MANUFACTURING BUILDINGS IN MASSACHUSETTS
THE LEGACY AND THE FUTURE

by CALLIE TRAYNOR

B.A., FRIENDS WORLD COLLEGE, 1978

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Submitted to the Department of Architecture on March 29, 1983, in partial fulfillment of the requirements for the degree of Master of Architecture.

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ABSTRACT

Manufacturing buildings are found in most towns and cities in Massachusetts. Standing in dominant isolation, or as part of an urban district, their presence is the built testimony to the role manufacturing played in so many lives. Machinists working in the mills produced technical innovations that were exported throughout the world. It is a tribute to the builders of those mills that today people in some of the same buildings are still manufacturing with "high" technology. Yet manufacturing is becoming work that fewer of us are employed to do in our economy. Some compare this to the decline of the farm as a source of livelihood a century ago. The results show up in an unfortunate parallel between unemployed workers and manufacturing space.

This thesis started from the proposal that these buildings are a resource that can be modernized for further manufacturing use as part of a community effort to create more jobs. Evaluating the proposal entailed an investigation into the existing market for this type of building, how efforts to expand that market have worked, how existing firms locate their production space, and the changes in design criteria for manufacturing buildings.

The proposal contains some implicit values that have been traditional ones in Massachusetts: that older things built well are worth using; and that as a commonwealth if we lose the pride of skilled production, or fail to share it among ourselves, we have lost a legacy that has been ours, and our future will become less certain.
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Buildings within the restored industrial district of Lowell.

INTRODUCTION
This fall the CBS Evening News featured a visit to a Westclox factory off Interstate 80 in Peru, Illinois. The factory was a one story brick building with a series of saw-tooth roofs. It wasn't a large or imposing building, but it struck me as having the old Vitruvian attribute of commodity. A large Westclox clock had been set above the main entrance, an invocation to production, still keeping the time.

But the building was empty. The people who had made the clocks inside had been laid off for two years. They had come back for the broadcast and were grouped outside the building. Each worker explained how they had been supporting themselves. Everyone was still having a hard time and few had many hopes for the future. Like the building that stood behind as a backdrop, the workers had been part of a system that decided it no longer made sense to use them.

The news was trying to highlight the effects of business practice, and it succeeded. There is something immediate about seeing a vacant building when it could be used, or in hearing people speak of wanting a job where there are none. It is a time when people are having to consider what is usually taken for granted, whether or not the capital market system functions adequately for the kind of society we want.

The market has developed to the point where it arranges and exchanges nearly all goods and labor in the world. The physical components that make up the means of production, such as computers, shafting or aluminum wall panels, are designed and utilized in ways that lower production costs. Labor is also a production cost for business. To stay competitive, companies seek pools of labor that have the right skills and working habits for the least wage demands. Larger businesses are now able to locate different segments of their operations where their respective costs are minimized. All the technical advances in communications, transportation systems, and production equipment have been used by management to create a spatial matrix for production that is unprecedented in scope. Companies follow the logic of the
market in choosing their locations throughout the world. This has been a right granted to private enterprise for centuries.¹

The buildings and people that are left behind when a company leaves become a problem for the larger community until they are re-absorbed into the market. It therefore becomes important to observe what happens with these buildings. Many change uses to become retail space, office space, artist studios, elderly housing, or even discos. Space that isn't being used can be an opportunity as well as a problem. There are now initiatives to have local governing groups invest in manufacturing buildings with public funds. They can then work to encourage manufacturing employment with goals and guidelines that can differ from the private market. They can also direct renovation of the building, which adds value into a neighborhood and creates an attractive workplace.

My thesis looks at the feasibility of modernizing this kind of building. It was done with the hope that architects can contribute to this kind of initiative. Understanding existing cost considerations and design standards are essential before a proposal to augment the market can work. The thesis draws upon disparate fields of expertise and my observations. The following paragraphs summarize the range of what is discussed under each topic heading.

**Manufacturing Buildings**

The manufacturing building is a relatively new building type. It first developed within the dynamics of capitalism, built to expedite production in a competitive, expanding economy. This function has always influenced the form and technology used in factory design. This has led to beautiful clarity, especially when technical advances are demonstrated, but it has also led to cramped, noisy, polluted working conditions.

I have looked at the historical development of the factory building. More than other kinds of buildings it can become economically
as well as physically obsolete. This means that understanding changes in design criteria over even a decade is useful when doing a feasibility study. Most buildings designed by architects are commodities for consumption rather than part of the means of production. This is a reason why architects have not traditionally been invited to design as much industrial architecture.

**Manufacturing Location**

The location of production facilities has always been important to both the company and its potential labor force. This has seldom been more apparent in this country. Recently the nation was able to watch the governors of Minnesota and South Dakota argue theatrically on television because plants were leaving one state and moving to the other. Lower tax and wage rates were the main reason. Something similar has gone on between Massachusetts and northern New England. Yet this ability to move has been intrinsic to the growth of capitalism. The history of manufacturing in Massachusetts is often a story of entrepreneurs harnessing a stream in the wilderness, and starting production by assembling a community to work for them. Today Massachusetts is again a bellwether for investment and locational trends in manufacturing. Community groups sometimes hope that "light manufacturing" can be attracted to urban sites when the private market will in fact never come in. Such groups need to understand how companies choose the location of their production facilities.

**Modernizing a Manufacturing Building**

Although each kind of manufacturing process and each renovation project is unique, there are common procedures in modernization work. A first step is to determine if the condition of the building merits further investment, although this threshold varies with different kinds of investors. Investment patterns change according to tax policies and economic indicators like interest rates. Public funding can shift with the political tides. There are also similar technical problems with this kind of older building. Despite the problems, the renovated space and the new hardware that is introduced work to-
gether to create a handsome, humane environment.

Planners and Manufacturing

Economic planning was once reserved for private businesses and some federal-level positions. Since the mid-sixties though, more state and local groups have tried to stimulate private investment in their manufacturing buildings. This section reviews such efforts, concentrating with attempts in the Boston area.

Initiatives in Massachusetts Communities

I visited companies that had modernized older buildings. The companies ranged from multi-national high-tech firms to a traditional garment factory, to a building with small businesses on each floor. Together the visits started giving me a feel for the existing demand in manufacturing space, and who can undertake renovation work. The buildings could meet modern requirements and looked very attractive. They are clearly a resource and should be used well. Massachusetts seems to have had in its destiny the role of developing emergent technologies, then releasing them and adapting its people and built environment to newer ones. Whether this is a sufficient economic model is another question.
A mill in Stow, Massachusetts. It is now the Gleasondale Industrial Park.

MANUFACTURING BUILDINGS
The Emergence of the Manufacturing Building

An old factory looks sublime if not beautiful. A sense of power imbues the building but the heavy walls ensure a silence outside. It appears stark and vast, not quite made for people.

That appearance reflects the central reason for the emergence of manufacturing buildings: to increase the production of goods for exchange. People partake in the production process if their labor is required, but factories can exist without workers being a "factor of production," as we know from automation and robotics. This makes the factory a distinct building type. The layout, scale and design of machinery has taken priority in determining its environmental quality.

The factory has been built in different times and places to serve as the setting for the expansion of capital growth. More than any other building type, the evolution of factory design is linked to the dynamics of market structures. The increased capacity in the volume of products and the profit incentives for innovations in technology come together in factory production, and are two reasons for the success of capitalism.

Factory production transformed the organization of work when it was introduced.

"Control without centralization of employment was very difficult, and so a precondition for management was the gathering of workers under a single roof. The first effect of such a move was to enforce upon the workers regular hours of work, in contrast to the self-imposed pace which included many interruptions, short days and holidays, and in general prevented a prolongation of the working day for the purpose of producing a surplus under then existing technical conditions."

The use of factories in the Industrial Revolution was not an
even, inexorable process. The critical mass of factors that made factory production benefit the owner over the customary outwork system varied according to the level of available technology, the owner, and the labor force. An illustration of this is that only 23% of the workers in New York City worked outside the home in 1840. Even today a lot of production is carried on outside a factory setting. Recently Italian electronics firms started to sub-contract assembly work to families working at home, to cite one example.

Before factories made sense for England in the 1700's a sufficiently large internal market had to be developed to absorb the increased volume of products. A "vast proletarian army" was formed, by forcing people from the rural village economy. At that time sheep functioned like automated machinery does today, used by capitalists in displacing people. It was more productive for them to raise sheep for market than to rent land to tenant farmers. Industrial capital grew when joint stock companies replaced the mercantilist practice of giving monopoly rights to merchant trading companies through royal grants. It took awhile before men realized the advantages of making money as an industrialist through the wage system instead of as a merchant through interest payments and trade differentials. From 1700 to 1770 English export industries rose by 76%, far above the domestic rate. A recurrent problem in capitalism is that new investment can easily lag behind increased output if wages are kept low. One solution is to increase exports, if markets are available. Another instance of this solution is Japan's model of developing internal, regional and then world export markets since the Meiji Era.

The owner of a prospective factory had to weigh the advantages of continuous production under one roof, with its greater efficiency and productivity, with the costs of building and maintaining the factory. An intermediate practice was to use rental workshops. A capitalist then as now tries to avoid investing large amounts of fixed capital unless the projected returns seem like they are worth the capital being tied up.
A yarn factory in Norwich, England. The tower was used for dropping down bales of material. (from Richards, *The Functional Tradition.*)
The organization of work has evolved over the industrial period. At first a lot of the work was subcontracted. Owners would hire experienced workers and expect them to hire their own labor in turn. The fundamental change was that workers were no longer able to invest in the means of production and the workers could no longer be independent producers. The type of market that had been characterized by medieval guilds, producing and selling in a single urban market, was superseded by the arrangements of industrial capital.

The Market and the Building

Market conditions not only determine when and where a factory will first appear, but they determine the rate at which a firm will modernize its production facilities. There is a strong incentive to lower the firm's average total cost, because a firm can make extra profits in the short run. \( \Delta \text{net revenue} = \Delta \text{total revenue} - \Delta \text{total costs}; \text{total cost} = \text{average total cost times quantity.} \)

When a period of expansion is expected, where the capacity added with improved technology will be met by increased demand, companies will invest in their plant. If the prevailing wage rate goes up, as it usually does during this time in a business cycle, older plants may not be productive enough to cover the operators wages at the desired profit margin. The highest risk for a firm is investing in components with high fixed costs and long durability. Their impact on future earnings cannot be predicted with confidence and if demand drops the extra capacity isn't needed. The building itself has one of the longest "lives" which is why many firms prefer to lease rather than buy. Lease terms free up capital and are now tax deductible.

If there is little competition in a firm's market sector there is also less incentive to invest in modernizing a building. We can see historically that in an expanding, competitive market, production facilities are constantly being modernized and expanded. The factory has never been a static form; even the thick masonry walls were not sacred when labor costs were low. The main criteria for investment
An early English factory that used the Georgian country house as a reference. (from Drury, Factories.)
is that any component must return its future replacement value in the improved productivity it induces in the production process. Productivity is the quantity of output per hour of labor.

The difficulty with investing in the building is that its contribution to productivity is harder to measure than a piece of equipment like a new computer system. To a firm the building is part of its "plant," which by definition includes both the building shell, machinery, and fixtures. The design of the shell has been integrated with the needs of the production process. This is why engineers as much as architects designed the shell that supported their installations. The role of the architect was often limited to conferring a sense of prestige to the outer facade.

There has been a direct incentive to increase the capacity of the building frame because the extra bay size increases productivity, and thus profits. This makes the factory a rich resource in tracing the advances of building technology. Capacity, not ornamentation is required, so that along with railroad stations and bridges, the factory offers innovative uses of new materials and a fresh clarity in the use of older ones. The rest of this section traces the evolution of factory design, concentrating on the adaptation of technology.

Early Factory Design

The first factories built both in England and New England were modest in scale and are some of the most beautiful. They were usually located away from the larger urban areas because the sources of power that drove the shafting for the machinery were rapidly flowing rivers and streams. The factories were built by engineers and craftsmen who were familiar with the traditions of Georgian vernacular building. This tradition, bridging the eighteenth and nineteenth centuries, had high standards of detailing that were disseminated by pattern books. Engineers knew the loading requirements for their machinery. The structural frame also supported the machinery, with column brackets and bearing plates. In 1840 only 40 of 1500 listed architects in England
A silk-weaving factory. The windows show the need to use natural light. (from Richards, The Functional Tradition.)

A "weaver's window," lighting the top of a five story factory. This type of window had appeared earlier in the weaver's houses where they used to work. (from Richards, The Functional Tradition.)
designed industrial buildings.

The clarity of Georgian design assured it a lasting applicability. "In fact, little was done which did not thrust the vague reflection of Georgian country mansions well into the nineteenth century, with cupolas and pediments of domestic scale sitting on grossly blown-up multi-story facades." 3

In the large country homes the windows varied in size from floor to floor but in the factory they were the same horizontally and vertically. This standardization remained characteristic of the building's utilitarian function. The other type of fenestration was adopted from "weavers windows." These were continuous, horizontal frames of glazing that weavers had built on the second floor of their cottages, which was where they used to work. The need for natural lighting has been a constant factor in factory design until very recently, and technology has been used to offer the widest area possible for glazing.

Factories immediately adopted the configuration of a shallow rectangle. This was because daylight only penetrates up to 15 feet, the capacity of the early metal frames was limited, cross ventilation was needed, foundations were costly, and the shape was the most efficient means of transmitting the power from the vertical shafts. An example of one factory using new building systems for its time was one built in 1801 by Boulton and Watt. It had seven floors and measured 140 feet by 42 feet. It used hollow cast iron columns that carried heat, and I-shaped cast iron beams supported hollow brick arches as the flooring system.

The designers and owners saw the importance of using lighter, longer-span roofing systems because it meant they could pack in more machines on each floor. Factories and railroad stations were
A factory window in the Georgian building tradition. (from Drury, *Factories*)
Interior sections of two textile mills. The close relationship of the production equipment to the structure is apparent. (from Dunwell, Run of the Mill.)
Drawings of a typical mill built in rural areas, with a front stairtower and cupola. (from The New England Textile Mill Survey.)
An early Rhode Island factory with clerestory windows. (from The New England Textile Mill Survey.)
1% in. Maple Top Floor laid on 2-inch plank on tar concrete, with thoroughly mopped tanned felt under plank.

Tar & Gravel Roof on 3 in. Roof-Plank grooved for hard-wood splines

Purlins 8 to 10 ft. on centres

Purlins 8 to 15 ft. on centres

A monitor roof using steel truss framing. Monitors were also built up from timber roof frames. (from Kidder-Parker’s Building Handbook.)
the buildings where new cast iron and steel building components were exploited in the nineteenth century. The same engineers designed both. The results were consistently discredited by the architectural press. One journal sniped at the amazing roof in St. Pancras station, calling it a "windscreen." Characteristically the station's architect, Gilbert Scott, only designed the front edifice. His facade had rich, historical detailing but he didn't dream of using the newer technologies as a design element.

The invention of the steam engine meant that factories could be built in the cities where there was a constant supply of labor. The improvement of mechanical design included belt drive and newer metal truss systems. Buildings became wider. This was no improvement for workers because there was no corresponding increase in ventilation or lighting, except that some potential roof trusses were fitted for clerestories on the top floor. Gas lighting meant the working day could be prolonged, with increased productivity for the owner.

Working conditions and the quality of the building design depended on the interest of the owner. One owner who paid particular attention to the building's design was Titus Salt, who opened a new factory, Saltaire, in 1853. It used a cavity wall structure for natural ventilation, which has always been a problem in factories. Cool air was drawn in at the floor level and carried through the hollow brick arches. The ceiling had built-in vents to draw off the hot air. The other early system for natural ventilation was to use a monitor in single story buildings or atop the multi-story frames. Saltaire also had an unusually large span for its time, 50'4". The truss was built up from rolled iron angles. They supported iron purlins which in turn supported skylights. The shafting was placed beneath the floor which helped unclutter the production area.

A textile factory like Saltaire usually contained some single story buildings that were used as weaving sheds. The one here used a corrugated iron roof that let in even northern lighting, and it be-
A cartoon appearing in "Vanity Fair" magazine, 1860, following the collapse of the Pemberton Mill. It shows the owner and architect collaborating in the operation of an unsafe building. The event caused tighter insurance regulations in factory construction. (from Dunwell, Run of the Mill.)
came a prototype for later design.

Heavy-timber Mill Construction

Cast iron columns and beams were experimented with in New England as well as in Europe. The Metacomet Mill in Fall River was the first American factory to use cast iron columns in 1840. However the fabrication methods were not advanced enough to ensure a predictable performance. A particularly disastrous failure occurred in 1860 at the Pemberton Mill Rhode Island, in which many workers were killed. Failures like this, and the vulnerability of the metal to fire, led insurance companies to demand better construction. The result was a unique, highly-developed use of heavy timber construction. It was used until a concrete frame appeared in the early 1900's that was cheaper and less combustible. These heavy-timber buildings have proven very durable and are prime candidates for renovation today. Wood construction was easily understood and able to be adapted, which was important because the period when it was used, roughly 1860-1900, was when production levels skyrocketed in New England factories. It is an interesting system to study because the insurance companies, like Factory Mutual, pushed designers to standardize details and consider safety features for the threat of fire.

The exterior construction was traditional load-bearing masonry or stone, although the scale of the buildings set them apart from their surroundings. The walls could get to be three feet at the bottom and were set on granite slab foundations. The window openings used segmental brick arches and granite sills, with small-paned double-hung windows.

The basement was used as a machine shop. These shops developed lighter, faster power transmission systems that were constantly improving plant performance. Cold-metal rolling began in the 1840's. Later, lathes were improved so that the bearings, pullies and fly-wheels could be balanced. Leather belts and light-weight shafts improved so that in time all the components along the system could run
Illustrations of hardware for heavy timber mill construction. (from Kidder-Parker's Builders' Handbook.) Typical pieces included joist hangers, post-caps and bases made of cast iron or steel.
at the same high speeds as the newer turbine engines.

What was called "slow burning" construction was introduced back in the 1820's. Thick planks were used instead of the usual joist system, and wood shingles were set in mortar. The regulations of the insurance companies pushed such thinking further. For the first time sprinklers were introduced and their capacity was related to the bay size. They were generally only used in high hazard areas though.

The mills ranged from 2,000 to 20,000 square feet per floor and were commonly designed for 120 lbs. per square foot loading. Every floor was designed to be separated from each other during a fire, and all vertical shafts were separated and encased in brick. The columns had chamfered edges to retard the penetration of fire and were held in position by cast iron post-caps and bases. Both columns and beams were left uncoated to lessen the chances of dry rot. Concealed spaces and partition walls were avoided. The effect was to create the first "open plan" work place. Its popularity today means that renovating these buildings for office space requires few alterations. The brick walls were never furred and sheathed with wood but were either left exposed, whitewashed or painted.

The beams, also chamfered, were usually long-leaf yellow pine sized around 8"x16". Often two pieces were bolted tightly together. Air space was always left between the brick wall and the beams and floorings. Beams rested on cast iron plates or beam boxes and column caps to evenly distribute the load. Ceilings were finished with a specified lime-mortar plaster to act as a fire retardent, especially below the roof trusses. Wire glass also was introduced to check the spread of fire to adjacent buildings. This was important in the larger complexes where buildings were built close together. All boiler plants and engine rooms were housed separately from production areas.
Drawings of the Durfee Mill, Fall River where printed cloth was manufactured. The plan is typical of larger, multi-story manufacturing buildings built after the Civil War. (from The New England Textile Mill Survey.)
The generating facilities at a German coal mine built in 1921.
(from Becher, Zeche Zollern 2.)
The flooring system in these factories were carefully designed. The wood planks were 4"x10". High grade construction added a pine-subfloor, laid diagonally to the planks. This helped to distribute the loads and reduce machine vibration. Layers of building paper mopped with hot tar were laid between floor layers, for water tightness and to prevent dust build-up. The finish flooring was birch or maple, laid perpendicular to the planks. Roofs varied, with the pitch getting shallower as the buildings widened in the later decades. Early pitches were as steep as 7 in 12.

These factory complexes also had one story buildings with saw tooth roofs. Here the use of metal trusses was allowed if there was a ready water supply but it was shown that a wood system still burned more slowly. While the lighting was better, especially if the underside was painted white, there were problems with leaks and heat build-up in warm weather.

The insurance company regulations served their purpose well. The quality of the heavy timber factories still with us is proof that functional considerations can help develop buildings of exceptional serviceability.

Factories Built Before 1940

As the new metal building system improved during the 1800's, the structural function of heavy masonry frames grew obsolete. In the 1860's James Bogardus was making pre-fabricated skeletal frames that were shipped out by rail throughout England. In 1872 Jules Saulnier built the Meunier Chocolate Factory in France that used a cast iron perimeter frame. The first exposed steel frame factory in the United States was designed by Charles Caldwell, the Fischer Marble Company in New York City, 1904. He used welded channels to form tubular columns and steel girders, but still used wood joists and flooring. An advantage to using skeletal frames was that the window areas could be extended. But there were problems with the use of exposed metal in multi-story factories. There was no adequate system of fireproofing,
The Packard Motor Car Plant Number Ten built in 1905 by Albert Kahn. (all Kahn photographs are taken from Hildebrand, The Architecture of Albert Kahn.)
the metal was easily corroded in an industrial setting, and sound dampening was inadequate. This led to the use of another new building technology: reinforced concrete.

The earliest use of metal to strengthen concrete dates back to the procedure of wrapping iron chains around the great church domes. The main impetus to develop the technology for more common building components came with industrialization. The development of reinforcing was not systematic and national rivalries tended to isolate new techniques. In England, William Fairbairn started using curved metal plates with concrete filling for a flooring system, a precursor to today's composite floor decks. Francis Coignet of France began experimenting with metal mesh in the 1860's, but he wasn't aware of the exact position of structural forces, and didn't conceptualize the metal as the tensile element of a composite system.

Starting in the 1870's research was carried out in France to calculate the structural forces. In 1892 Francois Hennebique obtained a patent for his system of reinforcing stirrups. He understood the principle of laying reinforcing rods over continuous spans, to reduce diagonal shear as well as provide tensile strength, and the ability to reduce stress by cantilevering. Robert Maillart was another pioneer in this kind of construction. He developed the thin slab and mushroom capital column which has been widely used in factories. He designed a building in 1908 with this system that had cantilevers at the perimeter to exploit the potential of extensive glazing. Auguste Perret is another man who used the plasticity of reinforced concrete to span larger areas with forms that expressed the lines of force coming down to the ground.

The first American to develop this technology was Ernest Ransome. He worked initially in California where concrete made sense to use because steel was scarce. His factory in Bayonne, New Jersey, built in 1898, was the first to have an integrated con-
The Boots Cosmetics Factory, Beeston England, built in 1932 by Wilfred Owens. (from Drury, Factories.)
crete frame and flooring system. The United Shoe Company in Beverly also had such a frame and looked ahead of its time with a curtain wall exterior. Concrete was increasingly used up to the Second World War in multi-story factories. It was cheap, it absorbed sound well, and it offered large window areas. One problem was that concrete doesn't tend to wear well, especially if built poorly, and the reinforcing can become exposed.

One of the most handsome manufacturing facilities designed with reinforced concrete is the Boots Factory in Beeston England. It was designed in 1932 by Sir Owen Williams, who was a civil engineer. He used materials in the spirit of industrial design. The skin is translated into glazing, both for the roof and perimeter, and the structure is concrete, with an elegant use of mushroom columns. Williams designed the building like an engineer, working closely with the Works Planning Committee, which was comprised of production engineers. This is now common practice for architects as well, but at that time the architect did not usually collaborate with such committees.

Towards the end of the century, owners began to employ more architects, but they didn't concern themselves with interior lay out and materials until legislation demanded more fire exits and other precautions. The architect's role was to be a conscious interpreter in building the spirit of the age.

The German architects Peter Behrens and Walter Gropius used the new building technologies in this artistic tradition, but cared as well for functional considerations. Behrens' A.E.G. Turbine Factory, built in 1909, is a world famous example.

"Beyond mere utility, Behrens sought to create monuments and temples of a culture based on modern industrial power...both physical and corporate." 4

The factory was 75 feet long and 90 feet high with a crane operating the length and a three hinged arch for the roof. To this his more
A factory designed by Auguste Perret.

The Fagus Shoe Factory, Alfeld Germany, built in 1910 by Walter Gropius and Adolf Meyer.
artistic instincts added a six-faceted profile and the concrete corners of the walls were inscribed to resemble masonry rustification.

Walter Gropius also explored the potential of new construction techniques. He went beyond functional necessity in composing the elements he chose, such as emphasizing the roof line in the Fagus Shoe Factory. Its stair tower, with the corners built of glass, was a signal that architects were beginning to experiment with industrial materials in industrial buildings.

The Legacy of Albert Kahn

Albert Kahn was a seminal figure in manufacturing design and the management of architectural practice. In a sense he industrialized the design process, expecting specialists to coordinate their work so that the program, the structure and the budget were worked out together. Kahn was also a pioneer in coordinating design and construction sequences. "Fast-track" construction is vital to owners of production facilities because delays mean output and profit are reduced.

Albert Kahn began his practice using conventional mill construction which had a spanning capacity of around 20 feet, then switched to reinforced concrete systems where the spans reached 32 feet. His brother Julius was experimenting with reinforcing techniques and they worked together from that point on. The first commission that really demonstrated Kahn's innovative flair was the single story George Pierce Automobile Plant, built in 1906. The group of buildings was carefully sited with regard to the production flow and all used a common structural module. The complex was already ideal for assembly lines although they were introduced later. Unlike other architects Kahn never looked for finite compostions; he thought more of the site plan, which located the circulation of goods in and out of buildings rather than the building's physical end. This ideally suited industrialists like Henry Ford who were introducing assembly line production.
The George Pierce Automobile Plant, Buffalo New York. It was built in 1906 by Alfred Kahn.

The interior of the Pierce Plant Manufacturing Building.
Kahn's first plant for Ford was a multi-story building built in 1909. Ford wanted to maximize use of what is termed "gravity feed" production, where processing begins on the upper floors. The product is passed through the floors by gravity with ramps and conveyor systems, becoming a three dimensional production grid.

It is interesting to compare this facility with another car factory built fifteen years later by an Italian architect, because the buildings reflect the different priorities of each designer. Giacomo Matter-Trucco designed a factory near Turin for the Fiat Company. Both buildings exploit concrete technology; in fact, Matte-Trucco worked with modular design, composing three structural elements to form the framing system. The difference lies in that Matte-Trucco used the exact opposite of gravity feed, slowly bringing the cars up to the top floor. The "piece de resistance" of the design was the roof-top testing track and a sinuous ramp leading the cars back to the street. It made little sense economically but was hailed throughout the European architectural community. Reyner Banham called it "the most futuristic building ever built" and it was a favorite of Le Corbusier's; there is a famous picture of him posing in one of the cars. Happily the factory is still used for bodywork. The dynamic loads of the assembly machinery became too large for the framing.

Although the Fiat building was "futuristic," the actual future of manufacturing facilities followed the choices made by Kahn and his corporate patrons. They quickly switched from multi-floor concrete frames to single story plants made with steel. In decades to come most large manufacturers followed suit. The advantages of concrete disappeared with one story design. Steel required no formwork, which meant a quicker erection time. The spanning capacity equalled that of concrete without the dead weight and depth of large concrete beams. Steel columns were also more slender which increases the flexibility of machine lay-out. Steel could be used more easily to create an efficient, integrated envelope, comprised of the structural
The roof test-racetrack on the Fiat Factory, Lingotto Italy. It was designed in 1916 by Fiancomo Matte-Trucco. (All Fiat pictures from Pozzetto, La Fiat-Lingotto.)
The reinforced concrete framing for the spiral ramp that carried the cars from roof to street.

Structural plan for supporting the test racetrack and car ramp.
The interior of the Packard Forge Shop, built in 1911.

Kahn's drawing for the Packard Forge Shop. He is showing the circulation of air and light.
system with lighting and ventilation outlets. In his design for the Packard Forge Shop this integration of structure and light is especially dramatic. The total wall height available for light and ventilation exceeded the height of the building itself.

Kahn standardized the approach and the criteria that his office used in executing a design project, but never an actual physical form. These always were adapted to suite the requirements of the particular manufacturing process. One of the best examples of a series of similar elements is Kahn's wide-span monitor roofs. He abandoned the standard saw-tooth roof as being too inflexible. When the light entered from a single direction it cast shadows on the other side of heavy machinery. Kahn's sloped monitors mixed light from two directions, which was then diffused off the underside of the opposing surface before it entered the main space. These monitors were built up from the main roof trusses.

An example of one of Kahn's later buildings, designed under the cloud of the approaching world war, was the Glenn Martin aircraft assembly building, built in 1937. The design problem was to produce a 300 foot by 450 foot column free space. Kahn sponsored an inter-office design competition for the lightest solution. The winning scheme was to support parallel Pratt trusses, 30 feet deep, at 50 feet intervals. These trusses were adapted from bridge design, the difference being they had lighter loadings. It was a magnificent space, that was huge without feeling oppressive. The 440,000 square foot project was completed with incredible speed. It started in February, and was finished on April 23, with a million dollars of equipment already installed.

A humorous footnote for architects is that for many years Kahn refused to hire any architecture school graduates, saying they couldn't work as a team well enough and were too egotistical with their work. Perhaps the humor fades when the profession looks at statistics showing in recent years architectural firms have steadily
The Chrysler Half-Ton Truck Plant, Detroit, built in 1937. Trusses supported at 60 foot intervals were adapted from bridge design.
lost their share of the market to engineering firms that have expanded to offer building services. Albert Kahn's achievements have always been understated, but from the industrialist's viewpoint his skills in coordinating design and production considerations to maximize productivity have never been surpassed.

**Post War Factory Design**

There are a number of factors that have developed over the course of this century to favor the construction of single-story factories with high ceilings and large bays. The use of electric motors tended to decentralize the production floor. There was no longer a problem with transmission loss as there had been when machines were fed from centralized vertical systems. Overhead electric gantry cranes introduced the need for much higher ceiling heights and had heavy loading requirements. In the 1930's fork lifts started to be used. They induce point loadings with stresses that can run three times the uniform loading, so it makes more sense to use them on the ground.

The fundamental difference in producing at the ground level is in the rate and the cost of production. For the firm producing a steady, high volume of goods, there is a natural energy efficiency in moving components horizontally instead of vertically. Vertical conveyance, like freight elevators, are an expensive fixed cost. The construction of road networks like the American interstate system in the 1950's, and the exponential use of trucks over railroads, augmented this horizontal flow, from assembly line to forklift to truck to the forklift in the distribution center.

The environmental control systems in factories have also grown in cost and complexity throughout this century. Their routing throughout the plant is a major design determinant now. After the Second World War they tended to be placed in the roof zone. This interrupts natural lighting coming from monitors or skylights, so that fluorescent lighting came to serve as the primary lighting
The exterior and plan of a European post-war factory, comprised of rental workshops to encourage new production. (from Drury, Factories.)
source. The HVAC systems in factories need to be replaced or upgraded more often than the building frame, which means they need to be designed with built-in flexibility. They were usually left exposed.

Designers after the war built innovative concrete shells for manufacturing space, with large column-free areas, but because the services had to be placed in the concrete they proved limited in their feasibility. The space frame, which started to be mass-produced in the 1960's, accepted services easily in both directions and had large span capacity but their fabrication has always been expensive in relation to truss and girder systems, and the number and close spacing of the struts was restrictive.

In Europe a great number of production facilities had to be built because of war damage. The portal frame with cross bracing was often used for smaller facilities. It was cheap and quick to build but its drawback was that it was an inherently linear system that could only be extended easily in one direction. Post-war production processes have come to be more cellular than earlier assembly "lines."

An interesting planning concept for European post-war factories was to build clusters of small rental production spaces for new firms. These were either multi-story or single-story with shared facilities. Spaces as small as 10,000 square feet were rented and often combined with retail, apartments or office space. It was probably not copied in the U.S. because there was more manufacturing space already available.

A new building system was developed during the war that has since mushroomed in popularity; the pre-engineered metal frame with metal sandwich panels. It started out as the Quonset hut, designed in Rhode Island for war-time use. Its origins can also be traced back to the sheds built in nineteenth century factory complexes using cheap
The Ipswich Chronicle Newspaper Plant designed by Woo/Williams Associates. The design modifies a low-cost metal-frame building system that the contractor had in stock.
corrugated metal. It was initially used for warehousing functions, but the engineering was advanced to satisfy higher HVAC and thermal standards. By 1979, 46.9% of low-rise industrial structures used this system, and in the last decade its sales increase was 16%, compared to 8% for construction materials as a whole. Its greatest advantage was predictability. Being largely prefabricated, labor costs were cut and erection time was quicker and easier to forecast. The long lead time for design changes and labor delays are risks for industrial clients, so their suppliers heavily advertise this advantage. Engineering for the metal sandwich panel has led to its current popularity. These can be easily removed when a company wants to expand, unlike brick veneer. They have been designed to give good acoustic, insulation and weather protection. Masonry is still used however, sometimes for the aesthetic, but it also offers superior impact resistance and sound absorption.

In America the most common lay-out for factories after the war has been the "deep plan." This plan is in a sense the culmination of efforts to increase the bay size to its maximum spatial level of efficiency in industrial production. The bays were extended in both directions. This was now possible because with the sealed environmental control systems, natural lighting and ventilation were no longer thought necessary. These systems were usually fed in through the roof.

The bay sizes are usually around 60 by 40 feet and ceiling heights are above 20 feet. The size of these facilities can become enormous. In time, some companies noted that the physical scale had become oppressive for workers. This rational, endless box lowered productivity in the people if not the machines. The importance of being able to see out of a working environment was rediscovered and many facilities built today are smaller, with more openings. Arup Associates of England and other firms have taken up developing the sloped monitor roofs used by Albert Kahn. The oil crisis in the 1970's also introduced a sense of energy use limits, but production facil-
A representative plan using a Butler building system. (from their trade literature.)

Many companies are installing the multiple controls inside clear plastic thermostat guards employees tampering with controls are possibly playing with profits.

(From building trade literature.)
ities usually have a longer economic life when they have built-in excess capacities.

Architects have increasingly taken up the problems and puzzles of manufacturing design. Some have worked on their own component systems, like Bruno and Fritz Haller of Switzerland. They designed cruciform columns that can carry trusses and crane rails in either direction and allow service piping to be passed through. The firm of Piano and Rogers and the American Craig Ellwood have also done work in industrial design, specializing each system in ways that mean it can be easily replaced or the structure can be extended without disrupting the main production area.

As described above there has been a variety of manufacturing shells built that are still used by firms. There is a matching variety in the types of production processes and some are more suited to certain kinds of building lay-outs than others. "Low tech," light production firms have modest spatial requirements and can use older, cheaper plants, modernizing them when needed. "High tech" light production on the other hand needs the capacity for a large array of services. Electrical systems are becoming an increasingly large component of building costs. Wide spans aren't as important as being able to adopt services quickly with minimum costs. In fact advances in production machinery have reduced the size of machines dramatically which means smaller facilities aren't always a disadvantage.

The system for materials handling is a key determinant in what kind of facility a firm will occupy. If a product is relatively small and light, is mainly processed in a small area, and is not being produced in continuously high volumes, then a multi-story factory may not lower the average cost of producing the product. Such a facility can use hospital design as a reference in the ways it routes services between floors. In general, smaller firms that are less capital-intensive can use this kind of lay-out.
Frames with fixed ends of reinforced concrete. They can also be constructed in steel and wood and are then generally solid-webbed. Suitable for heavy frames. Good building ground is a prerequisite.

A frame with two joints of solid-web steel construction. Construction in the form of a lattice frame is also possible and wood is also used. With reinforced concrete, an arrangement with spring joints is usual.

A frame with three joints (statically determinate) in the form of a lattice steel structure. Solid-web construction is also possible and construction can be in wood. Reinforced concrete is used more rarely in this design.

In steel-framed shops, the craneway girder is used also as a horizontal wind brace. Not every frame requires to have fixed ends, and the intermediate frames can be kept lighter so as to save materials, and be anchored below with joints (in this way lighter foundations are possible).

With very heavy steel-framed shops (large crane loads) it is often economical to place only two or three trusses on stanchions with fixed ends and to support the intermediate trusses with the craneway lattice girder. The system then takes the form of truss slabs on stanchions with fixed ends as described on page 74.

Alternative designs for a structural frame.
(From Henn, Buildings for Industry.)
Conclusion

It is important for designers to understand how a building's design can help or hurt the productivity of a firm. Probably the most critical aid is a flexible production area. Most firms need to be able to shift operations and change their scale of production quickly. A new market can open suddenly and if the firm is able to produce for it quickly it will make profits before competitors join in. Another area in which a good design can be a financial asset is when it reduces operating costs. This ranges from providing heat extraction systems that save on fuel costs to programming the right operations contiguously with adequate storage facilities. A pleasant working environment will increase the productivity of workers. Finally, the designer can provide the firm with an attractive façade which becomes a type of advertisement, and contributes to the nebulous but important concept of prestige.

To summarize, capitalistic industrial production has propelled the development of an efficient, well-tempered box in which to place workers and machinery. Capitalism has built-in incentives for firms to become large. It is these firms that demand the most modern facilities and set the standards for manufacturing space. In the next section I will put the manufacturing building in the context of its wider demand in the market. In this market a building's location is as important as its physical attributes.
Comparison of luminescence intensities in the cross-sections of flat-roofed buildings of different heights shown in diagrammatic form. The roof-lights are spaced at intervals of 15.00 or 7.50 m and span heights are 15.00 and 5.00 m. These uniform dimensions were chosen for purposes of diagrammatic representation, so as to obtain comparable values: however, they are not often used for particular forms of building and design.

The theoretical values of the daylight factor (determined by the glass-window method for the non-glazed bare structure opening) can only be used for comparisons between the different room heights and forms of roof-light. The absolute values of the daylight factor can only be determined after correction of the values found, by multiplying them with the reduction factors for obstruction, glassing and deflections.

For roof-lights of similar shape, which are only compared in respect of their openings and their height above the floor, the differences of the absolute values of the daylight factor are smaller than in the theoretical determinations, as the reduction factors in the examples to be compared are the same.

1 and 2 Flat-roofed buildings with slanted roof-lights. The glass surfaces have a pitch of 45°. High average daylight factor. In high rooms a high level of uniformity is achieved whilst in low rooms there is only a low level of uniformity. The maximum values of daylight factor are immediately under the roof-lights.

3 and 4 Flat-roofed buildings with mansard roof-lights. The glass surfaces have a pitch of 10°. The average daylight factor is lower than for slanted roof-lights with a pitch of 45°, in rooms of low height there is better uniformity above the roof than with LD. The maximum values of daylight factor are found under the roof-lights.

5 and 6 Flat buildings with slanted roof-lights and vertical glazing. The average daylight factor is smaller than for sloping glazing, but better uniformity is achieved. The maximum values of the daylight factor are located in high rooms between the area of the roof-light superstructure and in low rooms under the roof-lights.

7 and 8 North-light roofs with vertical window strips with a pitch of 80°. The average daylight factor is higher than for vertical roof-lights. There is a high level of uniformity of illumination in North-light level and the level is higher in high bays than in lower ones.

Diagrams for roof design using natural lighting. (from Henn, Buildings for Industry.)
Comparison of luminous intensities over the cross-sections of bays with various methods of lighting. Each room is 25 m wide by 50 m long. The size of the glass surfaces is taken as 30% of the floor area. The floor area is measured in the oblique and vertical window surfaces for purposes of comparison in all examples. This assumption is only of a theoretical nature, however, to enable comparisons to be made.

The theoretical values of the daylight factor are also only suitable for these comparisons determined with the great-circle method for the non-glazed bare structure openings. The determination of the absolute daylight factor is only possible after the usual reduction factors for dust deposits, etc., have been taken into account. In bays (5) and (7) the roof-lights are transverse and are therefore only 25 m in length. The daylight factor is also determined in these examples by the great-circle method so that comparisons can be made. As the roof-light strips are shorter, however, the values determined by the great-circle method must be correspondingly further reduced for the determination of the absolute daylight factor.

1. Bay with high side glazing and no roof-lights. Maximum values of the daylight factor are to be found in the window area both when there is illumination from both sides (A), and also when there is illumination from one side only (B).

2. Bay with high side window strips and ridge roof-light (inclination of 45°). The daylight factor reaches its maximum values in the centre of the bay (A), and also when the roof-light is the only source of illumination (B). If illumination is provided on one side only from a window strip (C) the luminous intensity is small.

3. Bay with glazing in the roof surface and closed side walls. The maximum values of the daylight factor are under the glass surfaces and give rise to high luminous intensities. Values for illumination on two sides (A), and on one side (B).

4. Bay with roof-lights sloping on two sides. The daylight factor attains its maximum values in the centre of the bay (A). The curve of the daylight factor when illumination is on one side only is shown at (B).

5. Bay with continuous ridge roof-light (inclination of 45°). The daylight factor reaches its maximum in the centre and decreases towards the side walls. There is little uniformity of illumination.

6. Bay with vertically glazed transverse roof-lights. The maximum values of the daylight factor are in the central region of the bay. The intensities of illumination are not high but a high degree of uniformity is achieved.

7. Bay with glazed roof-lights (inclination of 45°) in the transverse direction. The maximum values of the daylight factor are in the room centre and there is a marked reduction in the illumination intensity towards the outer walls. There are high illumination intensities, but only a small degree of lighting uniformity is achieved.
Industrial landscape in Lancashire, England. (from Richards, The Functional Tradition.)

MANUFACTURING LOCATION
A Brief History of Manufacturing in Massachusetts

"The machine was a new and demanding god; the mill town was its first parish."\(^5\)

In order to understand why manufacturing facilities are acquired or modernized in an area, it is useful to look at the history and projected changes in the area's manufacturers. Massachusetts has a long tradition of supporting the growth of manufacturing. There are similarities in the growth of factories between England and New England. Like London, Boston has served as a mercantile port city, accumulating the capital that financed the first manufacturing entrepreneurs. Francis Cabot Lowell was one such early industrialist. He organized The Boston Manufacturing Company, which became one of the state's largest firms. In asking for $400,000 in venture capital he stated that his firm would cure unemployment, increase exports, and lower consumer prices. This would become a familiar model; in fact today Boston is still a national center for providing such capital. With the money, Lowell's company set up the first integrated textile mill, combining all the cloth-making operations under one roof in Waltham. Over the course of the century hundreds of such mills were built, located first in rural mill towns by sources of water power, and later in cities throughout Massachusetts.

Steve Dunwell, in his book Run of the Mill, gives an excellent account of the New England textile industry. He describes the different scales of capitalistic production that co-existed within one industry. Companies like Francis Lowell's were heavily capitalized joint-stock operations, developing whole cities like Lawrence and Lowell into their production centers. There were also smaller firms who were more content to limit their markets and remain where they first began operations. Erastus Bigelow, a manufacturer and mechanical genius who invented the power loom, spoke against the joint-stock company's way of conducting manufacturing. He noticed it was inherently expansionist, causing periods of over-production followed by times of inactivity and wage-cutting. Nevertheless their
A comparison of spinning capacity in New England and the South from 1880 to 1970, based on Census Bureau statistics. (from Dunwell, Run of the Mill.) It shows the transfer of firms from one region to another.
methods prevailed and in time textile manufacturers expanded out of the state.

Until that time Massachusetts mill industries, primarily producing textiles, shoes and machine tools, experienced a golden age. "[Massachusetts]...enjoyed a century of unchallenged supremacy by virtue of having monopolized the nation's motive power, venture capital and mechanical skill. This changed through the mobility of these resources." 6 Eventually the innovative machinery, developed under its initial owner, was mass-produced and exported; just as England couldn't keep her most revolutionary inventions from leaving the country. This decline of the initial manufacturing base was gradual and came about for many reasons. The second and third generation manufacturing owners didn't show as much interest or expertise as a group and began to disinvest in the plants. Regions like the South built new plants with more modern equipment, as well as offering lower wage rates. Mills that did invest here and specialized in high quality market sectors were able to survive longer.

There was a huge increase in production in the traditional industries from approximately 1880 to 1927. Leather rose 321%, textiles 449%, machinery 562% and paper and printing rose 614%. Many buildings were correspondingly constructed in towns and cities during that time. It is often these buildings that are now underutilized because of the decentralization of production location. At the time they were built the truck had not yet become the standard means of moving goods. It was then more expensive to move goods and the railroad system caused a centralization in the manufacturing districts it served.

The Depression accelerated the decline in the traditional industries. By 1940, 2/5 of the total manufactured output in the state was in non-durable goods that had been produced here for over a hundred years. 6 This was two times the national average.
The next decades were extremely difficult for Massachusetts communities whose employment base had irrevocably eroded. This loss is still taking place. The old mill-based industries lost 61,000 jobs between 1960 and 1975 and are no doubt still losing more.

As is often the case, some businessmen were able to take advantage of this process. The most famous local example was one of the nation's first conglomerate firms, Textron Incorporated. It was started by Royal Little, whose uncle, Arthur D. Little, was the founder of one of the area's first "knowledge-based" companies. Royal Little first developed a successful rayon business, rayon being a product which was then coming onto the market. He next started to buy up many vacant mills around New England, which were sold cheaply because the Depression had caused many firms to abandon them. At the same time he was locating other facilities in the South. In both areas he introduced new working conditions and management practices, based on his analysis of time-motion studies. When workers in this area refused to go along he simply switched over to the Southern plants, leaving whole communities like Nashua without jobs. This resulted in some of the first plant-closing hearings, but everything Little had done was legal. Ironically, Textron has now diversified to the point where it no longer produces textiles in the South either.

Since the Second World War, Massachusetts has slowly organized a new manufacturing base, developed from scientific and engineering advances, like their initial industries. There were many conditions that supported reinvestment; a good supply of financial capital, labor willing to work for low wages, a continuing stream of highly-skilled engineers and specialists coming from institutions like M.I.T., and cheap space to begin production. Since the fifties newer firms, such as electronics and plastics producers, have moved into existing buildings, as well as building new ones.

Massachusetts has gradually shifted from producing non-durable
### Employees in Nonagricultural Establishments (in 000s)

By States, Annual Averages — States 1969, 1973

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A chart illustrating the shift of manufacturing activity to developing regions in the country.
goods, like shoes and clothing, to making highly specialized, research-based durable goods. These are often machines that other firms use, which is reminiscent of the area's earlier export markets. Massachusetts will probably remain dependent on exporting given its type of resources. Like all regions in the country, local employment in manufacturing has fallen more than its output has. 1953 was the year when manufacturing jobs peaked. Only a quarter of Massachusetts employees work in the manufacturing sector today.

The main area of job growth has been in the low-wage service sector. Despite the publicity of new "high-tech" industries, only 1/8 of the work force held these jobs in 1978. High-tech is expected to grow, but there is a trend already in evidence to move assembly facilities to areas offering lower wage rates. These are often out of the country as well. Capital spending on new factories in Massachusetts has been dropping for a decade relative to other regions in New England. What will probably remain are the administrative and research and development components of these firms. They want to be near the universities and financial districts. It is estimated that in 1978 New England financial institutions held $85 billion dollars in assets. They are starting to invest more heavily in regional research-intensive manufacturing firms that have the right credentials.

All these developments cause people to herald the "post-industrial future" when looking at Massachusetts today. One definition of "post-industrial" is: "the etherealization of national wealth from physical stocks to information flows." It is a time of Atari Democrats seeking answers to structural unemployment and course offerings in computer literacy; but also a time when plant utilization is at a post-war low with many wondering if investment in these facilities will ever return.

Most experts write that the path for Massachusetts to follow is
to continue to target investment in industries developing research-based products. They also stress the need for further development of international export markets; in a sense to become the American Japan. Another tack, that may in fact be complementary, is to develop high-quality artisan products and create a stronger regional economy. The key is investment capital, and right now, in 1983, its primary source is a unique one: the Pentagon.

Military Investment in Massachusetts

Massachusetts has a long history of producing for the military, dating back to the nineteenth century tool and armaments industries. It was during the Second World War that the military stimulated industries in Massachusetts to apply sophisticated electronics research for wartime needs. The development of the computer was hastened by the military's desire for precise calculations of shell trajectories and similar uses, and research on atomic energy was also later applied by local manufacturing firms. Many of the largest high-tech manufacturers now based in the state began from this relationship.

An agency within the Pentagon, the Defense Plant Corporation, supervised the disposal of military production facilities after the war. They allowed their former suppliers to take them over on very favorable lease-back provisions, with the added advantage that they weren't required to pay local taxes. General Electric plants in Lynn, Everett and Pittsfield were acquired in this way, which must have helped their rapid expansion.

Local manufacturers applying microwave technology are an example of an industrial sector that has developed since its infancy with Pentagon contracts. Research in the field was done at M.I.T. during the war and close links remain between the firms, the school, and the Pentagon. In a 50 mile radius around Boston there are now 189 firms; the highest concentration in the world of such manufacturers. They produce 80% of their output for the F.A.A. and Defense Department; although their production could equally serve civilian needs,
An emerging requirement is to provide protection for the crew as well as the equipment in a battle zone where nuclear, biological or chemical agents may be used. Combat vehicle crews must be able to operate efficiently during prolonged periods of "buttoned up" conditions. LFE units that maintain the equipment at proper temperatures will probably be called upon to perform this expanded role by cooling the operating chamber of the combat vehicle, or cooling the special protective combat suits.

An example of manufacturing for the military. (from an L.F.E. brochure.)
as is done in Japan. The microwave industry is under little pressure to be competitive. They produce in an insulated market, with a single buyer offering secure contracts. This distorts many factors in production, including the incentives to modernize facilities. On the television documentary, "Pentagon Inc.," a factory in rural Pennsylvania was shown that has been the sole supplier of artillery shells to the Navy for many years. The facilities had become so obsolete that private banks had refused to give the new owner any loans. His only recourse was to take money from the Pentagon's multi-million dollar modernization grant program; the hitch being that they wanted the firm to relocate to a brand new plant. The workers were not very pleased.

The Pentagon controls the largest planned economy outside the Soviet Union, spending more than the net income per year of all U.S. corporations. Civilian democratic control of its operations is limited to congressional appropriations committees, the proverbial pork barrel. For some communities, a firm with a military contract is the only hope for providing jobs, and working conditions suffer as a result. The output is planned, but inputs like unfair labor practices are relinquished to a laissez-faire scramble for jobs.

The development of new civilian markets, which in the end would create more jobs and equally boost the economy, will be slowly eroded if the Reagan-era defense budget goes ahead as planned. In the meantime the Pentagon is pushing its own version of "industrial base planning." This includes their vision of the new factory. The target: one "manless" shift per day; that is to say a highly productive facility where robots and automated machinery will further take the place of human labor. Because Massachusetts will receive many of their contracts for things like further weapons computer- ization, this upcoming investment will influence demand in manufacturing facilities. A more ominous influence is noted by the English historian and nuclear disarmament activist E.P. Thompson: "We are preparing ourselves to be the societies which go to war."
Determinants in Manufacturing Location

Theoretical frameworks have developed around the issue of how manufacturers choose to locate their production facilities. One framework, called "location theory," is based on neo-classical economics. Another approach uses Marxist analysis in studying the use of space under capitalism, both within a city and in a regional economy. During this century input-output analysis, developed by Leon Walras and made operational by Wassily Leontieff, has been used to link the different industrial outputs with shifts in capital formation in a metropolitan or regional area.

Location theory is said to have started in 1826, when a German economist, Von Thumen, published The Isolated State. He discussed the correlation between distance from the city center and the intensity of land use, noting that agricultural land closest to the city would rationally be the most intensively cultivated, growing products like garden vegetables instead of corn.

This type of modelling has been widely used in relating types of economic activities with their aggregated spatial forms. Each activity, for example business administration or retail services, has a "rent gradient," which on a graph is its demand or "bid rent" curve. This measures its command over what it can pay to occupy a particular spatial position, and the density at which it will build. Looking at such a graph, you can see that business is able to demand the highest prices and intensities of land use. If their demand and ability to pay increases, they can displace other activities further out along the distance from the city-center axis. This is an actual problem for inner-city manufacturers. When the business district expands, rents in other neighborhoods are driven up. A good example in Boston, taking place right now, is the Ft. Point Channel District. If the graph is then modelled in rings, a rough analogy with the actual skyline of a metropolitan region appears; the central business district containing the high-rise buildings and exurban housing forming the low end of the skyline.8
OBJECT OF GAME:
UNCLE SAM TRIES TO AVOID GETTING KILLED BY THE UNEMPLOYED, BY CONVINCING THEM THEIR FUTURE IS IN HIGH TECH INDUSTRIES.
...MEANWHILE HE MUST EXPLAIN ATARI MOVING ITS MANUFACTURING OPERATIONS TO TAIWAN.

Manufacturing has changed its position over time on the graph more than any other activity. It could probably outbid all activities except those in the central business district, but it chooses its location on other factors. Where at one time average costs to manufacture were lower near the center they have shifted to suburban and exurban locations.

Location theory analyses production costs and classifies types of firms according to how their costs are weighted. The objective for a firm would presumably be to determine the location that would entail the least accumulation of production, distribution and marketing costs. It is important to understand how the types of costs have decreased or increased in absolute value and as a proportion of total cost. For example, as automation increases, location in Third World areas becomes more feasible because the plant is less dependent on the costs of skilled labor.

The long run reduction in the proportion of transportation costs to total cost has been an important factor in the dispersion of factories from urban centers. As production processes become increasingly complex, with increasing amounts of labor costs imbedded in the materials sold to other manufacturers, transportation costs have decreased in their percentage of the total cost. Being near the source of raw materials is less important. In addition, the absolute cost of transportation over distance has decreased, with the government absorbing much of the expense in developing and maintaining road networks. Economies of scale have lowered prices for services like air-freighting. This means that labor costs increase in proportion, so that there is a strong incentive to deskill work and introduce automated machinery. It explains why it is now cheaper for firms to locate assembly plants in countries like the Philippines, shipping in the components and shipping back the finished products.

When transportation costs are significant, manufacturers are
The greater Boston region. It shows the major transportation routes that have been factors in manufacturing location.
likely to locate near their supply sources, especially when the
supplies are heavy, as in steel-making. Manufacturers also want to
reduce terminal holding charges, so that they often locate on a node
where other products they need are moving through. This may be a
port or a center for trucking terminals. Newer cities like Charlotte,
North Carolina expanded their economy because of this. Still other
firms lower their costs by being near their markets, whether they
are other industries or consumers. Foodstuff manufacturers fall
into this category. If a firm locates too far away, to save on
other costs, they risk customer dissatisfaction if their inventories
aren't maintained. Certain firms like printing need frequent personal
contact with clients, so they will probably remain near business
districts.

Highly skilled production process, making relatively small high-
value products, are free to locate where the skilled personnel and
administrators want to live and work. This is made possible by the
extensive road network. The suburbs west of Boston contain so many
of these firms now that the old image of a commuter belt is no
longer accurate. Great Britain has stricter controls on manufacturing
location, issuing Industrial Development Certificates in ways that
steer firms to areas with low-employment. The Inmos Corporation,
which makes semi-conductors over there, argued against the govern-
ment's choice saying, "...high-tech superstars want to wake up to
vistas of rolling green hills, not to a grey industrial landscape."

Manufacturers in Massachusetts do locate along the state's major
interstate and highway routes. Route 128, nicknamed Technology High-
way, has attracted firms since its inception, drawing many companies
that had started production in central Boston. Town industrial
development commissions and real estate developers are still packaging
sites along the road, but prices have risen enough so that some
production facilities are moving even further out, to areas like the
Interstate 495 corridor. Route 128 is increasingly used for office
and research parks.
The chart shows sectors in the economy have all become less densely located. It is related to the overall population dispersion pattern in the country.
For the first time since the 1850's there was a net out-migration from metropolitan areas in the national census (1980). This means that the labor force, as well as factories, has dispersed throughout the country and in Massachusetts. Community colleges have sprung up to train these people for skilled positions in local factories. Union activity tends to be lower outside urban areas and zoning regulations are looser. Another determinant for firms in location decisions is how long the planning process will take. Smaller towns with plenty of undeveloped land are in a stronger position to offer easier planning procedures.

It is good to remember that theory and practice may not always coincide on why a company chooses a site. David Gordon used historical data to point out that manufacturers left Chicago to develop centers like Gary, Indiana 25 years before the use of trucks, refuting the reasons offered by neo-classical analysts like William Alonzo. Manufacturers have left cities recurrently since the guilds lost control over production hundreds of years ago. The main reason has had more to do with the added profits that can be gained with a politically weaker labor force.9

The Decline of Urban Manufacturing

Urban manufacturing workers have a long tradition of struggling to retain their jobs. Complaints were raised against "the hiring of wenches" outside cities in the 1400's. Sam B. Warner wrote an article about Philadelphia textile workers in the early 1800's. They organized strikes and marches on newer suburban mills that were taking away their source of livelihood.10 Attempts to retain production in the city failed once control passed from the producers themselves to merchant and later industrial capitalists.

The United States is now sustaining an economy where it is more profitable for most manufacturers to leave the city, taking with them significant numbers of average to above-average wage jobs. At the same time more and more poor "minority" people live in cities.
At 23, Geoffrey B. Small is not only a prize-winning fashion designer and founder of the GBS Grey Card, a semi-custom fashion business in Newton, but he is also a visionary. He thinks it is not beyond the realm of practicality to imagine that Boston may one day become "the design center of the world for high-class ready-to-wear — the new Milano.

"It sounds crazy on the surface," he readily admits. "But you have to take into consideration that 15 years ago, there was no fashion business in Milano. The main centers of textiles in Italy were Florence and Rome. It was only after a few far-sensing businessmen decided to set up operations in Milano, and did a very good job of it, he explains, that city started attracting manufacturers and designers from other parts of the world. "Now, Milano is right up there with Paris, if not ahead," he observes.

Geof's comments remind a visitor to his Grey Card workrooms that Boston was once a textile-producing center. Why not again? Moreover, Geof adds, "Everywhere I go, people refer to Boston as 'the brain center of the country,' " because of the proliferation of high-tech industries, as well as the presence of MIT and Harvard.

The implication is strong that high technology can eventually help the textile and fashion industries sprint out of the "stone age" in which Geof believes they are atrophied. Already, he relates, machines are in use in Italy which employ lasers to cut garments. This process can implement the production of small quantities of high-quality merchandise at inexpensively as large quantities of low-quality garments. Wide application of such a process could revolutionize the garment industry.

Another of Geof's long-range dreams is the establishment of a vertically integrated company in which the production of fashion can be controlled "front to back:" from the design and production of fabric, through the manufacture of garments, to retailing in a space owned by the parent company.

The keystone in this concept is control of all phases of production. This represents a 180-degree turn-around from licensing, the process whereby designers allow their names to be used on products manufactured by someone else, in exchange for royalties. "Licensing has real limitations" in the present-day marketplace, Geof believes, not the least of which is "loss of uniqueness of product," which he sees as very important in the luxury market.

Despite his dim view of licensing, Geof is not averse to the idea of fashion designers expanding into other product areas, such as home furnishings or even cars. In fact, he envisions his future company becoming a sort of lifestyle center, where customers will be able to buy clothing, furniture and cars in one giant showroom. His sketches of this extraordinary emporium of the future show manufacturing taking place on balconies above the main selling floor — probably the ultimate integration of retailing and manufacturing.

He also believes this company of the future can become the American equivalent of Gruppo Finanziar-Tessile (GFT) of Turino, a $400 million company that produces the ready-to-wear collections of such designers as Armani, Valentino, Ungaro and Feraud. Or it could become the American Bidermann, a $300 million company, which Geof describes as "the largest privately owned company in France." It manufactures men's wear for Calvin Klein, Daniel Hechter and Yves St. Laurent, among others.

But to speak of these dreams of Geof's is to talk about step 99 in a 100-step process. Moving back to steps one through five, Geof started the GBS Grey Card semi-custom fashion business in September of 1981, on the top floor of his family's house at 17 Norman Road in Newton. He began with a list of some 30 customers who wanted quality clothing at reasonable prices. As his customer list expanded, he devised the idea of a monthly mailing of a swatched card that includes sketches, prices and brief descriptions of four or five fashions for men and women.

The clothing is premade to a certain point, and then custom-fitted to individual customers. Within a year, Grey Card membership has grown to 100. And there is actually a waiting list to become a member. Is it counterproductive to have this limit? Are potential customers offended by not being able to get on the list immediately? Geof doesn't think so. If the list were to jump to 500 suddenly, orders couldn't be filled promptly, he indicates. "We'd be cutting ourselves and the customers short," he says, using an unintentional pun that reveals his intense focus on the quality of his product. "It's better to take a few customers and treat them well."

The suggestion that large numbers of orders might be contracted out is regarded as anathema by Mark Sugarman, one of seven associates who have joined Geof in the Grey Card operation. "Our long-range goal is control," Mark emphasizes. "Contracting out production would contradict what we want to do."

The other associates in the GBS Collaborative are Leslie Fenton, Shelley Steinberg, Joan Cassesso, Derek Wittenberg, Jay Howard, and Philip Small. All were originally members of the Grey Card, which currently targets people working in the fashion business: retailers, designers, stylists, and photographers. "It's very hard to sell these people," Geof acknowledges. "They tend not to pay retail price points" because of store discounts or connections with manufacturers. "They know more about

without jobs. In 1979, 64% of white people lived in the suburbs versus 26% of black people. Inner-city areas have become the "sinks" of the economic system.

"Baltimore - like so many of the older cities of the Frostbelt - has become an increasingly inhospitable place for all but the most well-educated and well-connected workers in the population."ll

Residents of cities like Boston have become stratified between the "up-scale" Jacks and Jills that Jordan Marsh Co. likes to cater to and the poor and newly poor. Urban developers are trying to attract the well-connected workers with tasteful renovated shopping districts and cosmopolitan townhouse districts. It is said that those workers who will remain working in the city for high wages are "those concerned with the production of answers to unstandardized problems." For every one of them, three service workers will service them. H.G. Wells had a grim vision of the future city in his book A Story of the Days to Come that seems all too prophetic.

"...a vast lunatic growth, producing a deepening torrent of savagery below; and above, ever more flimsy gentility and silly wastefulness."

What can cities offer manufacturers? Experts agree that the city should draw from its strength; which is in offering specialized services in production and consumption. These exist because urban densities create what are called "economies of agglomeration." This is a term in economics that describes the lowering of average costs for a whole market sector when the firms in that sector are located near each other. This clustering can also stimulate increased demand, as you see in shopping centers. An example in manufacturing would be urban garment districts. By grouping together they can take advantage of skilled workers and carry lower inventories, important when a product changes every season. The central business district as a whole enjoys economies of agglomeration. Most top corporations
Armani than anybody, but they're the last people to spend $1,000 for one of his designs," he adds with a knowing, ironic laugh. "If we can sell them, we can sell anybody. They're the acid test." It seems that the test is working just fine to date. Though prices are modest and quality underlines high ($85 for a fully-lined, carefully tailored pant of Italian wool suiting; $45 for pure cotton shirt; $85 for a dress of lightweight Italian wool), Geof says, "We're not losing money. We find the twenty-cent solution to the million-dollar problem, and we translate that to the customer." Through integration of designing, marketing, and manufacturing, as well as control of sales and "cutting out a ton of middlemen," as Geof puts it, "we're probably making more than Ralph Lauren on each shirt."

The company ended its first year in the black. But Geof is quick to point out that the seven associates, all of whom work full time or are in school, "don't need this to eat." Though they all share in working in different areas — from operating sewing machines under Geof's guidance, to assembling the actual Grey Cards for mailing — they don't take money out of the business in the form of salaries. Profits are ploughed back into the organization to support it as a laboratory, where, as Geof says, "we're trying to perform all the tasks that will need to be done in the future on a huge scale. We're studying and learning everything we can, from selling to making garments, to making textiles. We're forming the nucleus of what we hope will be the best design company in the world, with as much manufacturing as possible to be done in the United States."

Among experiments undertaken in the GBS laboratory is the so-called Grey Card Collaborative Series. This draws on the talents of individuals who are members, and displays their products in a well-designed mailing piece. The premier issue presented Fenton Leathers by Leslie Fenton, who travels widely in order to select and import exotic leathers. Her Collaborative collection includes suede-lined cobra skin shoulder bags at $75 and $90, as well as checkbooks and wallets at $45 and $60. Subsequent issues may offer jewelry, pottery, or etchings, Geof indicates.

Another experiment in the planning stages is the GBS Special Order program. This will be aimed at customers who want totally custom-made clothing, and there will be approximately 100 styles and 100 fabrics to choose from. The concept was inspired by the custom tailoring of Saville Row in London. But because designs will be made one at a time, prices will be higher: shirts, $150 and up; pants, $250 or more; suits, $500 to $750. GBS design signatures will prevail, as in the Grey Card selections: pants for both men and women shaped full at the knee, tantal and narrow at the waist; shirts with asymmetrical collars that may be worn open or closed, and which eliminate what Geof terms the "out of date necktie." Other prototype designs being readied for this program are a woman's suit with one dominant diagonal lapel; a man's tuxedo jacket; and a classic Chesterfield coat for men or women in wool melton. As in the case of Grey Card offerings, avant-garde silhouettes will be balanced by traditional fabrications, like herringbone and glen plaid worsteds. In five to six years, Geof and his associates hope to have expanded the Grey Card operation into an international showroom in a building that the company will own in Boston. By that time, they also plan to be advertising consistently in Conde Nast publications. They expect to attain this goal through gradual expansion of the existing business, rather than by borrowing large amounts of money, or succumbing to the get-rich-quick allure of licensing.

Yet, as an astute entrepreneur, Geof is also a realist. Should the self-funded expansion of the Grey Card not work out, he says, its laboratory experiments will have produced "a very concise investment package" (including designs for ads and sketches of retailing spaces) for potential investors to inspect. Geof's goals for the Grey Card are clearly extremely ambitious. But he sees nothing wrong with that. He tells of the Hewlett-Packard electronics firm...
will want a New York office to take advantage of its specialized financial services.

Cities can offer manufacturers a wider array of support services. One example is that Typographic House, Inc., a large Boston typographic firm, can use taxi-cabs to deliver jobs quickly. There is also a greater aggregate supply of available vacant space, so that many growing firms find that cities offer them more flexibility if they need to expand or contract quickly. Until recently the cities have offered better police and fire protection and better utility connections. However the suburbs have been able to obtain low-cost financing from the federal government to upgrade their infrastructure. Such aid to cities has declined dramatically in recent years.

Despite there being a large low-wage pool of available labor in areas like Roxbury, this isn't much of an incentive for firms. This is because there are also "diseconomies of agglomeration," which describe what happens when too many people and activities are too close together. Traffic delays become an unnecessary annoyance for a firm which doesn't have to be near an urban market. Crime and arson are even more serious threats. Urban labor forces are regarded as being less productive by many managers. The higher densities means the planning process will probably take longer and be more of a headache, especially if there is a pollution problem. Beyond the issue of whether a firm will locate in the city or a suburb of a region is the question, will it be the country at all? One writer visited a plant in South Korea that contained brand new machinery, had three times the productivity it had achieved in England, and only paid out a quarter of its former wage rate. In the years ahead 1,000 million people will reach the age of eighteen outside the First World. Many will be literate and few will be unionized.

This does not mean that manufacturing has no future in the city, just that the city will have to be aggressive about stabilizing what
The back of a factory on a small urban site. The route out to the street is narrow with a blind turn around the building. Not all firms could use such a site.
exists now and planning for kinds of production that make sense in dense areas. These tend to be high-value compact goods that, in Boston's case, might take advantage of being produced in a port city with a reputation for exporting high quality goods. The gap between site size in the city and the suburbs is large: in Baltimore it ran 3.0 to 17.2 in 1970. This means cities have to compete in specialized markets which don't operate continuous high-volume assembly lines that require large loading areas and immediate access to interstate highways. Cities with older multi-floor buildings can not offer as many 18' ceiling clearances which is a standard now for pallet storage in new facilities. Some industries can take advantage of upper floors for the storage of products that aren't immediately in demand. The apparel, printing, and electrical machinery industries use such storage space.

City agencies like the Boston Economic Industrial Development Corporation have been able to retain manufacturing by coordinating planning procedures and providing funds for site improvements. They have been more successful in retaining firms already here and making it possible for them to expand at the same cost that they would incur in moving to a suburban site. All the site and tax incentives probably won't convince many large corporations to locate an assembly plant in an inner city. These corporations don't look at initial, relatively small cost differentials. They look at long-run calculations of their future markets and labor requirements.

**Industrial Real Estate**

The acquisition of manufacturing facilities is mediated by principles in real estate ownership. The primary purpose in owning real estate is for the property to increase its value over time and give the investor an adequate return for the invested capital. There is a constant recycling of value throughout the property market as a whole, with some areas gaining value, while others lose value. Some investors use real estate as a tax shelter, so that a loss in value is not necessarily a problem to income property-holders.
### Property Analysis

**Company**

**Full Address**

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**Size:** (Total sq. ft. area)

**Number of Buildings:**

**No. of Floors:**

**Floor Areas:**

- Gross (Dimensions)
- Net (Dimensions)

**Ground (Total Area & Dimensions):**

- Occupied by building
- Vacant
- Type of Terrain

**Construction:**

- Floors
- Walls
- Type of Columns (Cement, Steel, H Columns, or other)

**Date of Construction:**

**Condition of Property:**

**Ceiling Heights:**

- A) (Under beam)
- B) (To roof)

**Column Spacing:**

**Remarks re: Wall or Partition Divisions**

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A standard form used by industrial realtors to document a building they will handle. Companies evaluate possible expansion location with similar data. (from Kinnard, *Industrial Real Estate.*)
ELEVATORS:
A) Type
B) Size
C) Capacity
D) Locations
E) Maintenance Contracts, if any
F) Are Certificates posted?

WINDOWS:
A) Type
B) Location
C) Size
D) Storm sash or screens, if any:
E) Doors
F) Gates

TOILET FACILITIES:
A) Male (includes)
B) Female (includes)
C) Location
D) Restrooms
E) Condition

LIGHTING:
A) Type of fixtures
B) To be included in sale: YES or NO

ROOF:
A) Type
B) Bonded
C) Construction
D) Condition
E) What year
F) Monitors
G) Ventilation facilities

POWER:
A) Supplied by:
B) Voltage
C) Phase
D) Transformers

E) Panel Boards:
F) Bus Duct

HEAT:
A) Type Boiler
B) Age
C) How many
D) Are certificates posted?
E) Horse Power
F) High or low pressure
G) Pressure in pounds
H) Heat distribution
I) Blowers
J) Radiators
K) Oil storage facilities
L) Fuel used
M) Approximate cost per year
N) Process steam
O) No. of personnel
P) General condition of boiler room.

WATER:
A) Supplied by
B) Size of Main
C) Size of meter
D) Where located
E) Capacity
F) House tanks
G) Size and type
H) Pressure
I) Domestic hot water system

SEWER:
A) Supplied by
B) Size of pipe
C) Any restrictions
D) Location

GAS:
A) Supplied by
B) Size of Main
C) Location

SPRINKLER:
A) Wet
B) Dry
C) Size of sprinkler tank
D) Fire extinguishers

OFFICE FACILITIES:
A) Size (sq. ft.)
B) General description
C) Floors
D) Ceiling
E) Lighting
F) Partitioning

TRUCK LOADING FACILITIES:
A) Length of loading dock
B) Undercover YES or NO
D) Location
E) No. of trucks that can be handled

RAILROAD SIDING FACILITIES:
A) Name of railroad
B) Car Floor: YES or NO
C) Car capacity
D) Type of agreement in effect

FIRE TOWERS:
A) Number
B) Location

STAIRWELLS:
A) Number
B) Location

CRANES:
A) Number
B) Capacity
C) Age
D) How many
E) How old
F) Current

AIR CONDITIONING:
A) Type
B) Mfr.
C) Capacity
D) Approximate cost per year
E) Maintenance contract, if any

CYCLONE FENCE:

LIQUID STORAGE FACILITIES:
A) Size
B) Capacity
C) Size of pipes

ZONING:

WATER RENT:
SEWER RENT:

FIRE INSURANCE RATE ON BUILDING:
Amount presently carried

ASSESSMENT:

TAXES:
A) Mileage rate
B) Percentage of assessment to market value

POSSIBLE FINANCING:

RESTRICTIONS IN TITLE:

EASEMENTS:

ASKING RENTAL:

ASKING SALE:

POSSESSION:

CLIMATE:

LABOR:
A) Abundance of Male
B) Abundance of Female
MISCELLANEOUS:
A) ADT, and/or Plant Security Supplies
B) Autocall System and/or any specialized communication units, P/A system, etc.
C) International Watch Clock
D) Muzak
E) Pictures
F) Survey - Deed Lines
G) Monorail Systems
H) Floor Scales
I) Previous Occupant
J) Cafeteria details
K) Pollution controls
L) Available training programs in the Community, State, etc.

TRANSPORTATION:
A) Highways (Route numbers serving area, proximity to plant, etc.)
B) Airline Service (Name of Airline, Schedules, etc.)
C) Railroad Passenger Service (Names of railroads, schedules, etc.)
D) Bus Service (Names of Companies, Schedules, etc.)
E) Trucking Firms

INSPECTIONS:
A) Is plant in operation: YES NO
   If yes, will be vacant by:
B) Name of plant manager, or watchman, or representative
   Name:
   Plant Phone Number:
   Home Phone Number:
C) Keys:
   Can be obtained: YES NO
   In possession of:
D) Name of Industrial development representative in area, or Chamber of Commerce Secretary, etc.
   Business Phone Number
   Home Phone Number

The expression of spatial specialization in our economy:
Rectangle up = central business district
Rectangle down = suburban factory.
as it is for homeowners. Investors wishing to make money off inflating property values often purchase property that is run-down but undervalued for some reason. If they can market the building, they can make a good return on their renovation investment. Older mills have become prime candidates for this process. They can equally be torn down if they are located in an area slated for improvement.

The doctrine of "highest and best use" guides real estate investment. Factories are being razed now in Cambridge's Kendall Square. This was once the heart of the city's manufacturing district but the area is now being developed as a high-tech office and research laboratory district; the "highest and best use" because of its proximity to M.I.T. and the central business district. In capitalism a building's value is measured in its economic life. Its physical characteristics are an important factor but not the operative criteria. If the building endures it can live through a down turn in value and survive to have its value pushed up again.

"Wealth is no longer a tangible thing, but constitutes a statement of the rate of the current flow, capitalized over a future time period and supported by paper rights over future flows or debts outstanding from past flows." 13

A manufacturing firm usually finances expansion or a move to a new facility through retained earnings, or by selling corporate bonds and stock options. It tries to use the depreciation allowances made on the building shell and equipment rather than yearly net profits. Some firms buy and sell their buildings, but more find advantages to leasing. It offers more flexibility in the use of their capital and frees them from having a large debt service. A popular way of using space is through lease-back financing. Under this system the firm has the building built to its specifications, then sells the mortgage to a bank or insurance company. They then lease it to the firm on a long-term basis. This is an important source
of capital for banks, especially smaller savings and loan banks and insurance companies. The lease payments are tax-deductible for the firm and the system minimizes the threat of escalating lease payments. Firms can also obtain tax-free bonds from state or local development corporations.

The actual owner of industrial property has considerable equity tied up, so a return on investment of at least 15% is generally expected. Major realtors have well thought-out criteria for what industrial property they will manage. The Boston firm of Cabot Cabot & Forbes, which operates nationally, uses the following criteria: it must be served by a divided expressway and it must be in a major metropolitan area of more than a million people that is expected to grow. The average lease terms locally last year (1982) are for three to five years with a price of $7 to $10 per square foot for a pure net lease. Utility costs averaged $5 per square foot. These are averages. Prime locations, like those in established industrial parks on Route 128, would run higher, and space in older inner-city buildings can be as low as $1.50 per square foot. This is an obvious selling point. Companies, especially small young firms, do take advantage of the large amounts of space they can lease at low per square foot costs in older mills.

Depreciation is a concept that measures a fall in value over time. It is used by the government for income property in a way that stimulates the demand to invest in property. It is an incentive for the wealthy to become landlords. By inflating the supposed loss in value per year the government encourages investment in buildings that the ordinary market would ignore. Buildings seldom depreciate as quickly as is figured for tax deductions. Only with the arrival of life-cycle costing have the physical lives of buildings been more accurately appraised. A manufacturing building's probable lifetime also depends on the rate at which it will be rendered obsolete by future innovations. Different parts of the building may have different useful lives and the shell may be compatible with
the future innovations.

The owner usually wants an accelerated depreciation method for tax purposes because the initial investment will be "recaptured" more quickly. A manufacturing firm has additional considerations. If the firm sets their depreciation allowance too high, their net profit will be undervalued. If it is set too low, some capital will be lost. By not accounting for obsolescence the replacement costs will be higher than the allowance provisions. Depreciation allowances have been endowed with flexibility to support capital formation.

As previously stated, many manufacturers avoid the complexities of real estate ownership. After Route 128 was constructed, a new planning concept for industrial land-use was created that has since been copied throughout the world: the industrial park. Developers and community industrial development corporations can cut development costs, like the laying of utility lines, by grouping industrial sites close together. The first industrial park was The New England Industrial Center, constructed near the intersection of Route 128 and the Massachusetts Turnpike. It was a 148 acre tract with 4,5000 feet of frontage on Route 128. The management company offered complete utilities, a spur rail link, and provisions to either lease an existing building, buy one, or lease land and build. They had in-house design and financing services, and a wide variety of lots, ranging from 32,000 square feet to 23 acres. Their major design requirement was to use brick exteriors, presumably so it would not be considered an industrial trailer park. Industrial parks have remained useful for manufacturing firms that don't require extensively customized facilities.

Although dispersion from the larger cities in Massachusetts has added thousands of acres of industrial sites across the state, the real estate market in cities has been strong recently. One reason is the strong local performance of small business. Springfield, Worcester and Merrimack Valley cities like Haverhill were particularly
strong markets. According to a survey by the First National Bank of Boston, $250 million worth of mortgage financing went to urban industrial properties in 1982. High-tech industries plan further expansion, accounting for 50% of the planned investment this year. The amount was a 10% increase over 1982, with expectations for sustained investment in the next years. This is a hopeful sign for those who want to see an increased utilization of the state's existing manufacturing buildings. These kinds of firms have been historically receptive to adapting attractive older buildings.
MODERNIZING A MANUFACTURING BUILDING
These schematic sections show a typical response by an architectural firm to an industrial renovation.
"The stabilized existence of our environment allows us to act as human beings towards one another. It is the secure and permanent backdrop of our lives. At the same time it is our creation and will be ours only if we recreate it continuously...we should seek a way of building that makes every change the beginning of a new balance as much as the disturbance of the old one."15

Criteria for Modernizing Manufacturing Facilities

It is important to distinguish between different types of work done to existing buildings. Adaptive re-use means that the building will be used for different activities as a result of the improvements. These new uses are judged to be "better" uses because they will command higher rent levels and will make an economically or functionally obsolete building able to be packaged for investment. Because of their location and physical characteristics, older multi-level factories are good candidates for adaptive re-use. Many are located near expanding business districts, have sound structural frames, and can easily be divided for various uses. Artists and craftspeople are attracted by the large amounts of cheap space and natural lighting. The floor configurations and high ceilings make atmospheric office space. The over-all supply of manufacturing space is plentiful, but if cities want to retain manufacturing in their central districts they have to enact planning controls. Many cities are also using federal aid programs to convert these buildings into elderly, low-rent housing units.

Modernization has a different meaning than adaptive re-use. It refers to an ongoing process of improving the building without changing its use. It is an act of investment signaling that the activity, in this case manufacturing, is still profitable for the owner. As stated earlier in the thesis this is a variable, depending on the general economic outlook and a firm's particular profit-making
The chart shows total costs over the estimated life of a building. It then can recommend what the "economic" life of the building should be. Many vacant buildings lie beyond that estimate. (from Dell'Isola and Kirk, Life-Cycle Costing for Design Professionals.)
strategy. A firm may be bought out by another corporation and "milked," so that even if the facility wasn't originally economically obsolete, through deferred maintenance and general disinvestment it will become that way. Over the past two decades it has been a general business trend not to invest heavily in the building's shell. Such capital investment peaked in the early 1960's. More money is invested towards new equipment in work stations because equipment gives an immediate increase in productivity. New building space costs more to purchase over time, as a percentage of the employee's salary, than installing something like a computer system. Firms feel that investing in "new knowledge," embedded in the machinery, will help to keep them on the competitive edge.

The high cost of obtaining investment capital and inflation causes firms to build structures with short life spans and higher yearly operating costs. If the shell does have a short life it is not worth making many improvements on it; the pay-back time would have to be very rapid. This leads again to deferred maintenance. It seems to be a particularly American way of using environmental resources, similar to the use of farmland.

These realities have clear implications for factory design. Architects have to be articulate in demonstrating how their design decisions will improve productivity. They can no longer issue "recondite rationalizations for design decisions." Designing has become more four-dimensional, the added dimension being time. A facility doesn't have one life any more, but is a shell with many sub-systems within it, each having different life-spans, and they are designed accordingly. Such thinking actually favors renovation. Companies find using old building shells with new equipment inside is a productive use of capital. By 1981 building owners as a whole cited "productivity" as the second most important reason for investing in a building structure.

A method called life-cycle costing is used to give an economic
Leading architects and designers have specified MechoShade Systems for their most prestigious clients. Developers and corporate users are switching to MechoShades because they provide future cost benefit through low maintenance and thermal efficiency.

(From building trade literature.)
assessment of design alternatives. It considers the construction or purchase costs, and the operating costs for a design over its estimated life, expressed in equivalent dollars. This involves evaluating the worth of investment money over time. In most buildings the operating and maintenance costs will equal the original cost of construction within 30 years. The importance of choosing materials with this in mind becomes obvious, the problem being it isn't always easy to estimate a life-span. Electrical components have high operating costs, so the initial specifications need to be well thought out. Labor costs make up 80% of the maintenance costs, and will presumably stay the same or increase over time. This means that materials with good durability may be more economical even if their purchase price is higher. The differences between concrete and brick are illustrative. Brick has a higher durability factor and requires less maintenance, though it may cost more to construct. Finishes on materials become important specifications. For example, stainless steel door handles may be worth the investment because the acidity from people's hands will corrode untreated metal over time. In life-cycle costing a component becomes financially obsolete, even though it still works, when its annual operating costs exceed those of a replacement by more than the equivalent initial cost minus the resale value of the older component. If both are equal the advantage will go to the replacement if it offers greater future flexibility; a new system may be smaller for instance.

Because production was expanding, the mill factories of a hundred years ago were being constantly modernized. Besides constructing new buildings on the site, floors were added to the same building. This was possible because the structure was built with extra capacity, always an advantage in factory design. Old openings were widened for increased volume of materials handling, asbestos-cement shingles were put on old roofs, elevators were added, and whole bathroom towers were built next to the main production area. The toilets were originally limited to a couple of stalls in the corner. High-pressure steam systems and floreescent lighting was added quickly in
The Schrafft's Candy Company, founded in Boston in 1861, and located at Sullivan Square in Charlestown since 1928, is embarking on a significant plant modernization program which will enable it to remain in business in Boston, to engage more competitively in the candy business, and to increase its employment base by 25%.

The City of Boston was awarded a $1.55 million Urban Development Action Grant by the Department of Housing and Urban Development in December, and the extension of this amount to Schrafft's at low interest rates, together with the Company's own investment of approximately $4.5 million, will provide the basis of the two year improvement program.

Much of the manufacturing equipment installed when the Schrafft's building was occupied in 1928 is still in use. Though it served the Company well over the years, reliance upon the older equipment today has resulted in competitive disadvantages for Schrafft's in the industry, by contributing to inefficiency in the production process, and therefore to reduced volume and higher costs. The modernization program will focus primarily on the replacement of the old, with new, state of the art production equipment.

The American Safety Razor Company purchased Schrafft's in April, 1981, just two months after its previous owner had closed the Company. American Safety Razor reopened Schrafft's immediately, rehired most of its employees, and has shown its commitment to the revitalization of the candy maker ever since. The immediate effects of the modernization program will be to substantially increase production efficiency, while lowering manufacturing costs and increasing the volume of production. Long range plans envision the expansion of the market area for the Schrafft's product.

Schrafft's annual level of employment is 600; during peak periods of demand the Company employs some 900 workers. The modernization program will result in the growth of the permanent employment base by 200 jobs, and the construction schedule will yield an additional twenty positions. Fifty-one percent of Schrafft's employees are Boston residents, 27% are from Charlestown, and 36% of all employees are minority.

Throughout its 122 year history, Schrafft's has built and maintained a premier reputation in the candy making business. This is no less true today. The Company has also enjoyed a very stable and productive relationship with the Charlestown neighborhood and with the City of Boston. As it now recommits itself to the neighborhood and to the City, I would like to congratulate Schrafft's, and also the Boston Economic Development and Industrial Corporation, for their efforts in making this project possible. I would also like to thank Schrafft's and the American Safety Razor Company, for their consistent support of the City and for their contributions to Charlestown. I wish them every success with respect to this project, and to their future in Boston.

At one time the larger companies had designed small landscaped parks for the employees on the site. As they expanded, and as the car became used to get to work, these were paved over for parking. Given the choice most workers would probably take the car and a park elsewhere, but the idea is being brought back in many renovation projects.

The question of whether or not a manufacturer is investing in modernizing a facility is vital to the workers. It is an indication of the company's long-range plans. Both workers and management know that obsolete equipment or an obsolete working environment will erode profits in time. The company may be investing elsewhere. The United States Steel Corporation is a recent example. Rather than modernize their steel-making plants, they invested in things like buying Marathon Oil. In agreeing to wage cuts this past month (March 1983), the steel workers union wanted a guarantee that the company would invest a certain amount of money for modernization. Whether that can be enforced is unclear. Another reasons why workers benefit from management efforts to lower operating costs is that historically wage increases have come from advances in productivity more than annual profits. A company will rarely lower its profit margin to increase wages.

National Public Radio recently reported a unique agreement that is taking place in a Tuscaloosa, Alabama General Motors plant. Management was threatening to close the plant because its operating costs were too high for them. They agreed to reconsider if the workers could find ways to cut operating expenses by two million dollars. The workers in turn brought in university people to help them. One would think this was part of the management's responsibility, but the "bottom line" in capitalism is profit-making, not manufacturing efficiently. Having a great number of economically or functionally obsolete buildings in a market sector or in a country means that the capitalists have found more lucrative investments elsewhere. This is most obvious in Great Britain, but it has
Older buildings usually have to be modified to increase loading facilities.
been showing up in this country as well. The current popularity of the term "re-industrialization" is an indication of the problem. While preservation may be a benign phenomenon with older housing, applied to manufacturing facilities it becomes benign neglect. Factories need to be designed or renovated so that future modernization will further what remains.

Buildings that aren't adaptable or haven't been adapted become functionally obsolete in time. This again depends on market conditions. If the business cycle is in a downturn, the rate of output can be lower. Time (thus wages) spent waiting for goods in a slow freight elevator will then not be as crucial a factor. A physically obsolete building is an absolute liability on the other hand. If the foundation is sinking or if all the beams are rotting the building is probably not worth any further investment. Functional obsolescence is more conditional.

Older manufacturing buildings share similar problems that cause functional obsolescence. One issue is floor load capacity. Though older buildings were built for some amount of machinery, some more recent machinery is too heavy for the original design load. Low ceiling heights and narrow bay sizes are other characteristics that stop many firms from using older buildings. Other problems include inadequate elevators and inadequate loading facilities. Walls can be cut to enlarge a loading entrance and new hardware can be installed, but many older buildings on urban sites were built up to the lot line before the use of trucks. Trucks take up huge amounts of parking and maneuvering space, and few communities permit off-loading on a street.

In a report for the Boston E.D.I.C. on the future use of the Charlestown Navy Yard, Kaiser Engineers stated "...recurring problems seem to be lack of storage space, inadequate elevators, lack of environmental controls, and unsuitable space configurations." Another project that had to overcome functional obsolescence was the
Once Haverhill's Main Street Leather District was put on the National Historic Register, signs and prices changed.
Carrol Industrial Park, which renovated existing buildings in Baltimore, Maryland. They had to bring a freight elevator up to code, put in a new passenger elevator, repair the windows, add new lighting fixtures and improve the loading docks. They also designed an attractive lobby and common eating area, and included a post office and parking garage on the site. It is a good example of how functional obsolescence can be overcome with investment effort. Someone also knew something about marketing. Another common change when modernizing is to switch from a high pressure steam system to a low one with automatic controls. This eliminates the need to pay for constant supervision.

Renovation Procedures

Investment in the built environment is described in ecological terms, implicit in words like "life-cycle," "re-cycle," "revitalize," and "renovate." They describe a dynamic process of replenishment rather than a static freezing of something that one is afraid to loose. Old manufacturing buildings can be conceptualized as a social and a physical resource that has passed into a common heritage. This feeling is particularly strong in old mill buildings because so many people invested their labor working inside them. The building may be owned by one group of people, but it has been shared by thousands. The conversion of mills into elderly housing is made poignant by the fact that many of the residents once worked in the same building.

The appearance of mill buildings imparts a lack of self-consciousness in its design. This further aids in giving the impression of a public as well as a privately owned building. People admire and appreciate those corporations that invest in a community's past. This benefits the corporation because one reason for spending money on a building design is that it becomes a corporate asset and confers prestige. This ties in well with the New England tradition of valuing craftsmanship. Francis T. Ventre writes of "...the relatively few occasions when a 'flagship' building is designed to project a preferred image of corporate headquarters or other prestige-laden structures."
<table>
<thead>
<tr>
<th>Total cost</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Price paid for original structure</td>
<td></td>
</tr>
<tr>
<td>Closing costs, legal fees, administrative expense</td>
<td></td>
</tr>
<tr>
<td>Cost of portion of taxes, water rates, fuel, etc., paid at closing by new owners or refunded by existing owner</td>
<td></td>
</tr>
<tr>
<td>Cost of recycling</td>
<td></td>
</tr>
<tr>
<td>Construction cost, including tenant work</td>
<td></td>
</tr>
<tr>
<td>Architect's and engineer's fees</td>
<td></td>
</tr>
<tr>
<td>Costs of permits and other filing fees</td>
<td></td>
</tr>
<tr>
<td>Legal and administrative costs</td>
<td></td>
</tr>
<tr>
<td>Insurance during construction</td>
<td></td>
</tr>
<tr>
<td>Taxes during construction</td>
<td></td>
</tr>
<tr>
<td>Cost of obtaining mortgage and other financing</td>
<td></td>
</tr>
<tr>
<td>Interest on mortgage or other funds during construction</td>
<td></td>
</tr>
<tr>
<td>Operating cost</td>
<td></td>
</tr>
<tr>
<td>Taxes (real estate, water, sewage, improvement, etc.)</td>
<td></td>
</tr>
<tr>
<td>Cost of maintenance and repair; payroll; supplies</td>
<td></td>
</tr>
<tr>
<td>Contracts for cleaning, elevator maintenance, exterminating, etc.</td>
<td></td>
</tr>
<tr>
<td>Cost of utilities and fuel</td>
<td></td>
</tr>
<tr>
<td>Cost of tenant services called for by lease</td>
<td></td>
</tr>
<tr>
<td>Brokerage fees and rental commissions</td>
<td></td>
</tr>
<tr>
<td>Administrative and legal expense</td>
<td></td>
</tr>
<tr>
<td>Insurance</td>
<td></td>
</tr>
<tr>
<td>Management fee</td>
<td></td>
</tr>
<tr>
<td>Mortgage interest and amortization</td>
<td></td>
</tr>
<tr>
<td>Equity investment</td>
<td></td>
</tr>
<tr>
<td>Required return on money investment*</td>
<td></td>
</tr>
</tbody>
</table>

(from Reiner, *How to Recycle Buildings.*)
Mill buildings are natural "flagships" in Massachusetts.

These companies noticed a good deal. They were able to acquire the buildings for low per square footage costs compared to new construction. Because of the large spaces involved, renovation costs were lower than they would be for a smaller building. Since 1976, and especially since 1981, federal tax policies have offered good incentives to renovate old buildings. Before that time renovation costs would usually run slightly above new construction. Now the costs are roughly equal and in some cases renovation is cheaper. The quality of the space is usually superior to what companies will pay for in new construction. Companies are re-using resources that were made when labor and materials were cheaper to use. The scale of each floor is never overwhelming and there is an abundance of windows or monitors to provide light and a view outside. People enjoy the wood floors and brick walls. The new elements placed in the building give people a stimulating juxtaposition. A few successful projects can create an increased demand in the entire district.

Renovation makes use of our accrued resources. It can be seen as another segment of life-cycle costing. As well as considering the projected worth over time of new installations, renovation gives the same consideration to what already exists. After noting that the costs of new construction versus renovation average out to be the same, George Notter noted:

"...the plus factor is achieved by developing the potential assets into a final project of greater amenity - one having the right location, more space in either height or volume, more area or more character, materials of a special quality, and a potential for time savings in construction." 19

We live under "advanced capitalism" which seems to bring with it a corresponding decline in the quality of materials we can afford. It makes sense to take advantage of the lower costs that were paid out for finer detailing and workmanship in the past.
A zoning map showing different industrial parcels (M's). The author noted one located near a "planned residential development" would be a risky investment, which is why developers look at such maps. (from Reiner, How to Recycle Buildings.)
"Thus the production of the environment is the result of an intricate set of coordinated stages of assembly. It allows for the creation of combinations that never have to repeat themselves. The implicit system that is the result as well as its cause is infinitely rich. It is not technology that defines its limitations....

...This movement from the material source to the finished product on its site, this progress of assembly and refinement from human hand to human hand can become progressively rich and varied. The limitations are in the coordination between people and the willingness and patience to bestow love and care to the work at hand. The system becomes simplified not by technical innovation but by our desire to cut costs and time, above all to cut the number of decisions to be made and the stages that will have to coordinated....

...To put it very bluntly, the uniformity that may be evident in a given environment is not the result of technology or industrialization but comes from a broken balance in the exercise of power."20

Much of the work on a renovation project is done before construction begins. The building has to be zoned for manufacturing use and must have adequate parking. The neighborhood streets may not support the volume of traffic that manufacturing would generate. Codes have to be checked for what use classification the production process falls under and what fire district the building is in. There is a rough estimate drawn up for how much it will cost to meet the building codes. Renovation projects usually require variances for things like earthquake resistance and a lot depends on the guidelines issued by each building department. A lot of the estimating process is done by physical inspection. Floor load capacity and the structural integrity of the framing are two major cost determinants. Meeting fire exit requirements can also end up costing so much that the project will be judged unfeasible. Beyond
Exhibit 52
Illustrative Cost Estimate: Unit-in-Place — Labor and Material Costs Combined

<table>
<thead>
<tr>
<th>Building Costs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Excavation</td>
<td>2,435 Cubic Yards at $4.00</td>
</tr>
<tr>
<td>Footings, Foundations</td>
<td>565 Cubic Yards at $70.00</td>
</tr>
<tr>
<td>Walls, Front</td>
<td>11,600 Square Feet at $5.00</td>
</tr>
<tr>
<td>Side, Rear</td>
<td>42,840 Square Feet at $4.60</td>
</tr>
<tr>
<td>Enclosure</td>
<td>38,016 Square Feet at $2.40</td>
</tr>
<tr>
<td>First Floor</td>
<td>33,814 Square Feet at $1.50</td>
</tr>
<tr>
<td>Upper Floors</td>
<td>135,256 Square Feet at $3.80</td>
</tr>
<tr>
<td>Roof Deck, Roof</td>
<td>33,814 Square Feet at $4.00</td>
</tr>
<tr>
<td>Office Areas</td>
<td>4,000 Square Feet at $3.00</td>
</tr>
<tr>
<td>Plant Areas</td>
<td>165,070 Square Feet at $1.00</td>
</tr>
<tr>
<td>Penthouses</td>
<td>1,000 Square Feet at $6.00</td>
</tr>
<tr>
<td>Stack</td>
<td>100 feet</td>
</tr>
<tr>
<td>Heating</td>
<td>Boilers, 250 Horsepower at $180</td>
</tr>
<tr>
<td></td>
<td>Rad. and Vent. 22,000 Square Feet</td>
</tr>
<tr>
<td></td>
<td>at $5.00</td>
</tr>
<tr>
<td>Plumbing</td>
<td>97 fixtures at $300 Average</td>
</tr>
<tr>
<td></td>
<td>Piping, 10,000 Lineal Feet at $5.00</td>
</tr>
<tr>
<td>Electric</td>
<td>1600 Fixtures, at $70</td>
</tr>
<tr>
<td></td>
<td>600 Outlets, at $50</td>
</tr>
<tr>
<td>Sprinkler</td>
<td>600 Outlets, Power at $100</td>
</tr>
<tr>
<td></td>
<td>Tank 40,000 Gallon and Pump</td>
</tr>
<tr>
<td></td>
<td>1600 Heads at $40</td>
</tr>
<tr>
<td>Elevators</td>
<td>2 at $36,000</td>
</tr>
<tr>
<td>Alarm, Incinerator, Miscellaneous</td>
<td>10,000</td>
</tr>
<tr>
<td></td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>Add Overhead and Profit, 20%</td>
</tr>
<tr>
<td></td>
<td><strong>Total Building Cost</strong></td>
</tr>
<tr>
<td></td>
<td>(169,070 Square Feet at $13.51)</td>
</tr>
<tr>
<td>Other Site Improvements</td>
<td></td>
</tr>
<tr>
<td>Tracks</td>
<td>330 Lineal Feet at $16.00</td>
</tr>
<tr>
<td>Fence</td>
<td>1,750 Lineal Feet at $4.00</td>
</tr>
<tr>
<td>Paving</td>
<td>7,860 Square Feet at $1.20</td>
</tr>
<tr>
<td>Shipping Platforms</td>
<td>2,840 Square Feet at $7.00</td>
</tr>
<tr>
<td>Yard Grade, Gravel</td>
<td>80,000 Square Feet</td>
</tr>
<tr>
<td>Drainage</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total Cost, Unit-in-place</strong></td>
</tr>
</tbody>
</table>

This is a standard cost estimate, using unit costs that are being constantly updated. (from Kinnard, Industrial Real Estate.)
the general floor loading requirements, someone has to plan the general layout of each floor because some activities have added requirements. Filing and storage areas can add a considerable load over one bay for example. Beyond the physical frame, utility service capacities have to be investigated. Many production processes have unusual requirements. If their electrical loads are too heavy for instance, the new activity could cause a power outage in the entire district.

One of the advantages of using an existing building for manufacturing is that the planning process is often quicker and the space can be marketed more easily; you see what you'll get. Usually the management firm will do the minimal work necessary or set up a demonstration unit in order to sign tenants before loan repayments deplete their cash reserves.

Unit construction costs are usually higher than for normal construction. Economies of scale are harder to obtain, for example in tight interior spaces hand equipment may have to be used, which raises labor costs. Materials handling will be more expensive. Waiting with stacks of drywall for low-capacity elevators takes up workers' time. Temporary shoring and bracing needs to be constructed if any cuts are made in the structure. Once cutting and patching reaches a certain proportion it is usually cheaper to knock out the entire area. Often the usual construction sequencing isn't possible. If a sub-contractor has to start and stop frequently they will make higher bids. The finished work of one trade has to be protected more than usual. If only small quantities of a particular material are required the unit cost will be higher. If a company is modernizing they usually will want to do the work so as not to disrupt on-going production. Labor costs for irregular work hours are higher. If matching older materials is specified, the materials costs will be higher. Running new mechanical systems through an older building can bring unexpected problems. Snaking wires through walls and floors is never easy and is minimized in manufacturing buildings.
PROPOSED DEVELOPMENT CALCULATIONS FOR MORTGAGE PURPOSES

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing Income: All Three Buildings</td>
<td>$ 91,404</td>
</tr>
<tr>
<td>Horne Vacant Space Filled</td>
<td>35,880</td>
</tr>
<tr>
<td>Gross Potential Income</td>
<td>$ 127,284</td>
</tr>
<tr>
<td>Vacancy &amp; Bad Debt (5%)</td>
<td>(6,384)</td>
</tr>
<tr>
<td>Gross Effective Income</td>
<td>$ 120,900</td>
</tr>
<tr>
<td>Total, All Operating &amp; Management Expenses</td>
<td>66,670</td>
</tr>
<tr>
<td>Total, Real Estate Taxes</td>
<td>18,043</td>
</tr>
<tr>
<td>Net Before Financing</td>
<td>$ 36,187</td>
</tr>
<tr>
<td>Capitalized at .095</td>
<td></td>
</tr>
<tr>
<td>Capitalized Value $380,900</td>
<td></td>
</tr>
<tr>
<td>Loan to Value Ratio 80%</td>
<td></td>
</tr>
<tr>
<td>Indicated Loan</td>
<td>$ 304,700</td>
</tr>
<tr>
<td>Source &amp; Use</td>
<td></td>
</tr>
<tr>
<td>Use: Capital Budget</td>
<td>$ 350,000</td>
</tr>
<tr>
<td>Source: Loan</td>
<td>$ 304,700</td>
</tr>
<tr>
<td>Equity</td>
<td>45,300</td>
</tr>
<tr>
<td></td>
<td>$ 350,000</td>
</tr>
</tbody>
</table>

One kind of the financial statements necessary to invest in manufacturing buildings. (from E. Dennis Walsh Assoc., "The Action Plan for Haverhill.")
The Economic Recovery Tax Act of 1981 has been effective in stimulating demand for renovation. It added tax credits to some that had been offered since 1976. From 1976 to 1982 an estimated 2.2 billion dollars worth of investment has gone into renovation projects of all types. Tax credits at this time include a 15% investment tax credit for 30 year old structures, a 20% credit for 40 year old structures, and a 25% credit for buildings registered as historic buildings. These credits are deducted from taxes owed, not earned income, which yields greater savings. The depreciation schedule is also accelerated to 15 years. This affects the cash-flow for the project immediately. These tax benefits make it easier to raise equity capital for the project through syndication. The major stipulations for the credits and accelerated schedule are that the renovation costs must equal the adjusted basis of the building or $5000 within 24 months, and 75% of the external walls must remain intact. The 15% and 20% tax credits only involve filing with the Internal Revenue Service but the 25% historic building credit must be approved by the National Park Service. They have been lenient in their review process with a 5% denial rate. They allow for things like windows being replaced if the new ones match the scale, color and glass type of the old windows. The tax benefits are greater when the building's purchase price is low, so that construction costs are a large part of the total project costs. It is also useful for investors to calculate the weighted average age of the building if partial improvements have added value to part of the building.

Consultants from E. Dennis Walsh Associates prepared a feasibility study for attracting firms to an old mill in North Adams. Even though the management was to be a non-profit industrial development corporation, rent levels had to be projected that would cover annual operating costs and would provide future improvements capital. Their calculations showed that they could rehab the building for $5 per square foot in 1978 versus an average of $20 for building built in an industrial park. Older mill buildings have to be evaluated next to a typical new plant to understand the advantages they can offer.
Table 4-2
Comparative Costs of Single Story and Multilevel Structures, per Building Square Foot

<table>
<thead>
<tr>
<th></th>
<th>Single Story Construction Costs (80,000 Square Feet)</th>
<th>Multilevel Construction Costs (4 Levels, 80,000 square feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shell(^a)</td>
<td>$ 7.00</td>
<td>$ 9.20</td>
</tr>
<tr>
<td></td>
<td>including:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>extra floor support(^c) +1.50</td>
<td></td>
</tr>
<tr>
<td></td>
<td>extra wall footage(^d) 0.75</td>
<td></td>
</tr>
<tr>
<td></td>
<td>stairs(^e) 0.40</td>
<td></td>
</tr>
<tr>
<td></td>
<td>roof savings(^f) -0.45</td>
<td></td>
</tr>
<tr>
<td>Upgrading(^b)</td>
<td>8.00</td>
<td>9.80</td>
</tr>
<tr>
<td></td>
<td>Upgrading</td>
<td></td>
</tr>
<tr>
<td></td>
<td>including:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>elevator requirements(^g) 1.80</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>15.00</td>
<td>19.00</td>
</tr>
</tbody>
</table>

\(^a\)Includes $1.00 for "outside work;" $0.80 for foundations; $1.50 for the steel structure frame; $0.70 for the floor slab; $0.15 for precast concrete; $1.50 for exterior masonry; $0.60 for roofing; and $0.50 for miscellaneous items.

\(^b\)Includes $0.50 for heat; $3.00 for air conditioning and ventilation; $0.50 for acoustical ceiling; $0.30 to $0.75 for floor tiling; $1.75 to $2.00 for light; $1.00 to $1.10 for plumbing; and $0.40 for sprinklers.

\(^c\)Slab on grade, used for single story floors, costs $0.50 to $0.70 per building square foot while additional floors can only be constructed for $2.50 to $2.70. On a per square foot basis, this involves a differential of $1.50 in the illustrated case.

\(^d\)Exterior walls cost at least $2.50 per square foot of wall. A rectangular single story structure containing 80,000 square feet of building space and 20 foot high ceilings generates costs equivalent to $0.75 per square foot of building. A rectangular 4 level building requires, on a building square foot basis, an additional expenditure of $0.75 for a total of $1.50.

\(^e\)Based on two sets of stairs.

\(^f\)The same amount of space of the multilevel structure can be covered by one-fourth the amount of roofing needed in the single story structure of equivalent size.

\(^g\)Following the recommendations of Chester Browne Associates of Boston, it was assumed that the building needed two passenger elevators traveling at 200 feet per minute and four 4-ton freight elevators operating at a minimum speed of 150 feet per minute.

Sources: Nordblam Corporation and Vappi Construction Company, Boston.

The chart makes the point that single story construction is generally cheaper than using multi-level structures. (from Reiner, How to Recycle Buildings.)
E. Dennis Walsh Associates outlined two critical areas for comparison: the annual energy costs and the productivity of the working environment. Older buildings initially have higher energy costs because little has been done to weatherize the building and general maintenance may have been deferred. These buildings have large window areas, which though a visual amenity have to be sealed. Usually they will be replaced with double-paned units. If they are replaced the large amounts of daylight can be used to keep down lighting, heating and cooling costs. Storm windows have a payback period of around five years and so are usually installed. The overall surface area of mill buildings compares well with new plants, which have large roof expanses that can lose and gain a lot of heat. Most firms find that it pays to insulate the roof of a mill to take advantage of the reduced surface area. On the other hand heat loss through the uninsulated masonry walls will remain untreated because the cost is prohibitive. It was calculated that the mill in North Adams could cut its energy bills by 40% by initial investments in conservation.

The quality of the work environment is another selling point for older buildings. Besides the immediate physical setting, workers also like being located in a city rather than stuck out in an industrial park with no place to go for lunch. For a young firm a downtown location provides greater visibility. Many can take advantage of combining sales and production space. Grouping such firms together can stimulate business, as in a shopping center. Being able to watch people making what you are buying is a powerful, underutilized sales tool.

Technical Issues in Renovation

The North Adams mill provides an example of typical improvements that go into this kind of renovation project. Many of the problems could have been prevented with an on-going modernization program. The
Outline Specifications: Beaver Mill

GENERAL REQUIREMENTS - To be determined

SITE WORK - New bituminous Loading and Parking areas and paving for walks to building entries. Extruded bituminous curbing. Catch basins for positive drainage of paved areas.

Demolition - Masonry openings as required for new loading bays at truck access points. New openings for elevator and stairs.

CONCRETE - Elevator pits and footings for new stairs.

MASONRY - Exterior masonry cleaning and restoration as required.


CARPENTRY - Rough: Frame new openings for stairs and elevator. Miscellaneous vent and hatch openings.

MOISTURE PROTECTION - None.

Concretes - Thermal insulation of exterior walls and roof as required by code.

Roof - Repair existing built-up roof. New built-up roof as required.

Sheet Metal - Repair existing flashing, gutter and downspouts as required.

Caulking - Elastomeric general caulking.


PAINTING - Exterior: Wood - 2 coats

Metal Primer-plus 2 coats

Interior: Wood - one coat

Metal - Primer plus 2 coats

These are typical specification for a renovation project of manufacturing space. (from E. Dennis Walsh Assoc., "The Action Plan for Haverhill.")
## FLOOR & WALL COVERINGS -

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>FLOORS</th>
<th>WALLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offices &amp; Lobbies</td>
<td>Carpet on pad</td>
<td>Painted GWB</td>
</tr>
<tr>
<td>Bathrooms</td>
<td>Unglazed C. T.</td>
<td>M. R. Paint</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>Broom Clean</td>
<td>Paint existing as required</td>
</tr>
</tbody>
</table>

Bathroom Accessories: Sinks and toilets. Medicine cabinets, mirrors, soap, towel and napkin dispensers; disposals as required.

Specialties: Security devices for public and service entries.

### ELEVATOR -


### MECHANICAL -

- Miscellaneous valves, thermostats and pipe insulation.
58 Multi-storey warehouse/factory conversion with central access and storage for multi-unit use.

Key: 1, Communal loading bay: 2, Elevator (goods): 3, Central access route: 4, Storage zone (subdivisible): 5, Subdivisible units: 6, Buffer storage.

This is one proposal for breaking up a floor into rental units. (from Henn, Buildings for Industry.)
building needed a new roof, a better elevator, expanded loading facilities, weatherization, and new mechanical systems. The existing electrical service was 600 Volt service and newer machinery has to use 277/480 Volt service. In most projects an assumption is made at the start that most of the mechanical systems are obsolete and that it will be easier to scrap them and plan new systems. The interior of the mill was to have sandblasted exposed brick, refinished wood floors and new enamel paint on the exposed piping and other metal hardware. Architects can often estimate the costs and possibilities of what can be done better than contractors. Most of their effort goes into enhancing what is there, adding a minimal amount of new design features.

It is important to remember that the building has accustomed itself to the existing loading pattern and that changing the static forces could have unforeseen consequences. Even walls that seem to be non-bearing can create a channel for forces if they form a lattice over several floors. Structural change is avoided if possible. Sometimes a decision is made to cut into the floors to create an interior atrium. This breaks up the monotony of large floor areas that receive no light except at the perimeter. Any loading capacity below 150 lbs. per square foot will be carefully tested because many manufacturers require that capacity as a minimum. Elevators operating at a rate below 75 feet per minute or not having an 8000 lbs. capacity are considered slow by modern standards.

The feasibility of a project rests primarily on the condition of the structural frame, especially when the mechanical systems are considered obsolete at the outset. It is extremely difficult to add to the foundation. Tests of varying sophistication measure the capacity of structural members. A lot of the testing is done by visual inspection and with simple tools, like an awl. Connecting hardware has to be inspected to make sure it is still transferring the forces efficiently. Sometimes brick and mortar samples need to be taken to determine how much repointing is necessary. Pipes have
The most important consideration for most firms is not the cost/S.F., but the total that they must pay every month for the space they rent. Building management should permit the prospective tenant to visit the completely rehabilitated space, to see and discuss a preliminary layout prepared as a service by the management, and to know what the monthly rent for the space will be. Below is a rental scheme for the above two-tenant layout for a typical floor of the Horne Building.

<table>
<thead>
<tr>
<th>S/F</th>
<th>Rent/Year/SF</th>
<th>Yearly Rental</th>
<th>Rent/Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>1710</td>
<td>$2.25 net</td>
<td>$3,847.50</td>
<td>$320.65</td>
</tr>
<tr>
<td>2170</td>
<td>$2.25 net</td>
<td>$4,882.50</td>
<td>$406.90</td>
</tr>
<tr>
<td>3880</td>
<td></td>
<td>$8,730.00</td>
<td></td>
</tr>
</tbody>
</table>

A renovation proposal splitting a floor into two units. (from E. Dennis Walsh Assoc., "The Action Plan for Haverhill.)
to be tested along their runs. Air pollution has become a problem for exterior stone surfaces. In one mill all the cast iron columns had to be strengthened. Steel plates or jackets with lag bolts are used to strengthen wood members that have decayed. Luckily the construction methods used in heavy timber mill buildings tried to prevent such decay, but it still can occur.

Most of the older mills used a wooden built-up roof deck. These are often replaced with added insulation, using light-weight concrete fill. Rust is a problem with all exposed metals. When nailing exposed wood it is good practice to countersink the nails and plug them with a non-shrink sealing compound. Sometimes the interior walls are insulated by adding drywall over the bricks with the insulation and a water vapor barrier. In a few cases the exterior walls are wrapped with insulation and metal siding. Part of a wall can also be torn down and replaced with a curtain wall assembly. Careful detailing and installation is important because the glass joints are subject to varying pressures from parts of the building moving differently. Sometimes it is crucial when replacing an old element, like a granite window sill, to use a replacement of similar weight and volume. Over the expanse of the whole building facade the new loadings can affect the over-all loading when it reaches the foundation. Renovation work is always more painstaking than new construction. Instead of being able to quickly lay up a new firewall, in an old building a mason will have to cut into any lowered ceiling and work around the piping.

All buildings over 70 feet must be sprinklered. In renovation projects, particularly manufacturing buildings, it is far easier to fully sprinkler the building because fire exit requirements become much easier and less costly to meet. Dry sprinklers are used in unheated warehouses but most systems are wet. Sometimes the existing system needs to be upgraded with wider pipes, a standpipe or a booster pump. The spacing of the nozzles depends on the total area, joist spacing, and type of ceiling construction.
Katsy Simmons had bought an abandoned mill and with his wife was replacing 800 window panes. (From Dunwell, Run of the Mill.)

"Old ideas can sometimes use new buildings. New ideas must use old buildings."  
Jane Jacobs
The existing electrical power supply must be compared with the firm's anticipated peak service demand. Many firms run processes with wide fluctuations in demand, and they have to be timed to not go on at once. The estimated gallons per day of water also has to meet the existing supply. Any wrought iron piping will have to be replaced. Many firms will get rid of the heating system, but it is often useful to stay with a hot water system because it uses smaller pipes. Installations of ductwork require more cutting and patching and usually lowers the ceiling height.

Sometimes renovation work is done to address specific problems. O.S.H.A. regulations have forced many firms to improve the building's design for safety reasons. Some examples of O.S.H.A. demands are stair railings where there were none, more fire escapes and lighted passageways along fire exits. Dangerous materials also have to be removed in older buildings. Asbestos has been in the news most recently. Another example is cork, which was used as insulation. When cork burns it releases noxious fumes.
A lonely inspiration...

By Tom Ashbrook
and Ronald Rosenberg
Globe Staff

It will make great television.

In the background, a decrepit block of blighted Roxbury public housing and gaunt abandoned buildings—symbols of the nation's gnawing inner city malaise.

In the foreground, shimmering proudly next to the President's limousine, the spotless, modern high technology assembly plant of the Digital Equipment Corp.

Last week, White House aides were exuberantly calling the Digital factory an "inspiring model for the country" and the President appeared set to applaud the plant as a bold, successful thrust of high-tech private capital into an ailing urban center.

Indeed, the plant has become a bulwark against unemployment for most of its 275 employees and has transformed its small corner of the city along the Southeast Expressway into a miniature industrial showcase.

But for all the successes of production and employment found within the plant walls, the overall story of Digital's move into Roxbury has been a bittersweet tale of urban development.

When Digital announced in 1977 that it would build a plant in Roxbury's CrossTown Industrial Park, it was hailed as the first of many companies that would take the plunge into the depressed urban area.

Instead, it has been the first and last. Of 40 acres included in the urban industrial park, only the 7.5 acres occupied by the Digital plant and its broad lawns have been filled after seven years of planning and effort.

And now, observers say, Reagan Administration plans to cut back on federal subsidies for urban industrial development may make the task of attracting new manufacturers to Roxbury and other urban centers even tougher.

Many of the capital subsidy programs that were so helpful have been cut back or terminated," says James Howell, chief economist for the First National Bank of Boston. "I think it's going to be hard to get companies


PLANNERS AND MANUFACTURING
A lonely inspiration in Roxbury

In the numbers required to address the socio-economic problems of these areas.

With planned cuts in low-interest federal development loans and subsidies offered by the Urban Development Action Grant program and the Economic Development Administration, says Howell, the chances of attracting enough new industry to turn the tide on urban decay are "extremely doubtful."

But extreme doubt is certain to be the last thing on the agenda of Ronald Reagan in Roxbury tomorrow. White House planners, ever-vigilant for compelling "photo opportunities," have found a most photogenic subject in the Digital plant.

Immaculately groomed, spacious, light and airy, the factory is a planner's dream of a clean, high-tech industry. Nothing is actually manufactured at the 60,000-square-foot facility. The 113 men and 163 women who work there simply assemble personal computer keyboards from plastic and metal parts that have been made elsewhere. Inside its high-ceilinged production area, assembly workers earning from $8.72 to $8.92 an hour sit at broad work stations, plucking partially assembled keyboards and parts from two slowly rotating carousels that turn like giant dry cleaners' racks through the room.

Diane Smith, a young Dorchester resident, sits at one of the stations, pulling off bare keyboards and fitting each of them with 108 small metal springs — one for beneath each key. In one eight-hour shift, Smith is expected to outfit 40 keyboards with the metal slivers and several other parts.

Smith has been doing the job for three weeks as a temporary employee and hopes to be hired permanently.

"Once you get used to it, it's incredibly easy," she says.

Digital officials say 41 percent of the employees at the plant are residents of the "immediate community," by which they mean the City of Boston. Sixty-three percent, they say, are minorities.

Plant manager Ralph Gillespie said the company could not say just how many of the plant's employees come from Roxbury itself. Gillespie, himself a black, resides in Stow and keeps an apartment in the city.

Talking with reporters yesterday, Gillespie ran through a long list of ways in which the company, through training programs, summer job programs and donations to local civic and industry organizations is an asset to Roxbury.

At the same time, he said, the plant has become a valuable asset for Digital, with workers turning out fully assembled keyboards consistently on schedule and passing stringent standards of quality control.

But Gillespie said he regrets that Digital is the only company that has broken ground at the CrossTown site.

"It's unfortunate that we're still alone," said Gillespie. "It's too bad for Roxbury."

Also too bad for Roxbury is Digital's announcement yesterday, made lightly in the course of Gillespie's press conference, that the Maynard-based company will not be doubling the size of its CrossTown facility as originally planned, at least not for the foreseeable future.

Improved production processes and planned use of "robots" in the plant will make expansion unnecessary, said Gillespie, even though the plant's output is expected to rise to one million keyboards annually from 250,000 personal computer units.

The factory's workforce will continue to grow slowly as demand for its product grows and a full second shift is added, said Gillespie. But if the employment figures of 400 or more once envisioned for an expanded Digital plant are going to be reached at CrossTown, some other company will have to do the hiring.

Brian Dacey, director of the city's Economic Development and Industrial Corp., says Boston is preparing to participate fully if Reagan Administration plans for low-tax "urban enterprise zones" are implemented.

But Dacey warns that without the up-front federal subsidies for site preparation that Reagan planners now talk of cutting, prospects for bringing immediate neighbors to the Digital plant will be dimmed.

"If they are representing that this is inspiring because a private company made it happen on its own, that's incorrect," said Dacey. "If you didn't have the local, state and federal governments to clear the way, it wouldn't have happened."

What's needed, says Bank of Boston's Howell, is not a termination of federal subsidies but a more focused application of the funds on the nation's hardest-hit inner-city areas.

"I think the reason we see these [Economic Development Administration] subsidies under attack is that 84 percent of the country has been eligible," said Howell yesterday. "We need to target these subsidies more precisely."
Introduction

The ideal capitalistic system would provide an equal opportunity for everyone to have access to the means of accumulating wealth. The laws of supply and demand would work so that everyone who wanted to work would have a job, all the products people needed would be made, and even the built environment would reflect how each community wanted it to be used. Of course, the reality is far from this ideal. The government has been assigned the role of filling in the holes of the system, with innumerable planners prescribing plans. Many of them would like to offer new visions and solve "systematic inequities," but they are usually relegated to "damage control" and "managing decline." The phrase "managing decline" has physical connotations. As people and businesses move out of the city, vacant buildings and vacant lots become a problem, especially in neighborhoods undergoing disinvestment. To some experts this is an acceptable indication of fluctuations in supply and demand. Anthony Downs of the National Real Estate Research Board wrote:

"It's not necessarily bad for land parcels cleared in renewal areas to remain vacant for long periods of time. Society can be viewed as banking this land for potential future use whenever changed local conditions stimulate increased demand there."

The problem is that in most poor neighborhoods this may not take place in a person's lifetime. A more radical solution to the same process is to have the land revert to public ownership under local community control. This was attempted, in a weak form, in England with the Community Land Act. It was vigorously opposed by capitalists and never had a chance to be proven effective.

The government has to shore up capitalism in various ways. One of their roles is to stimulate a reasonable level of effective demand, or consumer purchasing power. In poor communities this is sustained by various transfer payments, but compared with the European welfare state economies, U.S. policy has not favored payments
A Plan To Energize Detroit

Every weekday in Detroit, thousands of people crowd into the local unemployment offices to wait for their checks. What is being called a recession around the rest of the country is a depression in the Motor City. Just on the metalworking side of the local economy—autos, steel and finished metal products—more than 150,000 Detroit residents have lost their jobs since 1978. And approximately 300 factories, large and small, have closed their doors.

“The local industrial base is coming apart,” laments Dan Luria, a research associate with the United Auto Workers Union (UAW). “So it’s important to find other activities people could move into which would reuse these [vacant] facilities.”

Luria and Jack Russell, a consultant to the Michigan state senate, have done just that. The two men recently produced a book called Rational Reindustrialization, which outlines an innovative plan to revitalize those empty factories. Many, Luria admits, are too small, too tall, too old or so rundown that they are no longer usable; but the majority, he insists, are still economically viable.

“The only thing missing,” Luria says, “is identifying what industry we could use to get them started again. We argue that there are other activities people could move into which would reuse these [vacant] facilities.”

But Saltzman and others in the local private sector won’t come out with a full endorsement, because they are put off by the ideology underlying Rational Reindustrialization. Luria and Russell believe that without a clear profit motive, private industry has no real interest in revitalizing cities like Detroit. What they suggest may be needed initially are such elements as worker ownership and public equity. However, the two authors don’t rule out private involvement: in fact, they say that with cities all over the country playing a sort of “economic cannibalism,” Detroit must also put together attractive packages of tax breaks and other incentives in order to attract at least some industrial capital.

There is one other aspect of Rational Reindustrialization that has drawn criticism: the suggestion that Detroit can easily lure energy hardware producers. Says the chamber of commerce’s Saltzman, “What makes me hesitate is that they’re going after an industry with no base here.”

Other critics point out that with the worldwide oil glut, the energy industry has a recession of its own. But Luria takes both points in stride. The Detroit area, he notes, is still the single largest metalworking center in the country, and it would be simple and economical to utilize the manpower and machinery the area has to offer. As to the situation in the energy industry, Luria says the oil glut, and the recession it has caused, is going to end. The time to get into energy hardware is now, before that happens, he says.

If Luria and Russell are right, there’s a chance that within a few years the big lines in Detroit won’t be found each morning at the unemployment office... but at the time clocks and assembly lines of a revitalized city.

—Paul A. Eisenstein

(from "Mother Jones" magazine, December 1982.)
of this kind. The result is a declining demand for goods and services in poor neighborhoods, which further depresses the incentives to invest in the area. The government also has to cope with the problems of "technological unemployment." The graph on the left illustrates this process. Management has the incentive to produce more output with less of a wage-bill. Those workers producing with obsolete machinery will eventually have to find other jobs. Each owner tries to keep wages as low as possible, hiring only as many workers as will sustain marginal productivity, but for the economy as a whole higher wages fuel further capital expansion. The government has to play the role of the disinterested manager, looking out for the common interest of those players in the marketplace. Programs to address this problem of technological unemployment are few and far between. One example, in the news last night, was a training program at the University of Lowell for industrial robot programmers. Whether creating jobs to implement and maintain new technologies that are wiping out other jobs will suffice or not is an unanswered question.

Supply-side economics has been trying to stimulate investment, which is not rising quickly enough to sustain a new cycle of expansion. The problem with capitalism is that both the supply and the demand levels have to be primed. Most government initiatives in economic development only address the incentives to locate and start up production. Companies need to see that enough people are able to buy what is produced. As Joseph Schumpeter stated, the accumulation of capital takes place in "a gale of creative destruction." Most attempts to police that process have been of limited significance. The next section will discuss some of the federal and state initiatives to encourage economic development.

A Review of Public Economic Planning

Federal policy has historically favored industrial decentralization. Industry has left the older industrial cities, largely located in the northeast and north midwest areas of the country, to
locate in diverse states across the country like South Dakota, North Carolina and Nevada. The reason for the shift seems to be an "under-developed" labor force rather than energy costs or whatever other explanations are offered. Various federal policies have contributed to this movement. Defense spending has gone to proportionally more communities in the South and the West. Public works projects have created infrastructure needed by industry in new regions. The interstate system and the inland waterway projects in the South are two examples. The tax structure has favored investing in new plants rather than upgrading older facilities. Trucking freight regulations have lowered the actual cost of producing for a market thousands of miles away. Suburbs have been funded for their smaller-scale infrastructure construction projects and F.H.A. mortgages paved the way for a large-scale population dispersion from the cities. The few programs designed specifically for urban industrial development could never mitigate the cumulative effects of this kind of national policy. Its main effect isn't so much that firms will relocate out of an entire region but that they will leave larger cities in a region for smaller cities and towns.

There has been a succession of federal agencies involved in economic planning. One of the most long-lived has been the Small Business Administration begun in the early 1950's. Its main function has been to provide loans and loan guarantees to firms who might not qualify for regular bank loans. The average loan in 1976 was around $30,000. A problem is that small businesses, like Third World Countries, need equity and venture capital, strong demand, and management training more than low-interest loans. Business is also offered tax breaks when the average percentage of taxes owed to total sales is .5%. However small businesses had to pay the same corporate tax rate as large corporations until 1978. Only 49% of their firms earned enough to be taxed at all in 1977. Some management training and crime insurance programs have been added to S.B.A. services to help inner-city minority firms.
Dexter Lock says a key to the extremely high productivity of its Auburn plant is a unique Alabama job training program. The state-funded program developed a proficient workforce from scratch, beginning with screening. It followed with hands-on training in mobile classrooms and shops and continues with on-going screening, upgrading and renewal programs. Dexter Lock’s Gerald Cannon credits the program for the plant’s low 2% turnover and absenteeism rates and extremely high productivity. Other significant benefits Mr. Cannon has found include: 

- Business oriented state government 
- An unequaled zero tax program 
- A total transportation network of roads, rail, air facilities, navigable rivers and a major ocean port 
- An abundance of engineers and technicians 
- State grants for industrial site development 
- High technology support industries. 

Find your key to greater productivity in Alabama by writing for details.

ALABAMA
Cut out for business.

Advertising a state's positive business climate. (found in "Engineering News Record.")
Industrial revenue bonds have been used throughout the country to finance development projects. Their appeal is the fact that they come tax-free, which makes them attractive to wealthier investors. Until now these bonds have not been used as part of a carefully targeted development program. 84% of all urban areas in this country use these bonds. There is a current proposal to limit their availability to urban enterprise zones. The problem with economic development at the federal level is that every congressional district feels it is only democratic to have some of the funds. The same problem affects military contract appropriations. Many states package themselves to firms by offering a combination of industrial bonds, property-tax exemptions, right-to-work legislation, and worker training programs designed by prospective employers. This has created the condition of the states becoming more competitive than the capitalists, an issue discussed in greater length in Robert Goodman's *The Last Entrepreneurs*. Using industrial bonds has meant that investment practices have had to be based on usual market criteria. Otherwise the state or local area's credit rating would be damaged.

The urban riots of the 1960's, which took place in black communities for the most part, suggested that "The Great Society" was not reaching inner-city neighborhoods. Political and business leaders were scared enough for awhile to pass more comprehensive legislation. The Model Cities Program was designed to address inter-related reasons for urban decay. Business leaders noted that at the time minority citizens controlled only 1% of the total capital assets while accounting for 17% of the population. The conservative viewpoint stressed developing a minority capitalist class whose wealth would "trickle down" to their "brothers and sisters." That has not happened.

Senators Robert Kennedy, Gaylord Nelson and other liberal politicians introduced more legislation that was later watered down under President Nixon's regime. One program was entitled the "Special Impact Program" which directed aid in the riot-damaged areas. One of their goals was to get large corporations to open branch plants in
these areas and exercise their sense of social responsibility. The idea is still with us but the success rate has been marginal. The plants generally do well enough, but there are few incentives for large corporations to come in. However they are the type of firm who benefits from the customary tax incentives. One estimate stated that only 1% of the top corporations would gain substantially from the incentives that had been offered.

Another liberal piece of legislation was the Community Self-Determination Act of 1966, drafted by Gar Alpervitz and Peter Edelman. It arose from a larger political and ideological base that was at its height of power as Nixon took office. The legislation created a Community Development Bank, offered more managerial training for minorities, gave small minority enterprises more tax breaks and gave federal charters to the first Community Development Corporations. It spoke of the importance of developing a strong local civil service, independent of partisan politics. Since that time, both conservatives and liberals have emphasized the importance of local self-determination. The difference is that the liberals wanted to back that power with direct federal aid. The conservatives have now reached the point where the C.D.C.'s (Community Development Corporations) must raise their own capital.

One of the goals of the Community Self-Determination Act was to build strong community institutions and local leadership. The leaders would mediate the public funding coming into an area and improve the effectiveness of the taxpayer's money. Local projects were meant to go beyond efforts to raise standard economic indicators and address "social pathologies" in ghetto areas. To help meet this goal the legislation allowed for direct political action on the part of the leadership and designed the funding mechanisms to by-pass local and state government control. Blacks had seen that their political rights had been extended by federal mandate and that local politicians would send the money into other neighborhoods. This fear has been borne out. Now that Urban Development Action Grants
(U.D.A.G.'s) are controlled at a local level in Boston, projects catering to the middle and upper classes, like Copley Place, have been funded. The earlier C.D.C.'s around the country were able to set up enterprises that could base their performance on other indicators besides monetary profit. Job training and developing cooperative networks throughout a neighborhood was encouraged. The idea of building inter-dependent economic institutions came from Islamic models and is a reason for the success of industrial complexes like Mondragon in the Basque region of Spain. They personalize the impersonal "free-trade" market concept to stimulate each other's demand. Under President Nixon, the C.D.C.'s began to be evaluated on profitability levels only, and more urban aid went to physical improvements in many areas of a city rather than economic development in the poorest neighborhoods. Firms were no longer encouraged to have strong links with their community.

The C.D.C.'s often began by supporting local small retail businesses. Later many decided that manufacturing firms provided more leverage for jobs, skill training and overall community investment. One C.D.C. in Chicago renovated an old meat-packing plant and managed the building for light manufacturing. A re-occurring problem in these attempts was that most of the firms who wanted to come in offered low-wage, low-skill, dead-end jobs. Opening higher-paying manufacturing jobs to minorities is still difficult. In Boston for example very few minorities have jobs in the type-setting and printing trades, which are always suggested as good sources for urban employment. Some development efforts that promote smaller retail firms have done a lot to revitalize communities. El Mercado de Los Angeles organized itself by selling shares of stock, with a 1000 share maximum, to local residents in the Chicano community.

The history of the community development movement contains two polar ideologies that have been intertwined in most minority communities. One has favored trying to catch up with the economic progress of the dominant group. The other strand views the dominant
group as the problem not the solution. Leaders in the 1960's, like Malcolm X, advocated mutuality, with the black community building institutions like community banks that would finance local enterprises and firms. They felt that local initiatives had been destroyed by outside capitalists. They also believed that the community had become controlled by outsiders working in the bureaucracies. They kept people going with welfare checks and foodstamps but never offered anything better. This viewpoint was know theoretically as "internal colonialism."

New programs appeared during President Carter's administration that had a new emphasis on "public/private partnership." City planning agencies took on more marketing functions themselves. An important tool that appeared at this time was the Community Reinvestment Act. For the first time local banks had to show the banking commissioner that they had provided local customers with a certain proportion of their investment capital. It has proven to be more widely effective than many development programs. The main programs providing funds for economic development that remain are grants from the Economic Development Agency and U.D.A.G. grants. During the 1970's state and local spending doubled. Much of it was used to infuse equity capital into urban projects that the private market would not fully finance. The public has had little chance to decide if tax money should be spent that way. Under President Reagan these funds have all been sharply cut. Between these cuts and a severe recession, manufacturing opportunities have declined.

The only suggestion for developing the industrial and employment base in depressed areas under the Reagan administration is to create enterprise zones around the country. The idea comes from an English planner, Peter Hall, who hypothesized that problems in these areas are so great that only "zones for fairly shameless free enterprise" would offer enough incentives for firms to locate there.24 This would mean that most of the legislation that has
protected workers rights would be suspended, in an attempt to recreate "the Hong Kong" of the 1950's." A proposal that almost passed in Illinois would have suspended all zoning and building codes, all right-to-work laws, the minimum wage, and would have weakened pollution and O.S.H.A. regulations. The promoters like to point a rosy picture of companies bringing in progress, cleanliness, science, and success. People want to believe that high-tech firms can solve the problems in the ghetto, or any community. In fact most planning experts believe enterprise zones will mainly create low-wage, low-skill jobs. After they initially hire, most companies in existing zones around the world don't upgrade the skill levels of their workers. There is also evidence that these zones only cause the over-all number of jobs to be shifted around physically and that companies locating in zones who are in highly competitive markets have an unfair advantage over those who cannot locate there. The government's customary role is to regulate the market and to make sure that it stays open to newcomers. Enterprise zones might have the opposite effect in a local economy.

The results of the history of using public funds to stimulate private investment is disappointing. With hundreds of communities competing amongst themselves to offer the best deal, more is given away that the firm probably didn't need in the first place. At the same time the opportunity to encourage more producers to enter the market or to enlarge the criteria for success was largely passed by. There were many exciting initiatives, but nothing has grown beyond one group, one culture or one community. At present the C.D.D.'s in Massachusetts are not even evaluated so that successes can be noted and spawned. Though public entrepreneurship could theoretically be a tool in advancing economic democracy, at this point the agencies involved are more bureaucratic and insulated from community opinion than a private firm. Robert Goodman noted that public entrepreneurs "...have no automatic purging mechanisms like private corporations; losing citizens can't easily move themselves and their tax dollars to new places and new public entrepre-
neurs."  It seems all too easy to inherit what the English call "lemon socialism," with the worst excesses in both the private market and centralized, bureaucratic planning.

Compared with most states, Massachusetts has a sophisticated network of umbrella organizations to support local industrial development. The Community Development Finance Corporation has given out equity capital from a ten million dollar fund in general obligation bonds. Their stipulations are that a firm must at least break even, be located in a depressed area, and be locally controlled by a membership organization. One problem they encountered was not getting enough proposals. Recognizing the need for technical business assistance another organization, the Community Economic Development Assistance Corporation was set up. The Industrial Development Finance Agency was started in 1967 to give out loans and insure loans for constructing industrial facilities. In 1972 the state chartered the Economic Industrial Development Corporation that were given more power to stimulate industrial development. They have the power of eminent domain to assemble industrial parcels and can build or renovate buildings before signing tenants. Like the I.D.F.A. they can float a $5 million bond for each of their projects. The Massachusetts Capital Resource Corporation has an investment pool formed by domestic life insurance funds, and local banks are starting to provide more venture capital, especially for perceived "high-tech" firms that are starting up or want to expand. After mentioning all the above sources of capital it is appropriate to note that the failure rate for new business is still extremely high and that most of these firms cannot provide secure, well-paying jobs.

Out of the hodge-podge of development efforts, one approach stands out as being more consistently successful than others. This is to develop labor intensive manufacturing for export markets. A report drawn up by the New England Regional Commission in 1976 lists dollhouse furniture, women's clothing, defense equipment and
types of technical paper as examples of this kind of production. They also recommend setting up artisan colleges throughout New England to make high-quality export products. The report mentions that the colleges could be sited in "small industrial buildings of historical significance to the New England economy." The Local Economic Development Conference, meeting in Boston in 1979, noted that federal programs have not had much of an impact on regional employment patterns. As Ian Menzies has mentioned in recent Boston Globe columns, New England could accomplish a lot more if it cooperated on regional economic development efforts of this sort. He also cited agriculture as a business that could be revitalized in New England. Plans for a more extensive rail network can also help to stimulate the regional economy.

Planning for Manufacturing in Boston

Manufacturing employment in Boston declined by 3% between 1970 and 1980. This is not as great a loss as many would expect and proves that manufacturing is still viable in cities. Some production sectors increased: rubber and plastic products went from 393 to 1,144 workers. Instruments and fabricated metals also increased. Traditional products like printing, leather goods, and paper products had slight declines. The average size of a firm was 47 employees, but the distribution was highly skewed. Only 3% of the firms had more than the average, but they produced 43% of all jobs. The wage rates in the area were lower than other cities. A machine tool operator in Boston averaged $7.05 an hour. In Chicago one would make $8.65, in Detroit $10.18, in Houston $8.33, and in Baltimore $8.77. Women and minorities were generally employed in industries that paid the lowest wages. The Boston Economic Development Industrial Corporation (E.D.I.C.) calculated that in the city limits of Boston there were 95 sites available for manufacturing use in 1980. This included six million square feet of building space and 250 acres of open land. Most firms currently manufacturing in the city did not feel they needed one story plants. What they did need were continued low rents, and
expansion space they could count on. This suggests an important role for a group like the E.D.I.C.

The E.D.I.C. uses its power to leverage private investment, by improving industrial sites and coordinating all the agencies that have to be brought together in most manufacturing relocation projects. Two of their biggest projects have been developing the Charlestown and South Boston Navy Yards. In South Boston they had planned to use old buildings for garment factories that were being displaced from Chinatown. The Boston Redevelopment Authority, General Services Administration, Massachusetts Government Land Bank and the Economic Development Agency all had to agree on the project. Ironically the Navy may decide to come back to the port. It is a good example of the principle of "higher and better uses" for prime downtown real estate. In this case a large institution, Tufts University, is causing the displacement.

The Chinese Economic Development Council is another group that is trying to attract manufacturing firms to use an older, inner-city building. They were able to buy the Boylston Building in downtown Boston with various funding sources. Originally Wang Laboratories had committed itself to setting up a branch plant there. Its president, An Wang, had a personal commitment to helping improve the Chinatown area. They later decided to build a new facility on a vacant site nearby. The reason given was that structural engineers decided the floors could not support the expected design load. There may have been other reasons however. Another example of public funds, in this case a U.D.A.G. grant, being used to help a manufacturer stay in Boston is the Hood Dairy facility in Charlestown. In their case the money was spent on modernizing and enlarging their existing plant.

The Cross-Town Industrial Park of Boston

The largest undeveloped industrial parcel that city agencies are trying to market for manufacturing use is the Cross-Town In-
The Roxbury plant of Digital Corporation.
Industrial Park. A lot of money has been spent to improve the site so that it can serve as an employment base for the Roxbury community. Roads around the site were widened and it is easy to get on both the Mass Pike and the Southeast Expressway. The land around it has been used for storing and distributing goods coming into the city and some manufacturing. The Boston City Hospital and a neglected housing project also border the park. Thus far only the Digital Corporation and the Stride-Rite Shoe Company are major tenants. The president of Digital, Kenneth Olsen, also has a personal commitment to help stimulate employment opportunities in the inner-city. This suggests that experts should never overlook corporate leadership in their studies of location decision-making. Digital's original agreement was to make rental payments of $.70 per square foot in lieu of taxes for 58,000 square feet. They had planned to expand later but recently have decided not to. This is one of their smaller assembly facilities. After 20 years they have the option of buying their site for $2 per square foot, which is extremely cheap for such a location.

The Community Development Corporation (C.D.C.) of Boston has been working for the economic development of Roxbury since the late 1960's. Their individual history is a good marker for the lessons learned since that time and the shifting attitudes planners have had about what is most effective. They were originally the economic arm of a Model Cities project. At that time most of their funding went to minority businesses in the form of a revolving loan fund and equity investment. Some beneficiaries were Freedom Electronics Engineering Incorporated and Housing Innovations, both of which are still in operation. They also supported smaller retail and service establishments like neighborhood beauty salons and corner stores. Their funding sources changed over to the Community Development Block Grants and Economic Development Agency grants. They were also involved in giving technical assistance in a Neighborhood Business District Program. This tries to help local small business improve their property and marketing techniques.
The building owned by the Community Development Corporation of Boston. It is currently vacant (as of February 1983).
Since that time in the 1970's, leaders of the C.D.C. have felt that they could provide more jobs by trying to attract larger manufacturers to the area. Towards that end they acquired a vacant four-story manufacturing building in the Cross-Town Industrial Park. In coordination with the E.D.I.C. they have been trying to market this space. Thus far two firms have made commitments then have backed out, and the space remains vacant. The building itself is in good physical condition with an attractive street facade. An architecture firm was hired to draw up a renovation proposal. It would have modernized the existing building and torn down another structure on the site to improve parking and loading facilities.

The C.D.C. had planned to rent the space at around $8 per square foot which is substantially lower than average prices on Route 128. There is a growing supply of manufacturing space in 25 or 50 year old buildings on Route 128 however. There seems to be an attitude amongst private entrepreneurs that locating their firm in a public industrial park is bestowing a favor and they should only have to come in at cost, if that. The efforts of the C.D.C. are a good illustration of the frustrations and limitations of trying to directly compete with other real estate offerings for larger firms. This particular C.D.C. has loose links with many Roxbury Community groups but has chosen not to work closely with developing local firms at this time.

John Ottensman, in his book The Changing Spatial Structure of American Cities, offers a pessimistic reading of the situation. Or it may be that the whole paradigm in which such efforts are directed must be changed by broader political demands.

"In sum, programs to alter the market-determined patterns of manufacturing firm location in urban areas like Boston appear likely to be relegated to the set of symbolic gestures that polish the image of quixotic mayors without making for any substantial change in the metropolitan employment landscape."
In reviewing the statistics compiled by the E.D.I.C. it appears that they can work to retain Boston's manufacturing base. John Ottensman over-dramatizes the failure to attract imported firms at the expense of neglecting the importance in providing opportunities to expand what is here.
INITIATIVES IN MASSACHUSETTS COMMUNITIES

The stark simplicity of a granite load-bearing shell.

FALL RIVER
Industrial Development

Fall River was one of the great textile manufacturing centers of the world. It retains a civic majesty that is unique in Massachusetts, with the remaining granite mills serving as its visible monuments. Fall River has the setting for such a role. Compared with the rest of New England, the weather is milder and more humid, which is better for working with cotton. The city is situated along the bluff of an inlet leading into Narragansett Bay. This meant Fall River could easily ship its finished products and receive raw materials. Fall River also had a river; literally falling down the rocky bluff to the bay. The early mills used this as their source of power.

Production expanded from Civil War contracts and Union soldiers had some of the world's first mass-produced uniforms. But the real growth of the mills came when the steam engine was introduced. Suddenly there was no need to depend on interior streams for sources of power. Also, the capitalists could take advantage of Fall River's rising number of immigrants and her port facilities. An entrepreneur did not have to develop a whole new town, but could simply build a factory. Fall River's industry was always kept under local control. Local merchants and industrialists had as many connections with New York, because of the Fall River Line steamships, as it did with Boston. The whole town participated in the expansion, from owning stock to working in the mills. It was a common practice for construction contractors and machinery suppliers to accept stock in a newly formed mill, rather than be paid. As with high-tech industries today, people believed in the expansion and wanted to be among the first to reap the benefits.

The darker side of the picture was the working and living conditions for the operatives. In 1900 Fall River had the highest child mortality rate in the country, 4.5 out of 10 children. (The national average was 2 out of 10.) Children and women were employed
more than men. (This remains true today. In one garment factory I walked through, there were around fifty women working as stitchers and one younger man.) Because of this employment pattern, family life was disrupted. Many families who rented housing from their companies were told that in order to stay they had to produce children to work in the mill; "5 to 8 children were desirable."

The successive waves of immigrants added to social tensions in mill cities. The original workers came over from working in similar English factories. They were followed by French Canadians, the Irish, the Polish, the Portuguese, and now the Hispanics. The owners tried to keep them divided into ethnic groups to prevent a unified demand for higher wages. During one strike in 1904, 13,000 residents left Fall River to settle in more rural towns nearby. Many had been skilled English mill workers. In 1890, Fall River was the only American city where foreign-born people outnumbered the native-born residents.

During the First World War, Fall River's manufacturers acquired more contracts to fuel further expansion--contracts for things like medical bandages. The owners wanted to keep such orders a secret so the workers would not ask for more wages. They colluded in secret meetings, leaving and entering a room in pairs to avoid detection. Instead of reinvesting in their facilities to compete with the emerging mills in the South, the owners chose to give dividends, and also had to pay a large "excess profits" tax to the federal government. Massachusetts also began to enact stronger legislation for workers, such as the 48 hour work week. This higher level of policization favored using Southern workers, many of whom still ran farms as well. It should be noted that the practice of dispersing labor was also true within a Southern region. For example the city of Charlotte North Carolina had many factories in the early 1900's. Gradually the owners move them to backwater towns where one employer could control the entire labor force.
Garment workers in a Fall River mill. (from "The Providence Sunday Journal, 1982.")
Cotton manufacturers have left Fall River. Those that modernized and made higher quality fine-combed cloth stayed longer, but the last such company closed in 1965. The impact of one closing could be enormous. During the height of its production, the American Print Works hired 5,000 workers. It closed during the Depression. Some mills switched to power-weaving production and are still in operation, like the F.R. Knitting Mills. Most of the mills had scattered absentee ownership, unlike cities such as Manchester, New Hampshire, where the Amoskeag Mills dominated the entire town by the 1930's. Much of the production space in the mills has been divided by floors, with four different firms using one building. Fall River has become a mecca for factory outlet operators who usually occupy the lower floors. It is not unusual to see production in one part of a floor and shopping in the other. 49% of the manufacturing base is still in the needletrades.

These garment factories continue to rely on skilled female labor and the cheap rents in the old mills. There are still around 75 of these buildings. The workers have a union, but most operate on the piece-work system. The union feels that this keeps the firms more competitive and that the women can earn more money. The union is now more concerned about their working conditions, and is researching job-related stress levels. Of all the factories I visited, the work here was by far the most demanding. The rows of machines with lowered fluorescent lighting fixtures and no view outside felt grim.

Fall River has seen other manufacturing besides the textile mills. For one example chemists at the Firestone Rubber Company developed the process for manufacturing neoprene during the Second World War. Fall River recently developed its own industrial park on the outskirts of the city. It contains a variety of firms, that make caskets, medical devices, plastics, fiberglass boats, and rubber products.
The variety of Fall River mills. All are still occupied.
Fall River Mill Architecture

Most of the mills were built from the granite ledge under the city. Later, when transport prices fell, bricks were also transported down by barge; but the cheap labor costs favored using the granite. One piece of cut granite could weigh 18 tons, so the beauty of the mills comes from many people's hard labor. The initial builders were local artisans and mechanics using construction practices that had gone into the earlier grist and fulling mills, and also had gone into the earlier English mills that some builders remembered.

"The buildings looked like large stone barns enlarged to gigantic proportions, with a refined finish and sophisticated detail, particularly in the carefully designed towers which dominated the whole city." 27

The rock was cut into squared ashlar and was hammer-finished on the edges, or was built as irregular rubble with widely parged joints. The heaviest machinery was put on the bottom floor. To reduce vibration the buildings would rest on bases of cobble. It was estimated that 7,000 tons of cobble was laid for Union Mill #3.

At first many mills had only one central stair tower, but after the Granite Mill fire in 1874, corner stairs were added. Ornamentation was usually limited to these towers and as a result they would often appear overblown. The imagery of Italian companiles was used because the mill would have bells at the top of the towers to serve as fire alarms. Fire safety continues to be a problem. The Fall River fire chief, in a Model Cities report, noted that factory workers were often working when sprinkler systems needed repair, and that the water mains were losing their capacity. All of the older mills have had to install outside water connections.

The buildings were designed by various types of people. The treasurer of a company would often draw up rough plans and consult a builder directly. The companies had to pay close attention to
Adapting to today's economy.

A view in the Durfee Mill complex.
fire insurance regulations and did not always trust architects to use them in their designs. The owner sometimes had a close relative with enough technical training to plan a building. But some architects did specialize in factory design. One man, William Henry, graduated from M.I.T. in 1870 and then supervised the building of 46 cotton mills in Fall River between 1875 and 1910. His method of teaching is interesting:

"...[Henry] would set a task for these young men and leave them to figure out the proper floor spacing and arrangement of the machinery. Then he would inspect the results, pointing out the flaws, and making them rework their plans. By such an arrangement he taught his apprentices to be self-reliant and skilled in drawing designs to fit practical requirements." 28

The actual builders were supervised by master masons and carpenters. These men were primarily responsible for the beauty and durability of the mills. The last granite mill was built in 1912 and by 1968 half of them had been destroyed. Many were burned in a 1928 fire, and the construction of a highway over the course of the former river destroyed more. Those that remain are being used for the most part. Their lack of elevators, which requires a large outlay of capital, is still a problem in attracting new industry.

Trina, Inc.

Trina, Inc. is located in the former Sagamore Mill Complex. They manufacture what are called "novelties," a variety of products that are constantly changed and redesigned. Examples of these are ladies cosmetics bags and vacuum-sealed sachet packages. They require fabric and plastics processing, and the items are manufactured in discrete stages of assembly. It is a labor-intensive, low-value kind of production. Their main competitors are in the Far East, and pay lower wages, but the company is doing relatively well considering the current recession. Trina began production in Providence, Rhode Island, moved to another Fall River mill, and bought the Sagamore building in the mid-sixties. The price was low and the building was
The Sagamore Mill, occupied by Trina Incorporated.
in better condition than where they had been.

The initial renovation effort cost .5 million dollars in 1967. They had to install a completely new electrical system and enlarge the blowers on the heating system. Instead of installing an expansive cooling system, the company gave each worker a portable fan to use at their work station. (Since I visited the factory in January I could not measure their effectiveness.) The ground level wall was cut to enlarge the loading facilities. There are three floors and an eight foot high basement, which is used for storage. (Concrete was laid over its original dirt floor.) Most of the production takes place on one and a half floors, which are connected by an inclined conveyor belt. Part of the top floor is used for storage and serves as extra space in case Trina wants to increase production. Its market seems to be volatile, with wide fluctuations in demand, so that low-cost space with extra capacity is valuable to the firm. Each floor measures 170'x700' and is mostly undivided. The scale is large, but not inhumane. Taped yellow lines demarcate different production areas and the traffic aisles. The production machinery is laid out so that products are progressively assembled moving up the length of the floor. At one time the factory used a conveyor belt to move the products to different work stations, but it was so confusing for the workers that the conveyor belts were taken out, with no loss in productivity. In fact there are no continuous "assembly line" kinds of operations in the six factories I visited.

Trina uses a shelving system that runs along each side of the floor for goods waiting to go on to another operation. The spatial arrangements for storing products are as important as the assembly areas in a factory like this. Each work section has modular furniture that forms a small lounge area. The supervisor has a station that is slightly raised.

Three areas were spatially distinct from the main production
floors. The product design employees use a separate room in a wing off from the freight elevator. It has been renovated, but I was not allowed in for security reasons. I noticed in all my visits to factories that industrial spying is a real concern. The administration areas has lowered acoustic ceilings and the windows have been filled in to look more like "office" windows.

Trina spent around $125,000 a few years ago to renovate one end of a floor for the workers eating and recreation area, and they hired a local architect to do the design. The results are extremely attractive. The large windows are screened by wooden shutters, which were specially commissioned. Brightly painted red designer chairs contrast with the wood and white walls, the floors have been sanded and polished, and low incandescent lighting fixtures have been installed. Beside the lounge area and the vending machines, the company has added a ping-pong table, a pool table, a foos-ball game and a full-height storage shelf separating the room from the production floor. I could believe that the employees often stayed after hours. What the exact motivation was for this amenity I do not know. The effort did show how these factories could be renovated to offer a better working environment than many modern factories.
A detail of the Clinton railroad station, now partly used as a bar. The cornice has beautiful green, red and white terra-cotta tiles.

CLINTON
The history of Clinton and Nypro. (from a Nypro Inc. brochure.)

In the 1840's, Erastus Bigelow invented the world's first power loom for the weaving of carpet. A huge mill was constructed in Clinton and the rhythmic sounds of these amazing new machines became symbolic of the Industrial Revolution surging through America.

The mills prospered and the citizens of Clinton were proud of their mill and its carpets shipped into markets around the world.

Then the looms fell silent as the Great Depression engulfed the country.

Recovery was slow and Bigelow decided to move South with most of New England's textile industry. By the late 30's the famous landmark had fallen into disuse. Broken windows and unpainted doors became symbolic of another era.

By the time Nypro "discovered" the old Bigelow Mills, most Clintonians had lost hope that their most famous landmark could be preserved.

Like Bigelow, Nypro has its roots in Clinton; emerging from Fred Kirk's garage shop in the 1940's. Now Nypro prospers as it plays its part in another revolution—the plastics revolution.

The rebirth and renovation of the Old Mill continues. Clintonians can feel pride in their heritage once again.
Manufacturing in Clinton

Clinton was once part of the more rural community of Lancaster. It was located on a river that was later dammed to become the Washusett Reservoir. Because of the river-side factories, the area was first known as Factory Village and later Clintonville, after Clinton Company. At the time Clinton seceded from Lancaster and began developing their own shopping district, which runs perpendicular to the Bigelow Mills. Clinton was originally serviced by railroads. Now it is only a few miles from Interstate 495, making Clinton a viable manufacturing location once again. Erastus Bigelow, with his brother as business manager, became the town's leading manufacturers and at the same time was a mechanical genius—an original high-tech character. In the 1840's he organized the Lancaster Mills which later produced the world's supply of gingham fabric. He next perfected the power carpet loom and set up the Bigelow Mills to mass-produce carpets for the first time. Bigelow's machine reduced unit costs per carpet from 30¢ to 4¢. They remained there until 1933 when Bigelow Carpets moved to Connecticut. The Lancaster Mills also stopped producing in 1930.

Since that time, Clinton has had to struggle to retain a manufacturing base. In the early 70's Nypro Inc. began to purchase the Bigelow Mills complex, and over time Clinton has been able to attract other firms. Another plastics concern, Van Brody Plastics, uses a smaller mill site. One of their biggest setbacks was the failure of the Colonial Press. When it closed a few years ago 2,000 jobs were lost, or 20% of the local workforce. The workers had tried to save it at the end, and ran the press cooperatively, but they were not successful. (The LFE Corporation is now leasing the same building.) In 1978 the two created a community economic development department which is trying to establish more diversity in the employment base. There are already 6,000 manufacturing jobs in the town, which makes Clinton more self-sufficient economically than most towns around it. The population is around 13,000.
The LFE Corporation

The LFE Corporation began after World War Two with government contracts to find peacetime applications for nuclear energy. They have remained an engineering-oriented firm, manufacturing sophisticated products in several market areas. LFE is currently producing equipment for other manufacturers that can measure the thickness of industrial coatings by nuclear sensors. LFE also makes traffic signalling devices, environmental control equipment, and has various military contracts. The military contracts and the production control equipment are doing well at present, but the funding cuts in the environment have hurt their other markets. This was a reason for leaving the Route 128 plant in Waltham, where they had incurred a debt.

LFE also wanted more production space. The Lancaster Mills looked attractive because they could lease enough space for one plant, instead of paying higher costs to operate two plants. Another reason was its location in the Interstate 495 corridor where other manufacturers were settling. Two other sites were considered out of 50 possibilities. One in Chelsea had structural problems and was in an "unattractive area." The other site in Dedham was too far away from where most workers lived—especially the higher paid workers; did not have a good lay-out, and LFE would have no control over who the neighboring firms would be.29

LFE moved from a 165,000 square foot building, which was then marketed as an office park named "Reservoir Place."30 They have leased 320,000 square feet in the Lancaster Mills, which has a total square footage of 700,000. It is 56 miles from Boston airport. An advantage for them was obtaining a long-term lease at $7 per square foot, which was lower than the other options that had been under consideration for nine months. LFE is leasing the building from Brickstone Properties, a real estate company based in Chicago. This firm has been buying up old mills in small cities throughout New England that they feel blend in with the environment—nothing too
The Lancaster Mill entrance area, now leased by the L.F.E. Corporation.
too grimy and "industrial." They feel that high-tech firms will be attracted by the visual amenities inside and outside the building. Brickstone Properties does the initial renovation work on what they buy. At the Lancaster Mills they have plans to add a restaurant and develop a park along the old canal and a pond which they own. Brickstone Properties spent $13 million on the complex, which indicates the enormity of their investment.

LFE financed their share of the renovation work with proceeds from the sale of their Waltham facility. A subsidiary architecture and engineering firm of LFE, Anderson & Nichols & Co. Inc., supervised the renovation work. LFE leases a four-story space, 60'x450', and an adjoining single story space with a series of beautiful wood-framed monitor roofs, built in 1844. The single-floor space was the main manufacturing area. The monitor gave the area a nice light quality, reducing the need for overhead flourescent fixtures. Contractors replaced the monitor's roof and added a layer of insulation. Opaque panels were installed instead of glazing in places where the processing equipment was sensitive to daylight. LFE's manufacturing is produced at a low rate, with each product costing thousands of dollars. Quality control is extremely important, and the work is done by a few, highly-skilled employees. This means that an older structure, lacking wide spans, is not a critical problem, although the architect did mention that it made space-planning more difficult.

Around one million dollars was spent on tenant work. LFE replaced 3,200 windows to weatherize the building. The building inspector approved the use of the old brick stairwells if a new fire-stair was added in the middle of the 450 foot building length. The freight elevator was in the process of being upgraded for higher speeds and for use by handicapped people. LFE had expected to replace all the mechanical systems from the beginning. Assembly work was also done on the second floor, but eventually it will go down
Detail of the Bigelow Mill.
to the one-story area of the complex. The engineering department occupied the third floor, and the corporate headquarters used the top floor. All the office space was open-plan. Being able to take in the entire 60'x450' space was enjoyable. This was particularly true on the top floor because the heavy roof timbers were exposed, giving the space a ship-like atmosphere. Acoustical panels were installed on the underside of the floor planking to reduce noise, but noise still was a problem for some employees. The fire alarm system had to be improved; however the building was already sprinklered when LFE moved in.

The employees I spoke with seemed satisfied with the building, although many had to commute a long distance. Like the Digital Corporation, LFE was using the building more for their research and office needs than for basic manufacturing. LFE did an especially nice job renovating the lobby area and the main stair tower. The tower had the original gracefully twisting wood stairs and closed balustrade. The contrast of old and new "high-tech" imagery was effective as a corporate image.

"All the facility and elegance of modern design will be blended with the warmth and mellowness of Victorian symmetry, old wood and brick."31

Nypro, Incorporated

Nypro makes injection-molded plastic components for other manufacturers. A local man, Fred Kirk, started the company out of a garage in Clinton in the late 1940's. They have grown from producing one product to being able to adapt their machinery to make practically any kind of plastic component. One part of their plant is tightly controlled environmentally and makes sterilized medical parts for example. They now gross around 50 million dollars annually, compared with 4 million dollars in 1972. Nypro has production facilities around the world; sometimes as a joint venture with a local company. One of their plants is in Taiwan at the Nantze Export Processing Zone where no duties are levied. Of their joint venture with Al-Kung Plastics, a company brochure states, "The
The Bigelow Mill looking from the town's main commercial street.
company represents an ideal source for procurement of cost-saving components which Far Eastern manufacture and assembly can offer." They also have a plant in Bray, Ireland to avoid EEC tariffs and to supply all the other manufacturers that are located there. A plant in Puerto Rico supplies components for the large number of medical supply manufacturies, and there is a plant in Galesburg, Illinois.

Nypro first expanded from the garage to a facility near Clinton. Once they reached 40,000 square feet, a further expansion was planned. They bought land and spent a year designing a custom facility. Then it was discovered that the land was on a floodplain, and the construction costs would be exorbitant. The company decided instead to buy warehouse space in the Bigelow Mills. At that time, in the early 1970's they could buy the space for only $2 per square foot. Nypro decided to expand within the complex and bought the remaining space from five different owners. The initial renovation work was for 150,000 square feet, out of the total 500,000 that Nypro now owns. Like Digital and LFE, the ability to be able to afford extra expansion space was a major reason for buying a mill complex. Nypro spent $1.5 million on the initial renovation work. In 1973 dollars they averaged $12 per square foot for renovating assembly areas, $18 per square foot for areas which had needed new flooring, and $22 per square foot for office space in the mill. In recent years they have spent an average of $20 per square foot for modernization work.

Nypro had a lot of work to do. 700 windows were replaced. The original windows had small panes but Nypro decided to put in larger-paned replacements. One distinctive feature on the building's facade is the bright lemon-yellow window trim. It is quite effective in conveying to the public that an old building has been renovated. Older skylights were replaced by Lexan sheets, which did not seem to be aging well. The company bought the building before the historic building tax credit was offered, but they may try to qualify an adjoining building and keep the small panes. It is a good example for
observing how visually important the window type is on a facade.

The elevators were obsolete but instead of replacing them the company decided to install ramps so that forklifts could travel between two of the floors. Because of the way the site drops, the ramp and the stairs were adequate. The main entrance faces the town and people walk over a footbridge to the building's second floor. The ceilings are 18 feet high which is adequate for Nypro's needs. In one operation, liquid plastic is fed through machinery via a hopper positioned on the floor above—an example of gravity-feed production. It was pointed out to me that one-story plants can spend the same amount of money using a pressurized piping system that moves the material horizontally instead of vertically. The point was that having stacked floors is seldom an absolute advantage for manufacturing today. A new factory usually will not be designed that way unless it will be used by many firms or if the cost of land everywhere is expensive, as it is in Hong Kong.

The ground level wood floor sagged and was replaced. The company installed two parallel service tunnels, 8'x8'x300', below a new concrete floor, which supports machinery weighing hundreds of tons. Eventually the machinery will be completely automated and a conveyor belt will be installed in the tunnels to service them. Robots have already replaced some assembly jobs but so far Nypro has retrained all their workers for new positions in the same facility. They found that the column spacing, which is 25', had to be worked around but was not a critical problem.

The quality of both the original construction and the renovated areas was impressive. The old Bigelow offices, which were left intact even when the building was vacant, had ornate moldings, wood paneling, and original ceiling fans. A new lobby and administration area had been designed by a local architect, to be perceived as a more free-form sub-system within the regularity of the overall volume. The viewer could read both systems and they complemented each other.
The structural frame was in good condition, so that most of the interior work involved refinishing the surfaces. The nicest space in the building for me was an assembly space that formed the top floor of a wing in the complex. A large monitor roof went along its length, letting in a wonderful amount of light. The architect had designed a conference room overlooking this double height space, with a large window allowing a view down the monitor-truss roof. In general the building seems to be adaptable to Nypro's long-range modernization plans and provides an attractive working environment.
A map of the Digital complex, posted in the corridors as a reference.

MAYNARD
Maynard was once part of the towns of Stow and Sudbury, which were farming communities. At that time it was called Assabet Village, being near the Assabet River. Maynard first attracted grist and cider mills, and then a mill to make spindles for the new cotton factories. In 1846 Amory Maynard and William Knight came to the area as entrepreneurs looking for a site to set up a yarn factory. They bought up all the water rights in the area and built the first factory in what is now the Digital complex, measuring 50' x 100'.

Maynard had become a manufacturing center needing urban services that the parent communities did not want to provide. As a result it became incorporated in 1871, naming itself after the man who had been its largest industrialist. In 1899 the same mill complex, located in the center of the new shopping district, was bought over by the American Woolen Company. They renovated the buildings and it became the largest woolen factory in the United States, employing 2,500 people at one time. Their business failed in the Depression and the complex was available in 1957 when Digital bought the first building, which contained 22,000 square feet of manufacturing space.

From 1957 to 1968 the Digital Corporation continued to buy more of the buildings in the complex, until they owned 2.2 million square feet of space. After 1968 they started to acquire branch plants, at first in nearby towns. Now they have plants in foreign countries. Their site selection criteria includes four major determinants: a skilled labor pool, a reasonably fast planning procedure, a one hour proximity to a major airport and easy access to an interstate highway. Two sites, Greenville, South Carolina and Albuquerque, New Mexico, were mentioned as having fast planning approval procedures. Two determinants in locating in foreign countries are wage levels and market considerations. Digital has a plant in Ireland, for example, to avoid paying high E.E.C. tariffs and to service their European customers. They usually allow a total cycle of three years
before a required plant is located and in operation, with a year spent on deciding the location. In 1981 they planned for 3.5 million square feet of new space, 2.2 million in 1982 and only .5 million in 1983. Digital has two inner city assembly plants, one in Roxbury and one that is in the former Springfield Armory.

The renovation work in the Maynard plant is handled by their own employees. Digital now allows from $40 to $50 per square foot to build or renovate a plant. They have spent around $16 million on the Maynard plant. It seems suited for that company because the complex was large to begin with, and Digital eventually needed all the space. They were able to expand without having to prematurely splinter off operations. One of Digital's major requirements is a high electrical service capacity as they manufacture computer equipment. This meant that they had to install a completely new system. 50,000 square feet in the complex is always undergoing modernization. The complex of buildings reinforces the feeling of a corporate empire, commanding the town.

Most of the production areas are open-plan; being broken up by half-walls. However many areas also have locked doors for industrial security reasons. The plans of the buildings have been kept the same for the most part, with a succession of brick fire walls dividing the spaces. Typical specifications include sanding and refinishing the wood floors and sandblasting the brick. Digital has done a particularly nice job with the cafeteria, which everyone in the company uses. Another project they are working on is to reuse the turbine engines that are still in place by the dam. It is estimated that using them as a source of power again would bring a 33% return on investment, which is quite attractive. The buildings contain the corporate headquarters of Digital. It was evident that the company felt at home in their baronial quarters and that the complex was able to accommodate computer design and manufacturing.
Main Street in Haverhill's leather district.

HAVERHILL
Loading off the street.

Main Street facades.
Haverhill is a city of 43,500 people located on the Merrimack River near the New Hampshire border. It has had a manufacturing center since the early 1800's, but compared to the neighboring city of Lawrence which was planned for manufacturing, Haverhill has had a more diversified economic base. By 1836 there were already 28 shoe factories in the city and shoes remained their main export. The invention of the Goodyear shoe-stitching machine in 1875 cut factory production costs by a large enough margin to bring all shoe-workers into factory production. In 1918 Haverhill's factories produced 10% of the world's manufactured shoes.

A fire in 1882 destroyed the first downtown manufacturing district. Because the incentives for production were so great, it was rebuilt at once, with an architectural uniformity that is rare in commercial and manufacturing districts. A system of ornate cast iron columns were designed for the storefronts. The buildings by the river and along the main shopping street were built with masonry, but a newer area further back used reinforced concrete construction as well. A complex of three buildings have seven stories of manufacturing space, built of concrete between 1911 and 1916, making it one of the first in the country. The downtown area is now called the "Washington Street Shoe District" and is listed as a National Historic District.

The shoe industry collapsed during the Depression and Haverhill has been working to attract other industry since then. The city began a concerted effort in the 1960's, forming the Greater Haverhill Foundation. The foundation did not think that the older buildings could be marketed, so they developed the Ward Hill Industrial Park on the outskirts of town and offered firms 100% financing. They had seen the success of such marketing in southern New Hampshire and decided to imitate it. Since that time, Haverhill has had a fairly strong industrial real estate market. Compugraphic Corporation built a 200,000 square foot facility in the industrial park in 1978,
The front elevation of a building decorated in an unusual "commercial Queen Anne" style on Main Street. It contains commercial and manufacturing space.

The back of the same building. Some manufacturing still exists, but also a lot of under-utilized storage space.
and smaller businesses have taken advantage of the low rents in the area—as low as $2 per square foot. Shoe-making has even staged a small revival, often in specialized markets such as jogging shoes, and by using new processing equipment, for example equipment to make integrated sole and heel units.

During the Depression one family acquired all the old buildings along Washington Street and allowed them to slowly deteriorate. The leaders of the town were not interested in developing the district until very recently, perhaps after seeing what has been done in Lowell. Banks were afraid to give out any loans because they had handled so many previous defaults on the properties. The planning board has also been very conservative in allowing development. Now that the area is registered, the owners are trying to market their upper floors for office space. Prices have jumped from under $2 per square foot to level of $12.50 per square foot for the same space. Whether the manufacturers who remain in the buildings can stay or not will depend on the demand for office space. Luckily there is a surplus of cheap manufacturing space nearby.

The Pentucket Development Corporation

The Pentucket Development Corporation, managed by Peter Godino, bought four multi-floor manufacturing buildings behind Washington Street five years ago. An architectural firm had been hired to draw up a comprehensive development plan for the buildings, but the banks refused to provide the necessary capital. The Pentucket Development Corporation has settled for renting the space to small manufacturers. Some kinds of businesses are considered to be too much of a nuisance and are not allowed as tenants. (Tofu-makers and carpenters were two that were mentioned.) Firms were renting spaces that ranged from only 750 square feet for an artist, to 32,000 square feet for a firm that reconditioned Wang computers. Other tenants included a wallpaper designer, a firm making printed circuit boards, a small production factory that made expensive solid oak vanities, and a shoe-making operation.
The Ellis Building, an early manufacturing complex built with reinforced concrete. It is still used, though not fully occupied.
Without bank financing the owners did not want to renovate the space in order to attract tenants who could afford higher rent levels. This means that the toilet facilities have not been up-graded and no passenger elevators have been installed. Tenants sometimes use the freight elevators for passenger use, which is illegal. All four buildings are heated by the old district steam heating system. At one time, this system linked most of the entire district by underground pipes. A new boiler has been installed. There is a cost trade-off on heating systems between maintenance costs and the initial purchase price for a system with automatic controls. An older man who has run the system all his life still works there, calling up for the weather forecast in order to set the proper temperature each day and night.

The owner buys 600 Volt electrical service at the lower industrial rate and each tenant has an individual meter and transformer. One advantage to using the building as a tenant is that there is enough extra space to provide flexibility if the firm wants to expand. As tenants move in, a full-height drywall system is built to define their area.

For a small business, the cost of moving can be expensive. Eventually the Pentucket Development Corporation would like to renovate at least one of the buildings for office space. Small manufacturing firms do not command high "bid rents" and so must settle for undervalued space with few amenities. In this particular area, a displaced manufacturing firm would find another location, but in other market areas such a change of use could be a hardship.
CONCLUSIONS
In each of the previous sections information was presented on the history and the motivations for modernizing manufacturing space. The issues contained inter-locking facets and paradoxes. While looking at the industrial real estate market, and the history of industrial architecture, I found myself at the heart of great failures and successes in capitalism. The information I presented hopefully reveals how dynamic the market is, with investment capital of all kinds being constantly placed and displaced. The relevance and importance of discussing these issues collectively was apparent. President Reagan paid a symbolic visit to the Digital plant in Roxbury in January (1983) as I worked on this thesis. It was only one reminder of the need for more people to plan the allocation of our human and physical resources.

The market for manufacturing space is shared by players that are vastly unequal. Some manufacturers are expanding as others go out of business. This incessant circulation gives the industrial real estate market a fair amount of slack compared with other markets. Companies can indeed be started up in garages and rents do not remain inflated unless the area is changing use. Adequate, low-rent space to start production is more easily obtained by new producers than some of their other needs. Yet zoning and industrial development are powers granted to public agencies and a publicly-owned manufacturing building can serve to tie together other programs designed to stimulate local manufacturing.

There are circumstances where it is beneficial for a community to use their taxes to modernize a building for manufacturing. From the evidence however, under present conditions a lot of money is being wasted to compete with other communities for "foot-loose" firms. Like the arms race, everyone but the manufacturers would benefit from dismantling the quilt of locational incentives. Citizens inherit all the risks of investing capital without gaining any profits or control over the results. They also have no voice now over the
working conditions of the firms they helped to attract. If the world had uniform labor practices, the criteria used in plant location would change quickly.

There is something appealing, if vaguely medieval, about encouraging people (not requiring them) living in a city to invest in new, local production. In a way it would be an attempt to restore the earlier marketplace of the small producer, which has been historically difficult to sustain under capitalism. A social goal could be to make everyone feel like they have access to the means of production and a chance to test their product. The goal now is to make everyone feel like they can accumulate wealth, which has a different emphasis. A corporation deciding to close a plant 2,000 miles away clearly shows the broken rings of power in economic planning today.

Even the work of public agencies, like the E.D.I.C., to influence the industrial real estate market is centrally planned. I have wondered if other demands on manufacturers would be raised if there really was more local control. Could the issue of giving more people work within a shorter work week or hazardous waste disposal be raised more effectively? Community Development Corporations were once allowed to operate on wider grounds than short-run profitability. "Externalities" like providing job training, producing less pollution or making high-quality products could alter the current "personality" of the market.

"The essential measure of the success of the steady-state economy is not the finite model of production and consumption, but the quality and complexity of the total capital stock, including the state of human bodies and minds." 32

There is an almost inherent polarity between the needs of a community and those of a corporate manufacturer. This may not be totally negative. Communities could seek and offer stability over time in their approach to economic planning. Capitalist firms on the other hand thrive by going after new markets and changing in
size and output. A system that could place the flexibility and vitality of capitalist accumulation under democratic control would have an interesting future in this country.

Watching high-tech manufacturing develop in Massachusetts is useful in understanding how capitalists use resources. Massachusetts has again been used as a launching pad for a new round of applied technical innovations. Despite the hopes of what high-tech can do to stabilize the state's economic base, jobs have already been dispersed to other areas. The firms have also tried to minimize the number of skilled workers who can demand higher wages.

Some people question whether or not they should support such a model of economic development, especially those people living in poor neighborhoods that are ignored anyway. The question of whether internal, "grass-roots" development could work better is still an open one. I am reminded of a surprising news vignette appearing in "Parade" magazine (of all places). It recounted the history of the destruction of a thriving black business district in Tulsa, Oklahoma at the turn of the century. White people had been jealous of the black community's economic success. This manifested itself over a black/white court trial. After tensions broke out, a while vigilante group burned down the entire district. To seal its fate, the city fathers later decided to put a new rail-yard over the former district. So much for "internal" development.

The lines between economic, physical and aesthetic criteria are not rigidly drawn for manufacturing buildings. After visiting firms in older buildings I realized that the renovation was profitable for each firm. The materials, scale and fenestration in mill buildings will always ensure their value. However the attractive "common" space of the production floor has been accompanied by poor working conditions. If both the physical space and the authority over production was held in common, the mill building could achieve its greatest potential.
Many economists simply lay the change in the composition of the US work force to the broadening of international market. "Du Pont and General Electric can never beat a sweat shop at manufacturing standardized lightbulbs, and it doesn't matter whether the sweatshop is on the Lower East Side [of New York] or in Puerto Rico," says MIT's Paul Samuelson.

The trend is leading the United States to become "a society more like Denver, a headquarters society," Samuelson says.

And Richard Caves of Harvard says: "Now we're beginning to get de-industrialization hysterics running around this country the way they have been in England for a long time.

"All I can say is that, if you can get over your short-term unemployment problems, maybe it's nice to have people sitting in clean offices doing services rather than working in gritty factories, hating management."

It is ironic that these old buildings can serve as a workplace for both traditional "blue-collar" factory work and "white-collar" office work. You can either say that high-tech production can be done in an office-like setting or that office work has become so specialized and mechanical that it resembles factory work. The executive director of Boston's E.D.I.C. alluded to this in describing a recent project for using an old manufacturing building:

"Part of the program is to create space for users who cannot afford downtown office space and who have very high labor-intensive operations, such as banks and insurance firms with a lot of clerical help who don't have to be located downtown." 33

Old manufacturing space can be used to make new things possible: new products, new working conditions, and new markets. I can not imagine a more appropriate setting than the mills of Massachusetts.

"...and Polo said, 'The inferno of the living is not something that will be; if there is one, it is what is already here, the inferno where we live every day, that we form by being together. There are two ways to escape suffering from it. The first is easy for many: accept the inferno and become such a part of if that you no longer see it. The second is risky and demands constant vigilance and apprehension: seek and learn to recognize who and what in the midst of the inferno are not inferno and make them endure, give them space." 34
The Crown and Eagle Mill before and after a fire. (from The New England Textile Mill Survey.)
LIST OF FOOTNOTES
1. A brief description of current industrial policy and alternative viewpoints can be found in David Moberg's book review in "In These Times," February 9, 1983.


5. Dunwell, Steve. Run of the Mill.

6. Statistics in this section were taken from Bennett Harrison's "Rationalization, Restructuring and Industrial Reorganization in Older Regions," and an article in The Boston Globe by David Walsh.

7. Some of the information and figures came from a transcript of "Pentagon Inc.," a television documentary shown on Frontline, PBS, February 28, 1983.

8. Taken from lecture material of the "Political Economy and Planning" course taught by Bennett Harrison, autumn 1982.


14. Figures in this section are taken from an article in the Real Estate section of The Boston Globe, March 5, 1983, written by Anthony Yudis.


16. Information in this section was obtained from the article "Building in Eclipse, Architecture in Secession" by Francis T. Ventre, Progressive Architecture, December 1982.
17. Ibid.

18. Ibid.


22. Cited in Robert Goodman's The Last Entrepreneurs.

23. Information in this section comes from lecture notes on black community economic development given by Bennett Harrison in course, Political Economy for Planners, 1982.


27. Lintner, Sylvia. "Mill Architecture in Fall River."

28. Ibid.

29. This was taken from a statement by the Chairman of the LFE Corporation, Herbert Roth. It appeared in a company newsletter, "Pulse," published in October 1981.

30. From the article "High Tech Firms like the Country Life" in the Real Estate section of The Boston Globe, 1982. It was written by Anthony J. Yudis.

31. From an LFE brochure.

32. Quotation by Kenneth Boulding. It was cited in "Expanding the Opportunity to Produce," edited by Robert Friedman and William Schweke.


(from Becher, Zeche Zollern 2.)

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