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Small Shop Dynamics: Time and Technology

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ABSTRACT

Nearly invisible in the manufacturing industry hierarchy are those small manufacturers with fewer than 50 employees. These firms, labeled Small Shops, constitute a large percentage of manufacturers. This study focuses on the impact of technological innovation and time relative to the re-emergence of small shops as a competitive entity in the industrial hierarchy.

INTRODUCTION

As American business settles into the 21st Century it seems quite apparent that US small manufacturing firms have become nearly invisible in the industrial landscape. The media, alongside the business schools, pay homage to the advancing phalanx of electronic technologies paying high tribute to the hard and soft components that have become a juggernaut in altering the social, political and economic landscape of spacecraft earth.

Yet, it is not only in America that the small manufacturing facility appears hidden behind nondescript roll-up doors in the ubiquitous industrial parks. Globally, the status of the Small Shop appears to be relegated to the shadows of the major firms with large, glossy signage denoting their status in the world of manufacturing. The relegation of the Small Shop to a declining, if not its demise may have had some legitimacy at an earlier time. Following the advent of mass production and vertical integration as developed by Henry Ford at the behemoth River Rogue plant and continued with verve on an international scale, the ability of small manufacturing plants to hold their own or even prosper in competition with large vertically integrated oligopolies was, at best, a challenge and typically a recipe for barely hanging on and keeping the doors open.

It is hard to pinpoint an exact date, but sometime in the late 1980's early 1990's, the status of the Small Shop began to slowly re-evolve into a viable piece of the industrial fabric. To be sure there are a number of reasons for this transition. Part of the reasoning may be the nature of the industrial process, with mergers and acquisitions on the rise and the need to quickly attain economic assets, and cash flow less productive or unrelated manufacturing lines were lopped off. There was also a perspective that the profit was in the assembly and not in the manufacture of components. Thus, vertical integration began to lose favor with the new managerial class. However, it will be submitted that the real basis for the rise of the Small Shop is due to two interrelated factors, technology and time. The primary focus of this analysis will be: First, the identification of specific technologies and their impact on the viability of the Small Shop. Second, how technology has had a profound impact upon time on their functions and competitiveness.

The format for assessing technology and time on the reemergence of the Small Shop in the industrial manufacturing hierarchy will be as follows: 1) Small Shops: The Historical Context, 2) Small Shops: Growth and Importance, 3) Technology and the Small Shop, 4) Time and the Small Shop, 5) Summary and Conclusion.

Small Shops: The Historical Context

The roots of the Small Shop can be easily traced to the crafts and guilds of the late middle ages and renaissance periods. By the mid-18th Century, blacksmiths, silversmiths, etc., were part of the emerging towns and frontier communities. However, as the 18th Century came to a close and the 19th Century began, America's fledgling

industry commenced a unique path that in time would become quite distinct from the European crafts oriented production process.

The American manufacturing process began rather innocently at the Springfield Armory where the War Department in 1798 issued advance contracts to arms makers for small arms and though Eli Whitney was the more self aggrandizing, history now suggests that it was Simon North (Hounshell, 1984) who proffered and possibly developed the idea of parts interchangeability. The fifty-year period between 1800 and 1850 witnessed a two prong development of the American production system. First, as mentioned interchangeability became an increasing touchstone for the Small Shops. Second, the development of machine tools began the transformation of how items were manufactured. Again it was a North's factory where the first milling machine was put to use (Hounshell, 1984). By mid-19th Century the foundation for the American production process comprising parts interchangeability and an anticipation of mass production.

Beginning in the 1850's several industries began what would become, by the post Civil War period, a juggernaut to implement the American system. Sewing machines, clocks, agriculture equipment, and bicycles would grow from Small Shops to large factories with outputs that would not have been remotely comprehended decades earlier. Some sense of the productive growth that came about with the advent of interchangeable parts, advances in machine tools as well as various gauges, blocks and precision measuring devices, can be seen at the McCormick factory where 46,000 machines were produced in the year 1882. Singer Sewing Machine, using two large factories, produced almost a million cabinets annually in the 1880's; and by the end of the Century, Alexander Pope is manufacturing 60,000 high-quality safety bicycles annually (Hounshell, 1984). Pedal power may have been in vogue, but just around the corner was something new that would forever change manufacturing and even society.

The bicycle in all probability can be registered as a condition precedent for self-propelled transportation and the advent of the automobile. Though Carl Benz is attributed with the title of Creator of the first automobile, he was in good company with the likes of Daimler, Peugeot, Bollée, Panhard-Levassor and across the ocean Duryea, Haynes, King, Winton, and Maxim among many others were bringing the automobile to reality. It would all come together in 1900 when a Mr. Henry Ford playing on his success with the Model N launched the Model T. The Model T represented much more than just another self-propelled vehicle for the well to do. The T or Tin Lizzie was a car for the masses and with an eclectic team of individuals a new mode of production—mass production. Using specialized machinery, moving assembly lines and just-in-time inventories, the Model T would roll out of Highland Park plant, then after 1924 the River Rogue plant at the rate of an annual production of in excess 1.5 million vehicles in 1923 (Chandler, 1964).

Henry and the venerable Model T marked the commencement of mass production and the rise of industrial oligopolies throughout the world in achieving market dominance by a few firms in a preponderance of the mainline industries. The Small Shops importance and competitiveness began a demise that would take a better part of the 20th Century to reestablish. In the meantime, highly vertically-integrated oligopolies maintained a hold on market dominance. The American production system had overcome the European system and even there, the American system took root in England, France and especially Germany. But what technology helped to create in the beginning of the 20th Century in the way of the large firm, it would foster the reemergence of the small firm towards the end of that century.

SMALL SHOPS: GROWTH, IMPORTANCE AND DEFINITIONS

Importance

Generally in the shadows of the Big Board companies and the dominant brand name manufacturers in towns and communities throughout the world there are a myriad of small and medium size manufacturing facilities that to a great extent are the backbone for the world's products. In fact it is quite arguable that small and medium size manufacturers comprise one of the most vital sectors in the economy: a role that is often ignored but increasingly important to understand in the face of increasing global competition.

A dated study by the National Association of Manufacturers (National Association of Manufacturers, 2001) in the U.S., using admittedly a different definition for small and medium manufacturers that will be used in this analysis, found that small and medium shops (National Association of Manufacturers, 2001):

- Account for 95% of all U.S. manufacturing firms
- Employ roughly half of all manufacturing employees
- Account for or produce over a third of all manufacturing receipts
- Account for more than a trillion dollars a year
- Pay workers 20% more than other small business employees
- Export increasingly more each year.

In addition to the hard data, Small Shops are an integral participant in the industrial mix, providing components, prototypes and other services to the large companies. Further, it is well known that Small Shops have been a leader in creating innovation and a source of new job creation. Thus, a safe conclusion at the outset of this study is that it is a propitious time to focus on the small shop and its role in the national and global economy.

Definition

One serious hurdle that needs to be bridged is developing a meaningful as well as serviceable definition for the Small Shop. The National Association of Manufacturer's
(NAM) definition for small and medium manufacturing firms is that small manufacturing firms employ 500 or fewer employees while those firms that employ between 500 and 2000 are regarded as medium manufacturers. Based on this classification, the NAM study notes over 300,000 small firms employ an excess of 7,000,000 workers. At the medium size, the finding is over 3,000 firms with a total of 2,500,000 employees (National Association of Manufacturers, 2001). The classifications by the SBA are not dissimilar from the NAM in that they define *small* by way of industry and use industry codes to define business size.

The suggestion here is that these classifications do not reflect the reality of the modern small shop. A review of various trade journals, observations and discussions with small shop owners in the U.S. points to a need for a more realistic definition of the Small Shop. Using U.S. Census data for the period 1988-1998, a period for the re-emergence of the small shop, manufacturing firms with employment between 0-19 numbered on average roughly 240,000 firms (Small Business Administration, 2002). Thus a substantial portion of the firms identified by the NAM definition are at the bottom end of their classification.

Field observation of industrial parks throughout the southern California region also suggests that the small shop is composed of substantially fewer than 500 employees. Randomly interviewing shop owners in these industrial parks found that their perception of a small shop was generally somewhere between 0-50 employees. Using the observations and interviews, this study applies what is believed to be a more realistic definition of small shops as manufacturing firms with 50 or less employees. A sub-group of small shops was also identified: *micro* shops with 10 or fewer employees. Though micro shops will not be the focus of this study, it is interesting to note that this classification would represent over half of the Small Shops, suggesting that they would be an appropriate classification for future study.

Thus, Small Shops hereinafter are defined as those manufacturing firms with 50 or fewer employees. Though this figure is one tenth that of the NAM definition, it still constitutes over three fourths of all U.S. manufacturers and continues to represent a very significant industrial group.

As previously discussed, during the late 1980's and early 1990's the exodus of viable Small Shops from the industrial landscape had been thwarted and replaced with a slow, steady return to growth and profitability. Though media, academic literature, and newsprint have concentrated on the decline of U.S. manufacturing and its lack of competitiveness in the face of offshore competition, the Small Shop appears to have weathered those forces. Clearly competition, tax burdens, environmental regulations, downward pressure on prices and narrow margins continue to confront the Small Shop. Technology and manipulation of time through technology has given the small shop a competitive position in the global industrial hierarchy.

TECHNOLOGY AND THE SMALL SHOP

The advent of the information age has transformed the practice of business globally. The transformation has impacted nearly all phases of the business and manufacturing processes from the operation of the front office administration to the loading docks. It is doubtful that anywhere in the business world has technology had a greater impact than on the Small Shop. Starting with administrative record keeping, bookkeeping, financials, design, production, and continuing through packaging, shipping, logistics, handling, as well as reverse logistics, technology and advancements in technology have given the Small Shop productivity, market access, and profitability in ways unforeseen three decades ago. The following analysis will assess the technologies and their impact on the viability of the Small Shops.

Administration

The perception of the older Small Shop being run by a craftsman proprietor, the basics of administration were often haphazardly dealt with, if at all. The scenario of mail piled in a corner, the desk overflowing, calls missed, were very real. The one person proprietor with a small work force may at best have hired the proverbial "gal Friday," someone to answer phones, do filing, and help with the books. As often as not, it was a spouse or many times there was no support. The technology available would have been a telephone, possibly even a second one out on the shop floor to save running back to the office every time the phone rang. It goes without saying that the Small Shop in the 21st Century is quite different. Desks may be so cluttered as to resemble a bird's nest which is of little consequence in the information age. Computers, business software, voice mail, online support systems ranging from basic management to engineering support, provide even the single proprietor with administrative essentials cheaply and efficiently.

The benefits from information technology on the Small Shops in day-to-day administration appear all too obvious and are presently taken for granted. But it is easy to forget that the small shop can be a very busy place. The manufacturing function by itself often consumes all the time of employees, managers and owners, leaving little in the way of handling the mundane administrative tasks that ultimately are critical to ongoing operations. The advances in the administrative operation garnered through technological innovation consists of freeing up time of productive personnel to focus on core manufacturing activities, providing organizational control and expertise to maintain productive administrative processes and minimizing communication dysfunctions on the Small Shop's front end.

Record keeping

It would be a safe bet that for most Small Shops doing filing and keeping track of various records is accorded low priority. The rush to get the product on the loading dock and shipped is the continual challenge. The advent of advanced software programs in off the shelf or affordable custom varieties has greatly decreased the drudgery of filing and the keeping of records. It is now possible to not only keep records in multiple files with singular inputs, but also paperwork for the complete production cycle can be generated at the early stages of making bids and sales. Just from filling out the order, production codes and packing/shipping labels can be created plus a number of quality control checks. The benefits for the firm can be substantial—at the outset executives/owners can free up time from necessary but mundane activities and devote more to the bottom line endeavors. They also can increase organizational control and oversight; additionally quality control can be greatly improved along with production procedures assessment.

Bookkeeping/Financials

When interviewing small shop owners in southern California one of their common comments was regarding the financial assistance delivered by software programs. Software such as Quick Books among others was identified as a real support system in allowing a single staff person to be able to run the front office and be able to take care of accounts payable, accounts receivable, cash flow, and in some cases payroll, among other accounting and financial controls and reporting. Once again the innovations and user friendly software applications have generated real time benefits for the Small Shop.

The gains to the small shop in many cases may be greater than owners/managers fully realize. The ability to have financial controls where previously they may have been nonexistent allows for keeping orderly track of cost functions, better product pricing and the ability to easily assess daily cash flows. Operationally it provides the opportunity to move from seat-of- the- pants bill paying and collecting routine to a real financial/bookkeeping operation with concomitant controls and analysis. Finally, an often overlooked attribute of current software packages is the ability to develop various financial ratios which, when operationalized, allow the Small Shop to understand its own internal efficiencies as well as how those efficiencies relate to the industry.

Design

The application of technology has been of great advantage not only to Small Shops but also to all small business. The advancements in design technologies with increasingly declining costs are of particular value to the Small Shop. At the forefront are the CAD-CAM packages and the hardware to drive those packages.

Computer aided design (CAD) in the early packages tended to be complex and required a substantial amount of memory and RAM that were not available on PCs and definitely not cost effective for the small shop. The evolution of the personal computer (PC) from the early Apple to the current crop with gigabytes of memory, dual programming and quantums of RAM have brought CAD programs within easy reach of the small shop. It is interesting to note that the costs of PCs starting with the Apple 2E and continuing to the current crop of Dell and Hewlett Packard Business PCs, the complete package has resided in the near $2000 price range. Thus, in a period of 25 years the exponential growth in PC capability has come with little increase and actually commonly a decrease in the package price. Clearly the necessary computer capabilities are readily attainable by the Small Shop.

Just as the hardware has exponentially improved over the last two decades so have the CAD programs. Not only have they become very user friendly, their capabilities have expanded and become very adaptable to the needs of the Small Shop. A simple CAD package allows for two dimensional drawing and printing, and nearly blueprint quality design can be produced by almost anyone in the shop. At the other extreme are three dimensional programs which can create holograms, which in turn can be rotated and viewed from any angle. The two dimensional and entry level three dimensional programs have become very affordable; in fact an entry level program can be had for a few hundred dollars.

In addition to off-the-shelf programs custom designed programs tailored for specific uses are often quite affordable. Drawings and design visualization are not the end of the exercise. The CAM part of CAD-CAM stands for Computer Aided Manufacturer which takes the CAD input and translates it for CNC machining. Using automated palleting it is possible for a designer to create and machine a part without ever leaving the computer console.

Building on the CAD process are the technological innovations in the field of prototyping, or more commonly referred to as rapid prototyping. A three dimensional design can be translated into an actual component, allowing designers to actually see their drawings turned into a tangible component. This process then allows designers to identify problem areas and make the corrections before it hits the manufacturing line or before dies are cut. The common approach to rapid prototyping is that a design is fed to a machine that uses various viscous concoctions that are laid down layer by layer, eventually producing, after hardening, an exact rendition of the designed component.

Rapid prototyping has added benefits, other than just design: it allows sales to show a customer exactly what the product or component looks like so that both the manufacturer and the purchaser know the actual dimensions and details allowing for changes to take place before commencing actual manufacturing production.

The days of toiling at a drafting table and then going to the Bridgeport with a large chunk of billet to reduce by 90% of its weight, scrap, only to find the flaws and start anew has for the most part been made obsolete by advances in technology, especially in the hardware capabilities and in the various software programs for CAD, CAM, rapid prototyping, and CNC applications. From the standpoint of the small shop, the continuing price reductions are making the latest of these advances well within the budgets of Small Shops and even accessible by the micro shops.

Production/manufacturing

The image of an elderly gentleman standing in front of a massive mill with furrowed brow and Germanic precision, turning the cranks that feed a sharpened mill bit into a block of metal to produce a precision component that can be measured with a micrometer is often just that, an image. The modern machine shop can be a surgically clean environment, machines enclosed in cabinets with lexan windows, whirring away. Automated pallets bring forth raw materials, and conveyor belts take away boxes of finished parts. The computer has definitely made its way into the manufacturing world. The goal of automating manufacturing probably can find its roots in the post Revolutionary Springfield Armory. Certainly by the time of Henry Ford's Model T the drive to automate was paramount. Following WWII new advancements in automation began to emerge: one was the well known development of numerically controlled tape drives similar to a player piano. The various machine tools using this device did not require continuous intervention by human operators.

Once again the real inroads in automation were the product of the information age and the now ubiquitous computer. The advent of the Computer Numerically Controlled (CNC) machine tools drastically altered the manufacturing process and its environment. The typical multifunction CNC machine can combine several of the chores performed by turret lathes, lathes, radial drills, vertical and horizontal mills. Combining multiple tool holders and multiple axis controls the need to move the raw material from one machine to the next disappears, cutting down labor costs, freeing employees for more productive activities, and possibly more importantly diminishing the intrusion of human error in the quality control process. An interesting side note is that some manufacturing shops using CNC tooling have adopted zero tolerance in their quality control regimen.

Adding to the automation of small shops is the increased application of robotics. Historically robotics tended toward large, highly capitalized manufacturing and assembly operations such as auto makers. Increasingly with advancing innovations in robot technology they are becoming increasingly available at declining costs. In fact basic welding robots that do somewhat simplified tasks are now available for as little as $60,000. When calculating manufacturing costs it is not unusual to see welders earning $50/hr plus, and the robot could be exceptionally cost effective where there are large batch runs.

Advances in production technologies are quickly filtering down to the Small Shops: used CNC machines have become almost a bargain and new ones are clearly within reach for a substantial portion of the small shops. Robotics, too, are becoming available at affordable prices. The net impact is to allow the Small Shop to enjoy increases in economies of scale, while at the same time reducing per unit labor costs, which in turn allows the business increased access to more contracts. The bottom line is that the small shop can become more competitive with higher quality output.

Material Handling

Material handling consumes scarce resources of businesses in the manufacturing segment, especially Small Shops which are not generally able to make the capital investments necessary. On the other hand large operations that are running large batch production cycles are able to take advantage of economies of scale at each step of the process starting with purchasing and stockpiling raw materials to shipping finished products and components. To date, there has been some trickle down in materials handling technology to the benefit of Small Shops.

As previously mentioned, advances in record keeping and front office activities have found their way onto the shop floor. Inventory and raw materials tracking have facilitated production work flow giving managers better control over production planning and scheduling. The use of automated palleting is finding its way into smaller batch production shops. The control of tool use through inventory type tracking has gone a long way toward preventive machine maintenance and tool breakage.

The automated materials handling technologies that exist in large manufacturing plants have not reached the small shop floor as yet; however, collateral technologies for tracking, tool rooms, controls, and inventory assessments have allowed Small Shops to operate more efficiently and have helped to minimize down time.

Shipping and Packaging

The state of technological innovation in the area of packaging and shipping remains similar to that in the material handling arena for the internal operation of the Small Shop. However, as will be demonstrated, the expansion and innovations in the logistics industry has had substantial impacts on the competitiveness of the Small Shop.

The labeling, packing slips and other paperwork can now be integrated into the initial purchasing documents thus simplifying the paperwork log jams at the end of the production process. Further, using these same programs it becomes much easier to track orders and production schedules. This in turn allows for a more orderly organization of the loading dock.

Other innovations in the shipping and packaging processes come by way of measuring and weighing technologies that allow for more efficient packing and meeting shipper's parameters whether by weight, size, or some combination of the two.

Logistics

The traditional real estate mantra has been "location, location, location," and this has certainly been true for Small Shops. Historically location within industrial clusters was of primary importance. Materials, orders, and deliveries were greatly influenced by proximity to suppliers and buyers, especially for the Small Shops. However, changes in logistics, the proliferation of third party logistics (3PL) and the expansion of UPS, Fed-Ex, and DHL has greatly changed the competitive environment and offered the Small Shops entry into markets and customers not previously available.

The expansion of the logistics industry, in conjunction with governmental supports by way of education and trade encouragement, has generated an increasing export activity annually. Contrary to what some would suggest, Small Shops appear to be expanding in numbers and in sales with an increasing product being exported, implying that Small Shops can in fact be competitive in the global market.

The logistics industry has been fraught with change over the last several decades, especially through the period following deregulation. Concurrent to these difficult years, developments in information technologies added to both the turmoil and the growth. Scheduling became more of a science than an art, package/pallet tracking became much more refined, and the development of GIS concomitantly with other technologies allowed tracking companies to track trucks in real time.

Ultimately the trickle down of innovation in logistics technology opened new vistas for the Small Shop. Location choices were no longer narrowed to the primary industrial cluster but could be optimized on other location priorities, which in turn meant that the small shop could take advantage of economic development incentives that had not previously been available. The conclusion appears inescapable that technological advancements in the logistics industry have had a very positive impact on Small Shops increasing competitiveness and profitability.

Reverse Logistics

For almost any business, but especially small business and Small Shops, the return of an item for almost any reason is a disaster in the making. The general regimen is purchase raw materials, produce the product, deposit the proceeds and start the process again. When the goods are returned, cash flow may be disrupted, storage in chaos, and employees' time spent on non-production activities. Very few businesses are really set up to handle reverse logistics. One suspects that reverse logistics may never be the forte of the Small Shop, however the strategy to deal with the possibility needs to be developed and in the alternative the better strategy may be preventive in nature. Here again technological innovations that we have previously identified go a long way in minimizing a reverse logistics disaster.

The Small Shops strategy to prevent issues of reverse logistics is by implementing previously discussed technological innovations in the context of quality and control operations. The use of CAD/CAM programs and rapid prototyping insures all parties agree at the outset as to dimensions, structural characteristics, materials, etc.

The use of scheduling and production software controls provides insurance that all parties in the production process are on the same page, also that marketing and production are aware of each other's product interpretation.

It appears evident that the trickle down of technological innovations has gone a long way toward increasing the competitiveness and profitability of the Small Shop as well as putting them in the global economy as real participants.

TIME AND THE SMALL SHOP

The previous section focused on the generalized technologies and their impact in broad terms on the product flow-through in the Small Shop. In a more specific focus the discussed innovations appear to have a common denominator: time. Each of the discussed improvements that lead to Small Shop competitiveness converges on the minimization of time getting a product from marketing through production and on to the loading dock. To fully understand the relation between technological innovation and time, the analysis will focus on four elements of the previous section: 1) from sales to the loading dock, 2) small batch production, 3) controls, and 4) efficiencies.

Time: From Sale to the Loading Dock

As previously noted, the adoption of technological innovations by Small Shops has greatly increased their competitiveness. Underlying this rather simple statement is the question of how these technologies are able to increase competitiveness and profitability. The root of the matter is the relation between the process of business and time.

The development of information technologies and their trickle down to the Small Shop has had multiple points of intervention in the production process. Starting with the front office with management and financial programs as well as a myriad of electronic devices has allowed each employee to produce more. The net effect is that with less time required to do the original tasks staff have time to take on more activities, thus increasing front office per person productivity.

On the shop floor the advent of machine tool automation, robotics and other technological advancements have definitely impacted the production cycle. The introduction of CNC machines which allow nearly automatic production meant that the machinist standing all day at the mill was no longer a necessity. He now could oversee several machines, checking their progress, and watching for glitches. For the shop as a whole, this saving of valuable machinist time in production could be used in prototyping or with training to set up the automated programs. The same scenario would apply with the application of robotics. The cost of a highly paid welder would be reduced with the ability to redeploy skilled personnel to economically higher return operations with the obvious point being that the technologies shorten various time elements in the production process and allow for expanded production through increasingly available employees. Again the crucial element is time in both product throughput and product per unit of time.

An alternative way of viewing the application of time analysis to the Small Shop is that the typical operation of small batch runs begins to take on characteristics of mass production allowing the Small Shop to be closer to a competitive equilibrium with medium and large manufacturers.

Prototypes and Small Batch Production

One of the operations to which Small Shops have been uniquely and historically suited is prototype development. Generally the creation of prototypes or "one-offs" requires craft oriented personnel and the process tends to be labor intensive. The advent of rapid prototyping puts the small shop in the position of being able to develop product models quickly at minimal cost. Once created, then with multi-axis machining operation, the Small Shop is able to quickly enter into delivery of the prototype, thus allowing an increased turnover of activities.

The importance of time once again becomes apparent. The Small Shop is able to engage in greater turnover of output, thus allowing it to begin to develop broader economies of scale, allowing the company greater market access and presence which once more translates to an increased competitive position.

Time and Control

Production oversight, walking the shop floor, checking on employees, all are time consuming activities, especially where each craftsman is producing a single part at each machine. Oversight is also difficult in the front office or the loading dock or the marketing sector with the net result of all this oversight activity is very tired managers, poor productivity or a haphazard operation. Technology by way of organizing and integrating activities provides the small shop with substantial organizational control minimizing systems failures and freeing up individuals to engage in actual production related activities. Once more the impact of technology on Small Shops is productivity and efficiency with increased quality.

SUMMARY AND CONCLUSION

The Small Shop, no matter what definition is being used, constitutes a substantial portion of U.S. manufacturing firms. Yet the small shop hardly finds mention in the media or academia. To some extent the small shop, a derivative of the European production system, was perceptually supplanted by the rise of the American production system following the Revolutionary War and its growth into mass production behemoths led by Henry Ford and his Model T. The transition from craft shop to industrial giants was facilitated by the rise of industrial technology that required large investments of capital to meet the output of mass production.

Somewhat ironically, advances in information technology have gone a long way in providing the impetus for the rejuvenation of the Small Shop. Low cost but with huge memory capabilities and augmented by effective relatively cheap software, the modern personal/business computer brings powerful financial, managerial, and engineering tools within the reach of almost all small shops. Adding to the technology revolution for the Small Shops are advances in automated machinery lead by CNCs and robotics. The net effect of technological innovation has been to provide the small shop with the implements to become more efficient and profitable and in turn a real competitor in the manufacturing industry hierarchy.

Integral to the revival of the Small Shop and rooted in the technological innovations is the impact of time ranging from output per person per unit of time and product throughput, which provides the fundamental basis for small shop competitiveness.

Not discussed in this analysis, but a rich area for future research would be a focus on time in the context of rates of change or velocity in the framework of organizational control and strategic positioning.

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