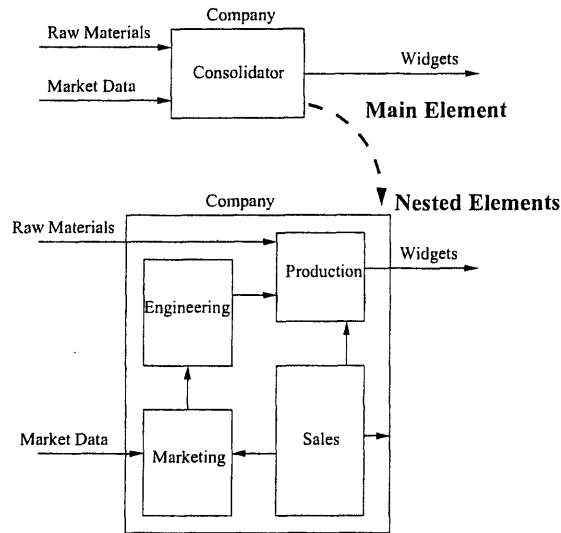
41

Figure 3-8: A Firm's OE and Its Nested Elements

For example, Figure 3-8 shows a product development firm that is represented by a Consolidator. The firm takes inputs of raw materials and market data and outputs widgets. The various business functions nested within the product development firm, namely engineering, marketing and support, are not required to be Consolidators, too. The nested business functions should use OEs that are appropriate for their individual business function.

The composite function of the nested organizations should be similar to that of the larger organization, but it need not be exactly the same. In the above example, the combination of nested elements does not exactly perform the Consolidator function of the firm. The output of the Sales organization does not appear in the firm's OE, because sales effort is not something that is a primary function for the parent element.

Chapter 4

Example Organizational Elements

This section describes the characteristics of each Organizational Element listed in the previous chapter. For each OE, a description, example usages, metrics and caveats will be presented.

Common Metrics

Although each OE is different, the metrics by which they are measured are largely the same. There are two major metrics: transfer efficiency and service levels.

Transfer efficiency refers to the OE's efficiency at producing it output(s)from its input(s). Measures might include time to transfer, inventory level, profit, performance-to-plan, etc.

For example, an OE that produces accounting information could be measured

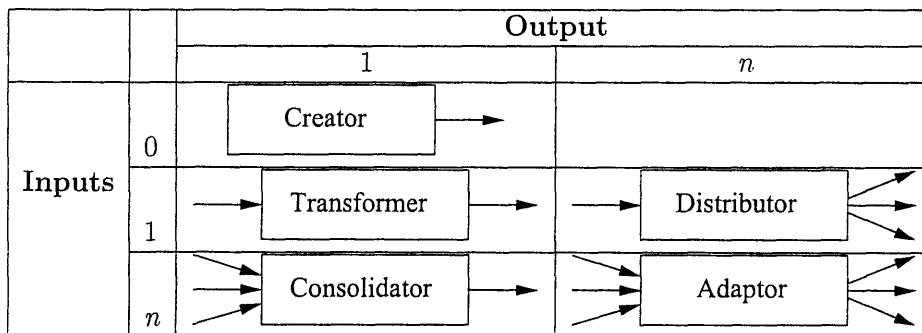|		Output	
		1	n
Inputs	0	Creator ⟶	
	1	⟶ Transformer ⟶	⟶ Distributor
	n	⟶ Consolidator ⟶	⟶ Adaptor

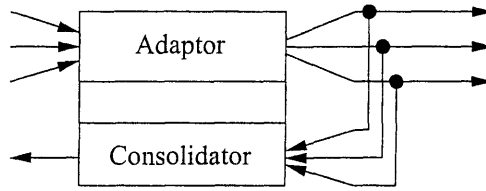Table 4.1: Taxonomy of Organizational Elements

Figure 4-1: Adaptor with a Consolidator for observation

on how quickly after the end of the quarter it produces the financial statement. Alternatively, if new, unprocessed accounting information is considered "inventory", then the OE could be measured on how quickly it produces a financial statement anytime after receiving new financial information (e.g. Cisco claims to have "live financial reports" that can be instantly produced from internal financial data).

Service level measures how well the OE services each of its input(s) and output(s) such that the organization's intention is satisfied. Output measures might include equal service, highest margin service, performance-to-plan, data accuracy threshold, etc; input measures might include lowest cost, equal service, minimum attention threshold, etc.

For example, an OE that sells a commodity chemicals might be measured on the total volume of its single output; an OE that sells specialty chemicals might be measured on the profit margin at each output. The commodity chemical sales OE might have budget as input and be measured on performance-to-plan; the specialty chemical sales OE might have highly technical new product information as input and be measured by a minimum attention threshold.

Common Caveats

Each input and output to an OE is crucial for the organization's overall function and, generally, inputs and outputs are visible to the organization. In some cases, however, inputs and outputs to an OE are not visible, so a composite OE can be built of the original OE and a parallel, witness OE. For example, a shown in Figure 4-1, a Consolidator pattern can be coupled to an Adaptor in order to return information about the Adaptors outputs. Because sales numbers and information are so important

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to many organizations, the above structure might be applied to a sales organization by Consolidating weekly sales reports into a overall sales report and then Distributing that report within the organization.

Another caveat for an OE model is that elements might add inputs and outputs to themselves. The commodity chemical sales organization might like to sell to high-margin customers, too. Adding the second output (ie. sell to high-margin customers) to the organization changes a Transformer (ie. sell low-margin commodities) into a Distributor and suggests that substantial organizational changes will be required. Adding a second Transformer focused on high-margin accounts might be an easier organizational change. Many organizations attempt to avoid this issue by communicating their organizational intentions with specialized terms ("wholesale", "always low prices"), strict workflows (purchase orders), specifications ("specialty chemical"), etc.

4.1 Zero Input Patterns

4.1.1 Creator

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┌─────────────┐
│  Creator    ├──────▶
└─────────────┘
```
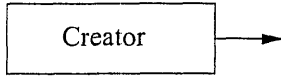
Function

Independent production/creation.

Description

As the name suggests, the Creator pattern produces a single output without input. That a Creator operates without an input does not mean that they operate completely free of any input. They operate within a social and business context, have outside pressures and get information about how their output is received, but their primary function is to create a new output without being directed by those outside influences. As such, this element is useful when the organization intends for one of its elements to operate independently of the other elements.

Often the participants in a Creator OE are selected for inclusion rather than provided with an incentive to join, because the OE has no input to adjust in order to provide the output. As an example, associate professors are tenured if they demonstrate a credible disposition for research and teaching because, after they are tenured, there is little ability to regulate their behavior via an input.

Examples

- Artists: the "starving artist" is the prototypical Creator, creating original art without regard for the market's needs. In reality, as shown in Figure 4-2, the starving artist often uses a second, parallel Transformer OE (e.g. waiting tables) in order to fund the artistic Creator OE.
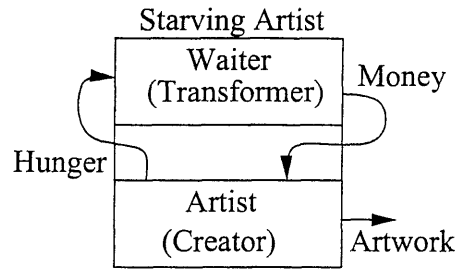
Figure 4-2: "Artistic" Creator funded by a "Waiter" Transformer

- Museum: the museum's output is a stream of exhibits. In many cases, these exhibits are created entirely by the museum using its permanent collection. Charitable donations are used to provide the museum with a source of funds which do not create influence, thereby allowing the financial flexibility museum to be a Creator. In other cases, the museum uses traveling exhibits and does not represent a Creator.

- Tenured Professor: although tenured professors may be influenced by some secondary inputs (salary, peer-pressure), they operate largely without external direction or formal input. This is by design: academia functions to explore advanced ideas and technologies, so might not need an input in the form of compensation adjustment, market directions or suggestions from school donors.

Specific Metrics

Because the Creator has no input, it is difficult to measure a transfer efficiency. Instead, a Creator is measured solely on its output service level. Because Creators do not have an input, measures of the output service level have a binary result: if the metric succeeds, the Creator OE is operating well; however, if the metric fails, the Creator OE must be removed or converted into an OE which includes inputs.

As an example, universities depend on professors' publications to boost the university's public perception, with professors represented by Creator OEs. The output service level metric is a minimum threshold of publications for the entire organization. If the metric fails (faculty publication rates are below the desired publication rates),
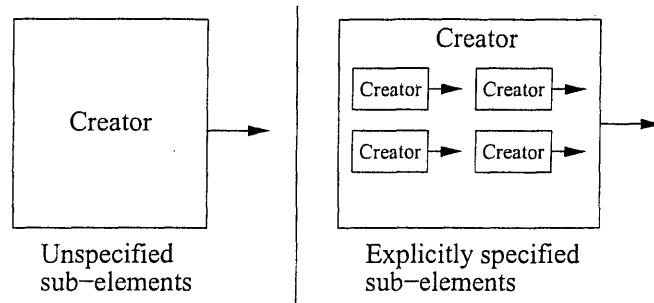
Figure 4-3: A Creator with and without explicitly specified sub-elements

then the university might change professors from a Creator OE to a Transformer OE and tie the input (salary) to the output (publications). On the surface, the change might be as simple as informing professors of their new compensation scheme. However, at a deeper level, the change requires professors to adjust their behavior to conform to a Transformer OE and will likely require more attention than a simple memo.

Specific Caveats

As mentioned above, the Creator pattern is used to signal that creative work should be generated. However, the output may not match the output desired by the encompassing or managing OE. In fact, this outcome may be the intention of the organization, as with the exploratory nature of academia. Or it may not be intentional, as with an artist whose works, while creative, are produced at long intervals.

When a Creator is used to generate creative work from a group of people or OEs, its output might tend to mirror that of its strongest contributor. Often this is a desired result, such as when a university research group is headed by a professor who specialized in the particular research area. Or it may not be the desired result, as with one professor who follows another's lead and produces derivative research. In this case, rather than assuming a group will act in aggregate as a Creator, as shown in the left side of Figure 4-3, each professor can be explicitly modeled as a Creator to signal that each is responsible for creating original output, as shown in the right side of the figure.

4.2 Single Input Patterns

4.2.1 Transformer

```
 ──────▶│  Transformer  │──────▶
```
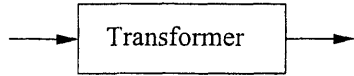
Function

Transforms single input into single output.

Description

A Transformer accepts a single input, processes it and yields a single output. "Transfer Agent" is a synonym for Transformer.

Transformer, as with all patterns that accept an input, can transform the input in a variety of ways. An obvious usage of Transformers is to process an input to yield an output different than the input. Another usage, which involves no direct modification to the input itself, is to move the input from one place or time to another, as with a shipping company or warehouse, respectively.

Examples

- Shipping Company: a simple shipping company acts as a Transformer because it takes a single input (packages), moves them to a destination and provides an single output (packages at a new location). More complex shipping companies, such as UPS and FedEx, might use two parallel Transformers OEs to handle ground or air shipping flows.

- Production Line: most mass production lines[1] can be considered Transformers because they take a single class of input (parts), assemble them and provide a single output (assembled parts).

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[1] This example excludes custom production lines in which information about how to customize a specific step for a specific order is crucial to the functioning of the production line.

```
            ┌─────────┐      ╱──────► Output
Input ─────►│ Transfer│─────◄────────► Output
            │ Agent   │      ╲──────► Output
            └─────────┘
```
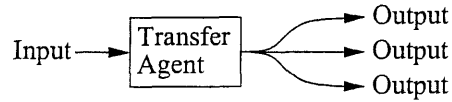
Figure 4-4: A Transformer with multiple client outputs

- Warehouses: a warehouse, such as a wholesale lumber store, that services a single type of customer can be considered a Transformer.

Specific Metrics

None

Specific Caveats

As shown in Figure 4-4, a Transformer's single output may be provided to multiple client OEs. However, the client OEs must have homogeneous needs. This is the case with a ground shipping company that services many customers, each of which has nearly identical needs. When the shipping company uses air *and* ground, a second OE will be needed to service the air shipping customers because their needs differ substantially from those of the ground shipping customers.

4.2.2 Distributor
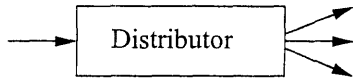
Function

Distribute single input to multiple outputs.

Description

The Distributor takes a single input and distributes it as a set of heterogeneous outputs. The difference between it and the Transformer is the type of outputs serviced: unlike the Transformer, the Distributor is specialized for servicing different types of outputs.

Examples

- Sales Organizations: some sales organizations can be considered distributors because they take information on a product and sell that product to a heterogeneous set of customers.

- Warehouses: as mentioned in the above paragraph, these are often the physical complement to the sales organization.

- Outbound marketing: responsible for gathering information on a product and conveying it to the market in a variety of different ways (print ads, conventions, direct customer outreach).

Specific Metrics

Since a Distributor has multiple outputs and each output is substantially different, different metrics can be used for each output. For example, a classical distributor/warehouse might be measured on the maximum time to service its high-margin outputs and the average cost to service its low-cost outputs.

Specific Caveats

If the single input is non-material (e.g. information), then a Distributor might intentionally or inadvertently ignore that input. In the case of the specialty chemical sales example above, this means that the business function might ignore the input of new product information in favor of concentrating on its existing specialty chemical sales. This might lead to highly profitable short term sales at the expense of future sales.

That a Distributor has multiple outputs does not necessarily mean that all outputs should be serviced. In the case of an advertising firm, it is important to *be able* to use any of the media outlets, but a client engagement might use only one of those outputs (e.g. television or newspaper).

4.3 Multiple Input Patterns

4.3.1 Consolidator
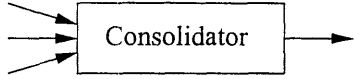
Function

Consolidation of a set of inputs into the production of a single output.

Description

The Consolidator pattern gathers or receives a set of inputs and produces a single outputs. The Consolidator takes a multiple, different inputs and consolidates it down to one output. The only difference between it and the Transformer is the type of outputs serviced: unlike the Transformer, the Consolidator is specialized for servicing multiple types of inputs.

Examples

- Inbound marketing: this Consolidator gathers inputs from a wide variety of sources (market reports, customer interviews, sales reports, etc.) and generates recommendations about how to market products and which products to develop.

- Accounting: this Consolidator gathers financial data from throughout organization and produces financial statements.

Specific Metrics

Since a Consolidator has multiple input and each input is substantially different, different metrics can be used for each input. For example, an in-bound marketing group might be measured on conducting a maximum number of customer visits per quarter, but on a minimum number of interactions with the sales function.

Specific Caveats

Consolidators of information are often predisposed or biased toward generating certain outputs. For example, marketing may have a favored product toward which they skew their recommendations. At the same time, Consolidators of information can have many possible inputs, so they might unintentionally miss a particular input. For example, marketing can miss a crucial input, even if it tries to gather every relevant piece of market information.

That a Consolidator has multiple inputs does not mean that each input must be used. If a Consolidator OE is responsible for purchasing goods, it is important to have access to multiple sources, but each purchases should be made at the lowest cost possible. In this case, the purchasing OE may have two service level metrics: lowest cost inputs and a minimum of 5% purchases through each input.

4.3.2 Adaptor
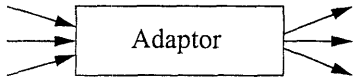
Function

Mates a variety of inputs to a variety of outputs.

Description

The Adaptor pattern adapts a heterogeneous set of inputs to a different heterogeneous set of outputs.

Key to the Adaptor is the non-separability of the relationships between inputs and outputs, which means that to effectively implement an Adaptor function, all participants must be fully knowledgeable about all inputs and outputs. Put another way, it is difficult to break an Adaptor into a composite of alternate OEs because the *tacit knowledge* held within the Adaptor is difficult to remove.

Example

- Sales: in the company that sells a variety of different types of products to a variety of customers, Sales "'adapts"' the products to the customers. This is in contrast to the case in which Sales acts as a Distributor, taking a single input/product and distributing it to a set of outputs/customers.

Specific Metrics

None

Specific Caveats

As mentioned above and in Section 3.3.4, it is easy to over-complicate the model by using an Adaptor to represent every possible input and output to each business

function. Instead, even if a group's overall function is complicated, relationships between inputs and outputs might not be as complicated, allowing simpler patterns to be composed together to more clearly represent the group's functionality.

Adaptors work with a large set of inputs and outputs, so the relationships between inputs and outputs can be difficult to ascertain, and the model becomes more difficult to interpret. As such, a model should minimize use of Adaptors.

Chapter 5

Example Applications

This chapter takes the example OEs presented in the previous chapter and applies them to organizations, both real and imaginary, in order to display the usefulness of OEs.

5.1 Three Sales Organizations

As mentioned previously, the definition of "native terms" such as sales or marketing can depend on the specific context in which they are used. In order to show the variability of one such term, namely "sales", this section provides three different views of the same organization. Two views examine the OE representation from inside the semiconductor firm while another view considers the representation from the view of the sales representative firm.

Semiconductor company sales organizations can take many forms depending on the size of the company, the breadth of its products and the characteristics of its customers. I worked in a $400 million firm which had 6 product lines and outsourced most of its sales work to sales representatives. The sales representative firm represented 10 different, though complementary, semiconductor manufacturers. They were less expensive than hiring an in-house sales team and were able to sell our products as part of a platform built of complementary products.
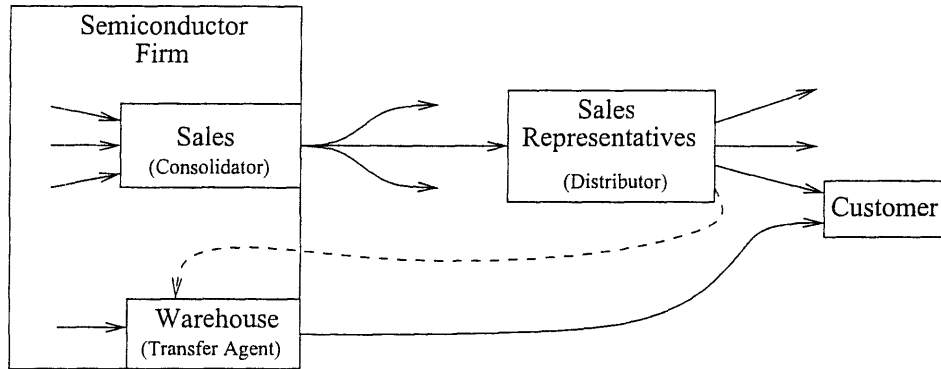
Figure 5-1: OE Chart for an outsourced semiconductor sales organization

Primary View

The company sales force worked with an contract sales representative firm in order to sell most of the product lines. As shown in Figure 5-1, I chose to model the extended organization using the following Organizational Elements:

- *Sales*: The company sales force is responsible for gathering product information, competitive information, guidance, etc, and presenting a single output to the sales representative firm, so it is representd by a *Consolidator*. The branched output in the figure represents the interactions with the multiple sales representative firms in the sales force's territory.

- *Sales Representative Firm*: Customers vary widely in their sizes and requirements, so a *Distributor* element is used to convey that the representative firm's main role is to take sales information from the semiconductor firm and tailor that data to a variety of customers. I did not use an Adaptor because, although the sales representatives handled six of our product lines, the interactions required to support any of the product lines were fairly homogeneous and could be considered a single input.

- *Warehouse*: Uses a *Transformer* element because the main role is to store products for shipment to customers; from the Warehouse's perspective, all customers are very similar; a secondary input from the sales representative firm coordinates shipments of product to the customer.
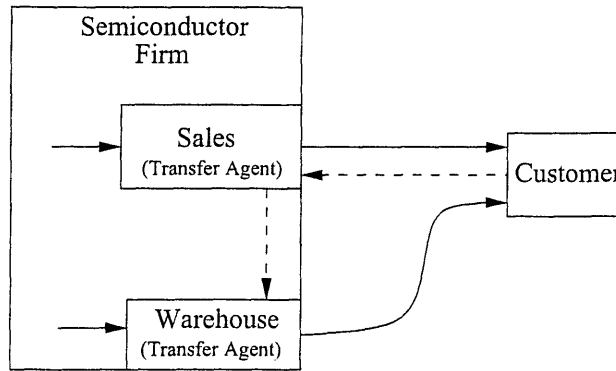
Figure 5-2: OE Chart for an in-house semiconductor sales organization
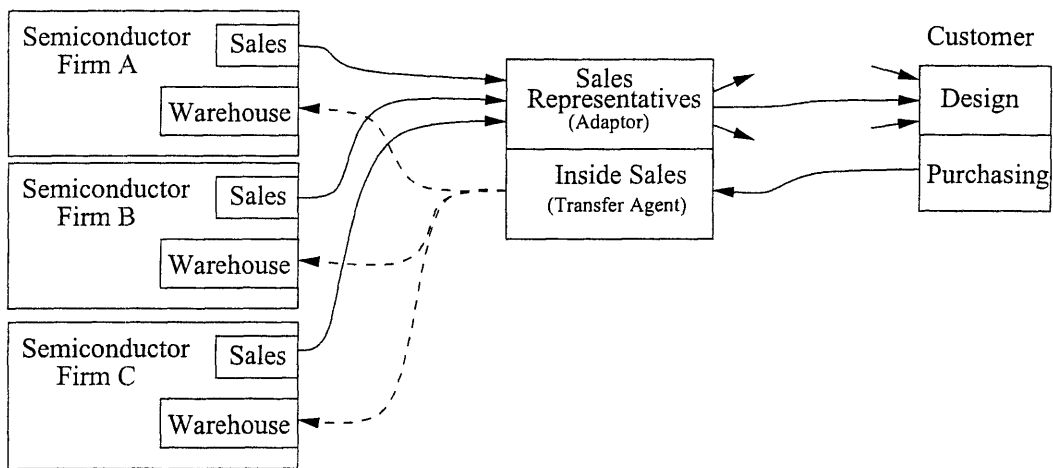
Figure 5-3: OE Chart for a sales representative organization

Direct-Sales View

For one of the divisions of the semiconductor firm, a separate in-house sales team
directly handled all interactions with the customers. In this case, a highly tailored
product was sold to one or two very high-volume customers, so there was no benefit
to using out-sourced sales representatives. As shown in Figure 5-2, the sales per-
sonnel are now considered *Transformers* since they are responsible for transferring
information from a single product line directly to a single customer.

External View

When viewed with from another perspective, the same organization may be modeled using different OEs. Figure 5-1 views the sales representative firm from the perspective of the semiconductor firm, representing the sales representative firm as a Distributor. However, from the sales representative firm's perspective, the upstream semiconductor firm is one of a number of different firms represented. Each represented firm has unique products and requirements, so, as shown in Figure 5-3, the sales representative firm would consider itself an Adaptor.

This difference in views can cause significant problems within an extended sales organization: from the semiconductor firm's perspective, the sales representatives are the conduit to the customers, so marketing and sales messages are expected to receive immediate and complete attention; from the sales representative perspective, the semiconductor firm is one of a number of firms they need to service. Some members of the semiconductor company's sales function wanted the sales representative firm to function as a Distributor, paying strict attention to the company's needs. Anytime that a sales representative acted as an Adaptor and paid attention to another represented-company's needs instead of to ours strained the relationship between the two firms.

5.2   Common Angels

My professional experience is in product development organizations, so, when looking for a real-world test case, I sought an organization which was unrelated to my past experiences. Common Angels (CA), a local, early stage venture capital firm, is a financial services firm and provides a test case well outside the industry in which Organizational Elements were conceived. James Geshwiler, Managing Director of Common Angels, volunteered his time and provided me with ample documentation, both internal and external, covering the CA organization. The following model was developed after two separate one hour meetings with Mr. Geshwiler.

5.2.1 Overview

Common Angels, like many angel investing organizations, is a large and loosely-knit group of individuals with both capital to invest speculatively and the ability to guide their own speculative investments. The investors in Common Angels come from a variety of backgrounds, so that every investment is lead by investors with expertise in the investment's industry.

Common Angels' three main activities are:

- Recruit: attract investors;

- Invest: attract, assess and fund companies;

- Manage: assist selected companies with management, marketing, etc.

In modeling Common Angels, this thesis focuses on the investment function.

5.2.2 Challenges

As expected, the Organizational Elements framework developed in the preceding chapters was challenged by this unfamiliar organization. Before addressing the model itself, I will discuss some of those challenges.

Organizational Fluidity

In the model of the semiconductor sales organization, the organization's grouping of people into functional roles informed my modeling effort by providing pre-packaged functions to which OEs could be applied. On the other hand, CA's organization is completely fluid and any group in the organization is transient, so I could not use pre-defined groups of people within the organization to build the model. Instead, my model focuses on the business functions themselves and provides a workflow-like view of the relationships within the organization.
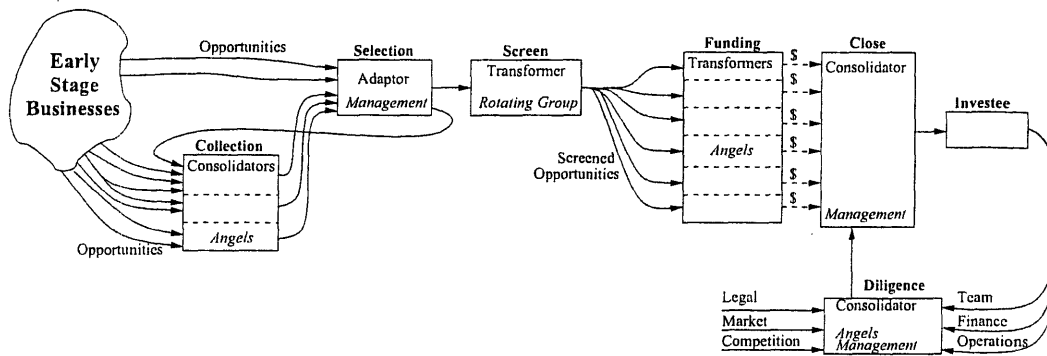
Figure 5-4: OE Chart for Common Angels' Investment function

Complexity

Organizational Elements are well defined models of lightly connected business functions. In contrast, the organization I was modeling with OEs had few defined roles and was highly interconnected. As I developed the model, I felt pressure to include each of the many interconnections and the smallest of tasks in the model. My initial attempts to model the organization lead to complicated, incomplete models.

Instead, I recalled that I should model the organization's intention instead of its exact workflow. I modeled the entire organization with a single OE (Consolidator) and then identified the most important function in the organization and elaborated the model to include that function. The I identified the second most important function and elaborated the model to include that function. The resulting model that shows the organizational intention and provides a foundation for understanding the complex interactions within the organization.

5.2.3 Model

Overall, the investment function of CA can be represented by a Consolidator OE: opportunities, market information and money are taken as inputs and investments are output. As shown in the model in Figure 5-4, many elements are nested within the investment function.

Collection

The Collection function represents one of the two major goals of an angel investing organization: member angels are used to gain access to and collect interesting investment opportunities. A Consolidator represents each angel in this function because each angel is responsible for taking the large set of opportunities they find and reducing it to a smaller number of opportunities. These investment opportunities are then forwarded to the Selection function.

As discussed in Chapter 4, a business function may add inputs or output to itself. In some cases, these additions may be unseen by the organization. The model shows angels as Consolidators, gathering opportunities and providing the interesting opportunities to the Selection function. It is impossible to force the angels to do so and they could choose to invest in the excellent opportunities on their own or to pass the opportunity to a rival firm. In such a case, the angel, although assumed to act as a Consolidator, would surreptitiously add an output and behave instead as an Adaptor.

Selection

The Selection function is run by management and receives opportunities, vets them to assure that they are appropriate for the group, and then passes them to the Screen function. Additionally, other opportunities come directly to management and, while management can vet and pass along some, many of these opportunities are routed back to the Collection function for angel evaluation. An Adaptor is used to represent the Selection function because inputs are taken both directly from early stage business and from the Collection function, while outputs are provided both to the Screen function and back to the Collection function.

As Common Angels grows, more opportunities will be presented directly to the Selection function and management. Currently, most of these opportunities are passed back to Collection for evaluation by an angel. However, management might begin to favor its own opportunities and knowledge of investments, and cut off the inputs from

and output to the Collection function.

Screen

The screen function is performed once per month by management and a rotating group of five angels. The input is a group of 10-20 opportunities and the output is the 2-3 opportunities which are to be presented at the Funding meeting. A Transformer element represents that the Screen function takes in one input and, after a delay, outputs a single output.

As with Collection, angels are involved in the Screen function and could invest their own money in the opportunity before the Funding function had a chance to be involved. Unlike in Collection, this action would be visible to the organization, so it is unlikely to occur.

Funding

The Funding function is the second major goal of the organization: screened investment opportunities are presented to the angels and the angel individually decide on whether to invest. This is also performed once per month by a meeting of the entire angel group. Companies which have made it through the Screen are invited to present, after which angels discuss the opportunity and decide whether or not to invest in the company. Although the function is undertaken by a large group, each angel acts as an individual Transformer, taking information in and deciding whether to invest.

Each angel acts individually in the Funding stage, choosing to output or withhold their own funds. If an opportunity is lightly, though adequately, funded, then the Close function can be held-up when an angel that intended to invest withholds their funds. Although angels are not likely to intentionally hold-up Close in order to extract beneficial investment terms for themselves, it is not uncommon for angels to unintentionally hold-up Close by waiting until the last possible moment to write the check.

Diligence

The Diligence function is an in-depth investigation of the opportunity and is performed by management and a small group of angels. This function is represented by a Consolidator because it accepts as input as variety of inputs and provides an investment recommendation.

As with any function that is represented with a Consolidator, the Diligence function can tend to ignore inputs if they do not agree with the Consolidator's favored output. In this case, the due diligence team is largely composed of angels who are interested in investing in the company, so they are predisposed to investing and might ignore or minimize inputs which do not support investing. Recognizing this as a failure mode, Common Angels' management assigns an angel who does not favor the investment to be part of the Diligence team.

Close

The Close function passes the angels' funds along to the target company if due diligence completes successfully. This function gathers all pieces necessary to complete the investment and then passes them to the funded company, so a Consolidator is used as the representation.

5.2.4   Results

The Common Angels modeling experience provided a test case for my hypothetical Organizational Elements and the taxonomy I had chosen. Unlike the semiconductor sales organization, I was unfamiliar with financial services companies and so did not know if the ideas presented in the previous chapters would work in this new environment. Initially, it looked as though they wouldn't: the organization was very complicated and had no boundaries (e.g Sales, Production) to guide my modeling efforts, and my models were groups of Adaptors with nests of connections (exactly as I advised against in Chapter 3).

The problem was that I was focused on identifying structural boundaries in CA

in order to suggest OEs for my model. In most organizations, business functions are grouped in cubes, offices or buildings, and a person in Marketing can interact with Engineering by walking across the office or with the sales representative by driving to their building. OEs can be wrapped around these pre-existing structures.

Common Angels does not have such physical structures. Instead, of existing in certain locations, many of CA's business functions exist only at certain *times*: the Selection function can only interact with the Screen function once per month. This lead to a workflow-like model, though I said that workflow was not suitable for my needs in Chapter 2. Like workflow, the flow of time is visible in the model. Unlike workflow, the model is focused on organizational structure and ignores the complex interactions within the organization.

Chapter 6

Conclusion

With the increasing power of computers, computer programs have grown rapidly in size and in organizational complexity, creating a rapidly growing body of research concerning computer program organization. If parallels can be drawn between computer program organization and business organization, then the ideas generated in one can be transported to the other. This thesis transported the "Design Patterns" approach to computer program organization into the field of business organization design.

In doing so, this thesis developed and presented a new view of the organization. In particular, this view is based on identifying features common to business functions, rather than on differentiating business function by specialized task (e.g. marketing, finance, accounting, etc). Two organizations were modeled. The first was the organization in which I worked when I began thinking about Organizational Elements and its model fit naturally with OEs. The second organization was a financial services company, Common Angels. I was unfamiliar with the organization, but, as a result of using Organizational Elements, I was able to quickly develop a model of CA's organizational structure and an intuition about possible organizational problems by using analogies derived from Organizational Elements.

Although this thesis takes the first step toward developing a theory of Organizational Elements, I was not able to take as many steps as I would have liked. In particular, I dramatically underestimated the amount of work necessary to develop

a comprehensive theory of Organizational Elements. Due to time constraints, this thesis took a passive approach and focused on modeling organizations using Organizational Elements. Instead, a more time consuming, active approach would have focused on how Organizational Elements can be used to affect organizations, instead of just visualizing them. The shrinking thesis scope reduced my very high initial enthusiasm, because I was concerned that the result would be a half-completed theory of how an idea from computer science could be applied to organizational design.

My concern abated when, after a recent job interview, I had the opportunity to test the Organizational Element in practice. During my interview, I was not able to get a clear idea of the rapidly growing organization's structure because the interviewer seemed unclear of the organization's structure. After the interview, I used the bits of information from my interview to model the organization using OEs and to identify where I would best fit. In follow-on conversations with the interviewer, I was able to convey a clear idea of how the organization could be structured and how I could help the organization grow. Although I would not causally link the subsequent job offer to my OE model, the theory's value was proved. Now than my academic career is drawing to a close, I am enthusiastic about continuing to use and develop Organizational Elements in my professional career.

6.1 Further Work

Following are areas which require further work in order to expand and prove the theory's value.

6.1.1 Alternate Segmentations

To limit the number of Organizational Elements in my taxonomy, I chose to use a very simple method for differentiation (number of inputs and output). There are many other possible taxonomies which could be explored.

If specialized OEs are added to the taxonomy, then patterns such as Gate, a specialized Consolidator which takes one set of inputs and holds them pending the
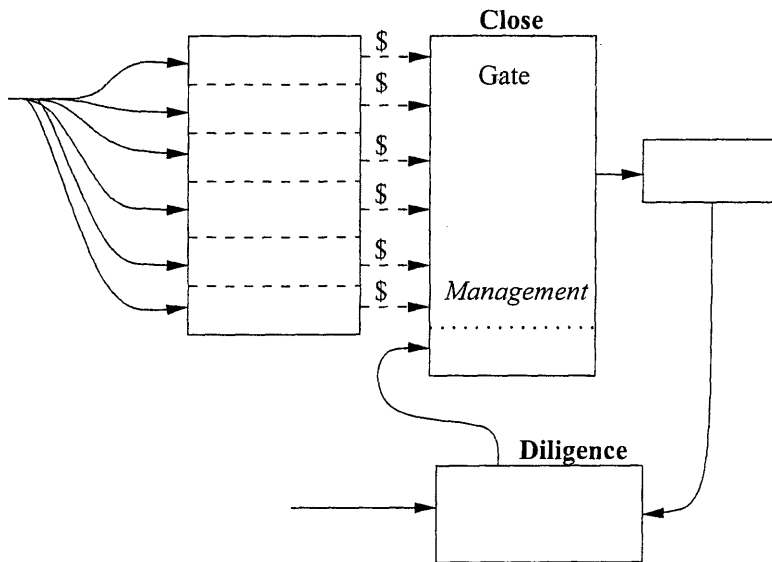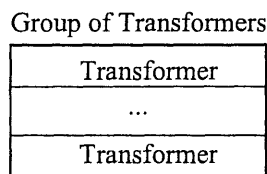
Figure 6-1: Common Angels with a Gate element

Group of Transformers

Transformer
...
Transformer

Figure 6-2: Group of Elements (Transformers)

results of the second input, can be added. In Section 5.2, the "Close" function is a Consolidator that combines individual angel investments with the due diligence results in order to put together an investment package. With a Gate element, the diagram of the "Close", shown in Figure 6-1 is changed little, but it is now clearer that the Close function holds money from investors until the Diligence function is completed.

The segmentation could be extended to capture structural characteristics of business functions. A "Group of Elements" (GoE) element, shown with Transformers in Figure 6-2, could capture the characteristics common to groups that are composed of individual Organizational Elements. In a GoE, each enclosed element has strong communication with the other elements. For example, this element could be used in the Common Angels model: the "Funding" business function is GoE which contains

the angels as separate Transformers.

6.1.2 Organizational Design Patterns

It might also be common for business functions to use one of a few arrangements of elements or Organizational Design Patterns. Terms such as "three tiered sales organization" and "direct sales organization" are used to communicate a commonly understood organizational structure. Organizational Elements could be used to capture these structures, providing managers with a menu of organizational structures from which to pick when considering starting or reorganizing a business function. As an example, a manager who needed to add a distribution channel to an existing direct sales organization could look over a set of sales Organizational Design Patterns to find one which could be most easily grown from the existing sales organization.

6.1.3 Further Modeling

This thesis modeled two organizations. To prove the utility of Organizational Elements, a much larger number of organizations should be modeled. In particular, organizations from a variety of industries should be included in order to test and extend the taxonomy used in this thesis or to develop a new taxonomy.

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