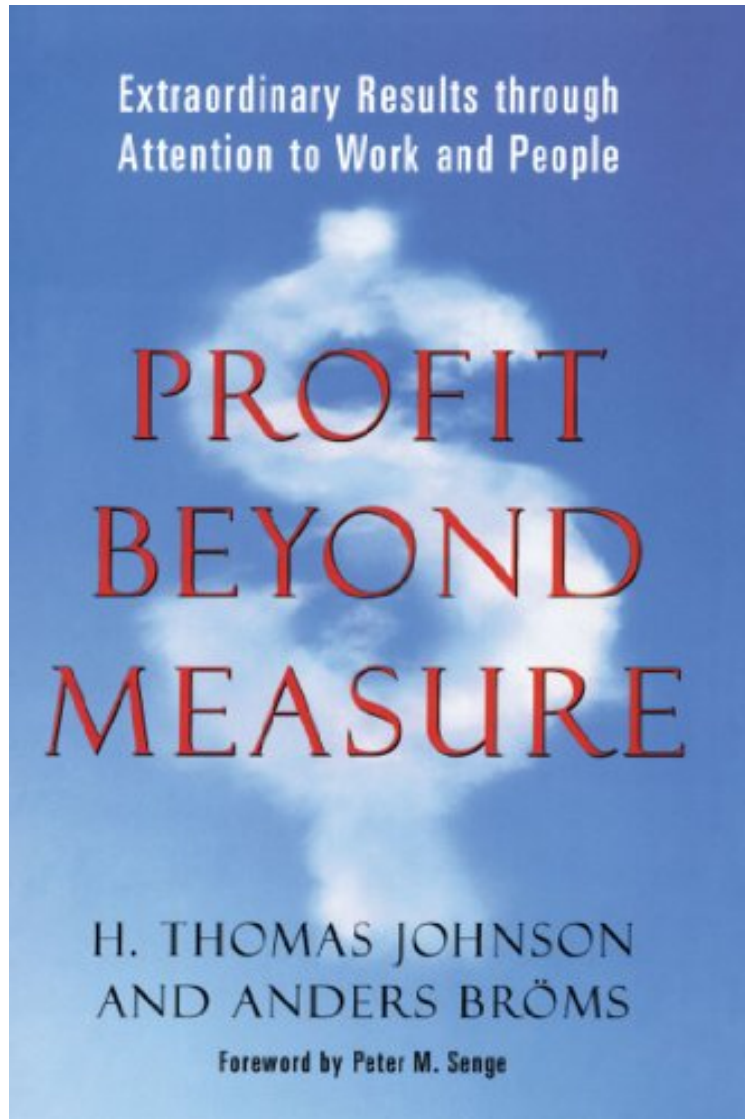


[Download] Profit Beyond Measure: Extraordinary Results through Attention to Work and People

## Profit Beyond Measure: Extraordinary Results through Attention to Work and People

*Anders Broms, H. Thomas Johnson*  
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**Anders Broms, H. Thomas Johnson : Profit Beyond Measure: Extraordinary Results through Attention to Work and People** before purchasing it in order to gage whether or not it would be worth my time, and all praised Profit Beyond Measure: Extraordinary Results through Attention to Work and People:

0 of 0 people found the following review helpful. An introduction to the "natural systems" worldview of managementBy Leif C. UlstrupThe authors explore the deeper philosophy behind Toyota's success and that of Scania. They refer to this mManagement philosophy as "natural systems" thinking vs. traditional western management of

"mechanistic systems" thinking. They explore the very deep difference between how most large western corporations management thinks and act vs. how a Toyota executive would see the world and practice their role as a leader and manager. Belief in principles such as "self-organization", the focus on the link between "knowing and doing", enhancing the relationships that interact to create profitable value for customers, and the "union between customer and organization" are explored by the authors. They illustrate how the "profit beyond measure" management philosophy contrasts with what most western manager experience and do in large corporations driven by "quantitative abstractions" of the business that are one dimensional and disconnected from the deeper inter-relations in business that enable sustained and profitable customer relationships. I enjoyed the first half of the book much more than the second. There is significant repetition that needs some editing. I could do without some of the section toward the end on how these techniques could save society from other "sustainability perils" as seen by the authors. The very end includes a very good table and summary of the key concepts. I highly recommend this read on the philosophy of management to anyone interested in alternative ideas on leadership and management of successful and profitable large corporations. Many of the ideas will seem intuitive to successful entrepreneurs; however, they are much less commonly practiced at scale in large corporations where it is much more common to see the "mechanistic" and imposed controls based top down management approach.

7 of 7 people found the following review helpful. Living systems applied  
By Jamie Flinchbaugh  
Tom Johnson's new book could be just as impactful as *Relevance Lost*. His close study of perhaps the most powerful and robust company on the planet, Toyota, exposes what others don't see. Toyota is perhaps the most studied and imitated company, and not just by the other autos. Many people look for that one missing link that others don't see. Others have seen it, but few have articulated it as well as Johnson. If you resort to curtailing travel and eliminating donuts to try and make budget, or think lean is a material control system, or simply feel that their current patterns of management will never get you where you need to go, you should read this book. Through the attention and cultivation of the work and relationships of the business and not just the measurement results you will find many disconnects in how you are serving your customers. The work of the organization carries all of the information you need with it, and while output measures are important for reporting reasons, they are not helping you to design a system that connects workers to customers. This can help. I predict this book and not *Relevance Lost* will be considered Johnson's greatest contribution. Enjoy!

1 of 1 people found the following review helpful. Somewhat dense, yet little new  
By Tim Carmack  
If you do not know much about "lean" system thinking, then this book can be beneficial, though I feel it is a "dense" book, and not well written for the simple messages that it is conveying. If you have a basic understanding of Lean, I would pass on this as in the end, it adds nothing relative to the time it takes to read through.

Waste has plagued almost every industrial-age firm for the past century. In this powerfully argued alternative to conventional cost management thinking, experts H. Thomas Johnson and Anders Brouml;ms assert that any company can avoid the waste that is generated through excessive operating costs in the short run and excessive losses from market instability in the long run. To gain more secure levels of profitability, management must simply change how it thinks about work and how it organizes work. *Profit Beyond Measure* details how two extremely profitable manufacturers, Toyota and the Swedish truck maker Scania, have rejected the traditional mechanistic mindset of managing by results that generates waste. Johnson and Brouml;ms explain how Toyota and Scania achieve their legendary cost advantage through a revolutionary concept they call managing by means (MBM). Instead of being driven to meet preconceived accounting targets, the production systems of Toyota and Scania are governed by the three precepts that guide all living systems: self-organization, interdependence, and diversity. Amid a wealth of new insights into Toyota's vaunted system, Johnson and Brouml;ms introduce the tools of MBM to show how design, production, and profitability analysis are done to customer order. They demonstrate that by following the principles that emulate life systems, even a lean and profitable company can organize work to greatly lessen its long-term earnings instability and sharply reduce its short-run operating costs. Scania has achieved sixty-five years of financial stability and longevity in the face of fierce competition. Toyota has amassed a market value since 1988 that has rivaled -- or sometimes surpassed -- the American "Big Three" automakers combined. The principles that Johnson and Brouml;ms set forth in *Profit Beyond Measure* can guarantee the same richer, longer life to any company that applies them.

Bala V. Balachandran, J. L. Kellogg Distinguished Professor of Accounting and Information Management, and Director, Accounting Research Center Northwestern University A masterpiece...With insights, imagination, and illustrations, Johnson shows how excellent businesses can be created, cultivated, nurtured, and built to last. About the Author H. Thomas Johnson is Professor of Business Administration at Portland State University in Oregon and Distinguished Consulting Professor of Sustainable Business at Bainbridge Graduate Institute in Washington. He co-authored *Relevance Lost: The Rise and Fall of Management Accounting*, which is considered one of the most influential management books of the twentieth century by the Harvard Business Review. Excerpt. copy; Reprinted by permission. All rights reserved. Chapter 1: Lessons from the Rouge It is clear that the primordial intention of the

universe is to produce variety in all things... -- Thomas Berry He who would do good...must do it in Minute Particulars. General Good is the plea of the scoundrel, hypocrite, and flatterer. -- William Blake Managers of business organizations will find as a result of reading this book that they can no longer accept without question the conventional wisdom that says an organization will reach its bottom-line goals best if it drives its employees and suppliers to achieve financial targets in their work. Given this belief, a manager's primary task is to motivate people to reach and exceed quantitative targets defined by financial measures. If you are a manager who takes pride in your ability to cause people to reach quantitative targets, read on. This chapter and the next show that your success actually creates unseen and unnecessary inefficiency and instability. The new management thinking that will help you avoid such inefficiencies and instabilities is then discussed in succeeding chapters, where you learn how to lead your organization to profit beyond measure. Managers who adopt the new thinking offered here will accept as second nature the idea that what decides an organization's long-term profitability is the way it organizes its work, not how well its members achieve financial targets. This chapter compares the long-term records of Toyota and the American "Big Three" automakers to demonstrate the truth of this proposition. It posits Toyota's principles as an example of new management thinking called "management by means." Managing by means is the antithesis of "managing by results," practices identified in this chapter with Toyota's American competitors. Those who manage by results focus on the bottom-line target and consider that achieving financial goals justifies inherently destructive practices. Those who manage by means consider that a desirable end will emerge naturally as a consequence of nurturing the activities of all employees and suppliers in a humane manner. Managing by means requires a profound change in thinking that is a bold alternative to conventional management thinking and practice. The alternative to managing by results which this chapter advocates requires disciplined practices, sustained attention to how work is done, and nurturing every step of the work at every moment. Managing by means requires all managers in an organization to focus, as does nature, on minute particulars. Such attention to detail involves encouraging employees to cultivate their creative talents so they may best serve a customer's specific needs. This management behavior manifests the belief, not that the ends justify any means, as conventional twentieth-century management practice holds, but rather that the means are ends in the making. The job of managers who manage by means is to cultivate and nurture conditions that bond company talents and customer needs in a profitable union, not to drive work with destructive financial targets. Instead of a quest for relentless growth of quantitative targets that burns out companies before their time, managing by means, as this book shows, can enable a company to profit beyond measure for generation after generation. To demonstrate what this change in thinking can mean for companies today, this opening chapter tells how differences in the way people think about work actually caused a significant difference in the long-term economic performance of real companies in recent decades. The story contrasts the consequences of acting on the belief that order must be externally imposed with the consequences of acting on the belief that order self-emerges from within. Specifically, the story tells how certain automobile manufacturers between the end of World War II and the 1980s responded differently to the problem of producing vehicles in varieties at low mass-production costs. One manufacturer is Toyota Motor Corporation of Japan and the others make up the group of American auto makers known collectively as the Big Three -- General Motors, Ford, and Chrysler. The three American companies' practices differed from one another in many respects. But they are grouped here to emphasize similarities in their thinking and in their consequent styles of manufacturing that contrasted markedly with the thinking and manufacturing style found at Toyota from the 1950s to the 1980s -- similarities and contrasts that persist more or less unchanged to the present day. **THE STORY: TOYOTA AND THE AMERICAN BIG THREE** In the early 1950s Toyota and the American Big Three struggled independently with a problem that confronted virtually all manufacturers following World War II. How could they satisfy customer demand for an increasingly varied range of new products, yet do so at mass-production prices? Replicating mass quantities of one variety of a product -- as if each item had been stamped by the same "cookie cutter" -- was the way many early-twentieth-century manufacturers, including automobile makers, had provided an abundance of material goods at prices average people could afford. Indeed, the auto maker Henry Ford helped pioneer the concept of low-cost repetitive mass production before World War I. He then pushed that concept farther than anyone else before or since in the giant facility he opened in 1919 on the banks of the River Rouge in Dearborn, Michigan. After World War II, it was obvious that great opportunities lay ahead for companies able to offer customers the widest range of styles and models at the lowest prices. The different ways that Toyota and the American Big Three addressed this opportunity between the 1950s and the 1980s epitomizes the essence of manufacturing history in the second half of the twentieth century. To understand this crucial history, and its lessons about the impact of management thinking, we must know how executives of Toyota and the Big Three after World War II perceived the remarkably low cost at which Henry Ford's River Rouge plant produced automobiles in the 1920s. But to understand those perceptions, one must know the conventional story about how work was organized at the Rouge in that decade. Henry Ford's River Rouge Plant in the 1920s Probably the quintessential example of successful mass production was the giant Ford Motor Company plant built during World War I at River Rouge near Dearborn, Michigan. That plant and Ford's Highland Park plant in Detroit together produced some 15 million Model T cars by 1927. Dedicated to making one model, the Rouge facility operated virtually around the clock year in and year out until it literally sated the public's first-time demand for a basic

automobile. The high profits Ford earned in that setting are usually attributed to the plant's remarkable efficiency, where "efficient" is equated with low cost per unit. The principle Ford ostensibly followed to achieve low cost was to build a facility to produce one variant of a product and then run it without interruption at full capacity until demand was sated. If the variant is referred to as A, then the most efficient and most profitable schedule for producing A is AAAAAAAAAA etc., where each A is assembled in a continuous flow, one at a time. A way to organize work to meet that schedule is shown in Figure 1-1, a highly simplified schematic of the flow of work in Ford's River Rouge plant in the early 1920s. An important point to observe in that figure is that the work more or less paced itself. Indeed, the schedule pushed material at a relentless pace that was sustained by having machines and workers -- the people themselves being little more than "cogs in the gears" of the system -- perform repetitive tasks as fast as possible. Given the simplicity of the flow and the repetitive nature of tasks at each work station it was not necessary to spend extra resources on activities to control and expedite the flow of material. In effect, the flow was dictated by the plant's initial design -- a design that promoted efficiency by allowing work to flow continuously from beginning to end and by having it consume at every point only the resources needed to advance one unit of output one step further toward completion. The River Rouge plant in 1925 produced about one vehicle per minute in a total lead time of about three days and nine hours from steel making to finished vehicle. A sign of the mechanistic roots supporting this mass-production system is the relation between information and the flow of work. The primary information influencing the flow of work originates outside the process, in the schedule and in the layout of the plant. Neither the material nor the workers who transform it supply any information to guide the process. Both material and workers respond only to outside influences, literally being "pushed" by external information. Underlying that information is a design, or abstract model, that defines the laws governing the motion of material and workers in the plant. The mass-production model features homogeneity of inputs and outputs (such as uniform material and interchangeable parts transformed by endlessly repetitive steps into identical black Model Ts), large scale, high speed of throughput, and uninterrupted flow of work. The design of the work process and the quality of incoming material insures an acceptable level of quality. The uninterrupted flow of homogeneous units at a rate as fast as possible insures the lowest possible cost per unit of output. The primary rule suggested by this mechanistic model of production -- a rule enshrined in the phrase "economies of scale" -- is that costs per unit fall as the speed and volume of output rise.

How Perceptions of Low Cost at the Rouge Shaped the Quest for Variety after World War II

Until the mid-1920s, Americans delighted in Ford's Model T, a private, enclosed, gasoline-powered alternative to bicycles and horse-drawn buggies. Few buyers expected or sought a variety of designs. The Model T's low price, sustained by the low costs Ford achieved at the Rouge, offset strong desires for variety, at least into the mid-decade. As time passed, however, and the car-buying public grew more sophisticated, they wanted cars with more features and styles. General Motors responded after 1920 by coordinating activities among its several divisions so as to provide a car for "every purse and purpose." But on the whole, such efforts were thwarted first by the Great Depression and then by World War II. The solution to the problem of producing variety at low cost awaited the rise of the strong postwar consumer market. After World War II, Toyota and the American Big Three addressed differently the problem of how to produce varieties of automobiles at low cost. Their distinctive responses to that problem reflected adherence -- although perhaps unacknowledged -- to basic differences in thinking. To appreciate the starkly different kinds of thinking that characterize Toyota and the American Big Three, consider the following meeting in 1982 between Eiji Toyoda, then head of Toyota Motor Corporation, and Philip Caldwell, then head of the Ford Motor Company. At that time, Toyota was emerging as the lowest-cost producer of the highest quality automobiles in the world. Ford and its Big Three partners were then plagued by falling market share, rising customer dissatisfaction with the quality of their vehicles, and unprecedented financial losses. Presumably, Caldwell visited Toyota in Japan in 1982 seeking new ideas. During Caldwell's visit, his host, Mr. Toyoda, is said to have toasted Mr. Caldwell by saying, "There is no secret to how we learned to do what we do, Mr. Caldwell. We learned it at the Rouge." It must have been obvious to Mr. Caldwell in 1982 that he and his colleagues at Ford, as well as his counterparts in the other Big Three companies, had definitely not viewed the operations at Henry Ford's Rouge River plant in the same way as had Toyota. As Caldwell surely observed, Toyota by the early 1980s was using stunningly simple means to successfully produce a diverse array of vehicles at mass-production costs, while maintaining the highest quality and earning gratifying profits. Meanwhile, Chrysler, General Motors, and Ford from the 1950s to the 1980s produced an increasing variety of vehicles by using complicated means, generated products of variable quality, and often suffered disappointing financial results. Why did the Big Three apparently not discover the same key to success at the Rouge that Toyota claimed it did? When Toyota's managers considered that facility, what did they perceive? When executives at the Big Three companies contemplated that facility, what perceptions did they share? To understand the differences in how Toyota and the Big Three interpreted operations at the River Rouge plant is to understand the difference between Toyota's distinctive thinking and the thinking that has dominated management practice in most of the world's other businesses during the past five decades. How different methods of thinking affect long-term performance is the lesson to be learned from what follows.

MASS-PRODUCING VARIETY IN BATCHES

What the American Big Three Saw at the Rouge

The AAAAAAAAAA mass-production schedule and the way to organize work shown in Figure 1-1 faced a challenge when companies realized that their economic survival demanded

making products in more than one variety. By 1950, the growth of markets, and the even faster growth in demand for varieties of products, was convincing more and more companies that they could profit most by selling products in increasing varieties. One way to meet these demands was to build a new plant dedicated to each new variant. But the idea of replicating a plant as large and complex as the River Rouge facility for each variant seemed impractical, especially as the number of varieties increased. Therefore, companies searched for ways to make two or more variants of a product in the same plant, but do so efficiently and profitably. In the past fifty years, most manufacturers who have strived to produce output in varieties have remained committed to the mass-production thinking that says high profits depend, ultimately, on producing at low costs by running operations without interruption at full capacity for as long as possible. But in the context of making products in varieties, they discovered that "running without interruption" and "running at full capacity" are not necessarily achieved as simply as they are when the production schedule is AAAAAAAAAA and work is organized in a continuous flow that consumes resources at the rate needed to produce one order at a time. Look first at the effect variety has on the production schedule. Whereas the mass producer of one variety, A, can simply "turn on the faucet" and watch product flow at a steady pace such as AAAAAAAAAA, that same producer must consider what to do about the time it takes to change from A to other varieties of product, if a decision is made to produce varieties. Were it possible to change instantaneously from A to B to C, then a flow such as AAABCCAACBB etc. could be achieved without "turning off the faucet." However, if changing from one variety to another takes time, then one cannot produce a second and third variant, say B and C, in the same plant as A without "turning off the faucet" from time to time to change from A to B to C. The key to understanding how the Big Three automakers and most American manufacturers addressed the issue of variety after World War II is to realize that they all took for granted the times it took to change over the various types of equipment used in their plants in the late 1940s and early 1950s. They apparently saw no benefit to reducing the time it took to do individual changeovers. Instead, as they increased the variety of output, they took steps to reduce the total amount of time spent changing over. They did so by separating the various processes through which material flowed continuously in the early River Rouge plant. With processes separated, material for different varieties could be batched and processed "efficiently" in long runs that economized on changeovers. The System the Big Three Created in Response to What They Saw at the Rouge As noted above, if changeover time is not reduced it causes delay, and the more so as varieties increase. Hence, variety is not produced by taking the daily production schedule from AAAAAAAAAA, where every A potentially is produced to customer order, to something like AABAAABBBCCAAA, where each A, B, and C is also produced to customer order. Instead, following the same sequence, the daily production schedule becomes AA(delay)B(delay)AAA(delay)BB(delay) CCC(delay)AAA. Each transition from A to B to C requires stopping to change something, and often very many things. Such delays are problematic to a mass producer whose rule is to "run without interruption at full capacity" as much as possible. Each delay not only requires extra work and cost, their number can extend the production schedule into another shift or another day -- prompting yet more cost and delay. The general solution to this problem favored by most American manufacturers who regarded variety as necessary to survival after 1950 was to schedule production so that each variety could be batched separately and run without interruption as long as possible. Continuing the above example, batching each different variant would generate a schedule AAAAAAAAAA(delay)BBB(delay)CCC. This schedule reduces the number of interruptions and increases the percentage of time that the facility is up and running product, all of which reduces cost and, presumably, increases profitability. However, producing varieties in long-running batches creates new costs because the mix of varieties produced does not automatically mesh with the mix of varieties that customers wish to purchase. Producing in batches means producing out of step with the flow of customer orders. Thus, to avoid having production deviate too much from consumption, time and resources must be spent on forecasting demand or, alternatively, on stimulating demand so that it fits what you are producing. Market forecasting and advertising become expensive necessities for achieving the low costs promised by batch-producing varieties of output. Even so, there is still a chance of being wrong much of the time. Sometimes a batch will contain more of a variety than customers ultimately want, which is a costly waste. At times, a batch will tie up capacity and prevent making something else that customers do want, which can lead to a costly loss of sales. Most mass-production manufacturers addressed these added costs of batching varieties by speeding up the flow of output for each batch. More output in a given amount of time meant lower costs per unit, including the costs caused by batch production. Thus, manufacturers who reduced the total amount of time lost changing from one variety to another by producing varieties in batches adhered to the mass-production principle of "running without interruption as fast as possible," at least during the time each batch was running. By speeding up production and increasing output, thereby reducing costs per unit, they attempted to control the costs of forecasting demand, discounting prices on unwanted output, and losing sales. In this way they honored the mechanistic concept of "economies of scale." Making varieties in batches led to new ways of organizing work that generated additional costs, besides those costs caused because batched production is invariably out of step with customer demand. In principle, material flows without interruption as one batch of components is being produced. However, all the batches of components that go into making one variant of a product do not flow continuously from start to finish, like the flow that occurs when work is organized as it is in Figure 1-1. Because of the widely different changeover times among

operations such as stamping, painting, casting, component building, and final assembly, work on each variety of component will occur in separate batches in each operation. Thus, while the components needed to make each variant of a product eventually travel from raw material to final assembly, they do so by lurching through the operations in discontinuous fits and starts. In practice, components from each operation are produced in a separate department or plant and then sent to staging areas, such as warehouses, from which they are shipped in the appropriate order to separate final assembly departments or plants. While batch-produced materials may flow ultimately into varieties of finished products through a final assembly operation that resembles the pattern in Figure 1-1, the continuous flow in machining and component making seen at River Rouge in the 1920s did not exist in a typical American automobile final assembly plant by the 1970s. To deal with the realities of batch production, mass producers who wished to manufacture automobiles (and other products) in varieties after World War II reorganized their operations in a completely different way than Henry Ford had done at River Rouge. As variety proliferated after 1950, most large manufacturing organizations in America and Europe separated their otherwise linked operations into separate departments, and allowed each operation to perform according to its own changeover rhythm. This "decoupled" batch production approach to mass-producing variety featured uninterrupted work only in each separate operation, followed by transit to a central staging area, or warehouse, where material waited until a schedule directed it to flow in varieties to a final assembly plant (Figure 1-2). Making all the pieces in this complicated "flow" come together in the right places at the right times required people and equipment not employed in the actual making of the products themselves. These resources, referred to as "overhead," were employed in activities such as scheduling, controlling, expediting, storing, inspecting, transporting, and reworking. Particularly noteworthy was the investment of resources needed to profitably handle the material flows shown by solid lines and arrows in Figure 1-2. Those resources were invested in sophisticated scheduling and control systems, increasingly computer-based, shown by the dotted lines and arrows in that figure. One could say that all these resources represented an "information factory" that was separate from but alongside the material-flow factory. Ironically, this "information factory" was needed to impose order on a batch-driven system that had been created to minimize the costs of producing output in varieties. Eventually, the "information factory" in most companies would employ more workers than the real factory would employ to actually transform material into finished products. However, company leaders believed that they could control the added costs of the "information factory" by applying the same mass-production logic of economies of scale and speed that says that cost per unit falls the more units you produce in a period. According to this logic, profitability is always assured if enough output is produced to reduce unit costs below the prices customers will pay. So, the answer to the added costs of building an information factory was to increase the speed and amount of output (i.e., "throughput") even more, and then engage in advertising or other incentives to stimulate customer demand. Most companies attributed the activities associated with batch production to complexity caused by producing varieties of product, not to complications caused by the way they organized work to produce that variety. Those activities were virtually absent from a continuously flowing mass-production system such as that shown in Figure 1-1. They were utterly essential, however, to the smooth working of batch-production systems that produced varieties of products as shown in Figure 1-2. The following list describes only a few examples of such added activities: Separating parts of the system, to accommodate their different operating rates, made inventories and warehouses indispensable. All work, until final assembly, was forwarded to warehouse staging areas from which balanced flows to final assembly could be coordinated in the varieties desired. Mass production without variety does not require warehouses (Figure 1-1). By the end of the 1950s, however, most American manufacturing plants could not operate without them (Figure 1-2). Separating the system into independent stages -- decoupling -- created a need for production controllers and schedulers to coordinate the movement of things between these stages and from inventory to final assembly. To cope with the added level of complication brought on by this work, by the 1960s and 1970s, most large American manufacturing organizations were using production scheduling algorithms, such as material requirements planning (MRP), made possible by the recent appearance of high-speed mainframe computers. Over the years, exponential growth of the capacity and speed of computerized information technology (IT) systems reinforced the illusion that computers always made it possible to manage the complexity attendant upon mass-producing more and more variety. Over long periods of time such as a model year, output from all parts of the system in Figure 1-2 is expected to balance out with customer demand. However, that "balance" is often forced by means such as building inventory, scrapping excess output, investing in advertising campaigns, reducing prices to clear out excess stock, and, in cases of severe imbalance, eliminating parts of the system by laying people off and selling assets. Workers in each independent part of the system, producing to schedule for inventory, cannot receive immediate feedback from workers in the next operation. Hence, many errors and defects either go undetected, or are detected and intentionally ignored. Errors and defects must be remedied through rework at a later time, often at great cost. Not unexpectedly, the number of uncorrected defects appearing in the final consumers' products rose dramatically in the 1960s and 1970s in most American manufacturing companies that adopted the mode of production shown in Figure 1-2. Compartmentalizing -- decoupling -- the flow of work to accommodate different changeover rhythms creates a correlation between increasing varieties of output and decreasing the amount of time spent each day actually producing, as opposed to changing over. To meet annual output schedules, therefore, work

must be done at increasingly faster rates during those times when output actually is being produced. This means that the rated capacity of machinery (size and speed) must increase as variety (and the consequent need for changing over) increases. Rising costs encourage the belief that if performance incentives are offered to workers, workers will hasten production, thus helping drive down unit costs. Unfortunately, the outcome of performance incentives has proved as a rule to be analogous to what might happen should each musician in an orchestra be rewarded for playing faster and louder than the others. Cacophony would result, not the harmony arising from the interaction of specialized instruments adhering to the same fundamental rhythm. Performance incentives invariably are a source of cacophony that translates into yet higher costs. As variety and volume of output grow, the practice of separating the flow of work into segments -- decoupling -- creates increasing delays, and therefore increasing costs, in the overall system. Changing over for more varieties generates delay, as does the time needed to inspect and rework parts, to schedule flows of work, to sort and store parts, and to move parts and material over longer distances. As an example of this impact, the overall lead time to make a vehicle went from three days and nine hours at Ford's River Rouge plant in the mid-1920s (Figure 1-1) to several weeks in most auto-making organizations by the 1970s (Figure 1-2). Similar increases in lead times caused most American manufacturers after the 1950s to experience painful increases in total costs. These increases usually appeared in the accounting ledgers under headings such as "overhead" or "indirect costs." Most accountants before the late 1980s did not have, for various reasons, proper tools with which to analyze and explain costs that fell under those headings. Traditional cost accounting practices simply allocated such costs to departments, products, and other cost objects, and gave little or no regard to what caused the costs. Thus, accountants could show when, and by how much, costs rose, but they could not explain why costs rose, especially not overhead costs. Nor did it seem to occur either to accountants or to those managers using their numbers that the way work was being organized might itself be the primary cause of rising costs. As noted above, executives in most manufacturing companies, following mechanistic principles of scale economy and mass production, believed they could address these costs, and keep unit cost (i.e., cost divide; unit) in line, by increasing the scale and speed of output in each one of the various operations of the decoupled work system. In that regard, cost accounting and production planning became essential tools to help determine the necessary scale and speed to keep costs in line with targets. This scale-and-speed model enabled executives to further rationalize the decision to separate the system into parts. Moreover, this model encouraged subordinating the issue of how work is done in the parts. Instead, the model placed emphasis on the perceived need to get products out the door, without regard to any imbalance in the rates at which the various parts of the system operated. In other words, while great attention was paid to meeting output targets, slight attention was paid to how work was done to produce output. A comparison of Figure 1-1 with Figure 1-2 suggests that the shift from mass production without variety to mass production with variety created a complicated and messy pattern of work in which it was difficult, if not impossible, to perceive any sense of order. Systems resembling the flow of work in Figure 1-2 were designed according to the same mechanistic principles as the continuous flow systems in Figure 1-1 -- that is, run without interruption and at full capacity -- but they did not present the same appearance of order. Order seemed to be introduced, eventually, by computer-oriented production control, scheduling, and cost accounting systems. Production schedules (e.g., MRP) and standard cost budget variances, for example, provided managers with a sense of what should be done at any time, and how far actual results deviated from targets. At first the abstract information compiled and transmitted by these computer systems merely supplemented the perspectives of managers who were already familiar with concrete details of the operations they managed, no matter how complicated and confused those operations became. Such individuals, prevalent in top management ranks before 1970, had a clear sense of the difference between "the map" created by abstract computer calculations and "the territory" that people inhabited in the workplace. Increasingly after 1970, however, managers lacking in shopfloor experience or in engineering training, often trained in graduate business schools, came to dominate American and European manufacturing establishments.<sup>10</sup> In their hands the "map was the territory." In other words, they considered reality to be the abstract quantitative models, the management accounting reports, and the computer scheduling algorithms that were used to make sense of decoupled batch-production systems. With the rise of this new generation of managers after 1970, mechanistic and quantitative thinking began to shape management practices with a vengeance not only in large manufacturing firms, but in business, governmental, and educational organizations all over the world. The hallmark of this emphasis is the use of abstract economic models and quantitative measures to drive work and to evaluate individuals at all levels in organizations. Instead of paying attention to how work is organized and how the organization of work might affect financial results, managers increasingly saw workers and organizations as collections of objects, responsive solely to pressure to achieve external quantitative targets. This belief in quantitative measurement as the primary tool of management led to "management by results" (MBR), a subject that chapter 2 covers in much greater depth. MBR is perhaps the primary legacy of applying mechanistic thinking to business practice. Indeed, the use of abstract quantitative measurement to direct work -- the hallmark of MBR -- spread rapidly after the 1970s. Beginning with manufacturers' efforts to control the costs of mass-producing variety with batches, MBR spread eventually to almost all types of business, regardless of size, type of markets served, or extent of variety produced. However, the decoupling of work into compartmentalized stages, the increased speed of work, and the

increased size of batches inevitably drove a wide chasm between workers and final consumers. Not only did this not reduce costs, it led to rising costs and an accompanying decline in quality. After the late 1970s, these developments drove away customers in many cases when alternative suppliers appeared -- often from Japan and Western Europe -- who could provide variety, with quality, and low cost. By the early 1980s, most manufacturers assumed it was nearly impossible to efficiently and profitably make increasing varieties of products for large markets. They believed they could profit by producing wide varieties or by selling in large markets, but not by doing both. Indeed, a cornerstone of strategic management thought since the 1970s is the belief that a company, to be profitable, must choose between differentiation and mass production. Presumably, a company that differentiates sacrifices scale economies by multiplying the varieties of its products. Therefore, it can be profitable only by selling in small niche markets where prices are high enough to cover the high costs of variety.

Alternatively, the argument goes, a company that limits its product variety can sell large quantities profitably at low prices, because it efficiently mass-produces each variety. Proponents of this strategic thinking assume that variety spawns complexity and, therefore, extra costs that make it difficult to be profitable in large markets. They are right, at least up to a point. Variety does generate complexity, and lots of it, in most organizations. What strategic analysts have failed to consider is that such complexity may not be due to proliferation of product variety. Instead, it may be due to the way that work is organized. If work were organized to avoid complexity, then choosing between differentiation and mass production would be unnecessary. But to organize work so that it produces variety at low cost required a shift in thinking, from the mass-production thinking that was implicit in the American Big Three auto makers' methods to a different way of thinking that became embodied in Toyota's methods.

#### PRODUCING VARIETY IN A CONTINUOUS FLOW

What Toyota Saw at the Rouge When Eiji Toyoda told Philip Caldwell that Toyota had discovered the secret to its success at the Rouge, his comment implied that what Toyota had perceived about operations at the Rouge was very different than what Caldwell and his Ford colleagues or their counterparts in the other Big Three auto companies had seen. For one thing, it seems that Toyota people did not view low cost at the Rouge in terms of its scale, its throughput, or its managers' efforts to impose external targets for speed and cost on workers in the plant. Instead, they seemed to perceive a holistic pattern permeating every minute particular of the system. On one level, the pattern that caught Toyota's attention was the overall continuous flow of work in the Rouge as a whole. But at a much deeper level, they observed that work flowed continuously through each part of the system -- literally through each individual work station -- at the same rate, the rate that finished units flowed off the line. It is not difficult to see that this pattern has the potential to produce the superior costs, quality, and flexibility for which Toyota became so famous by the 1980s. If every step in a continuous flow works at the same rate, then at any moment each step consumes only the resources required to advance one customer's order one step closer to completion. In that case, for the volume of output being produced, costs are as low as they can be, given the total number of process steps, the work designed for each step, the design of the product, the prices of inputs, and the certainty that everything done in each step is done correctly. Indeed, to Toyota's people, Henry Ford's River Rouge system achieved low costs because balancing every step in a continuous flow conserves resources. With all steps linked in a balanced flow, no worker did more than was needed to prepare only the work called for by the next step, and then pass it on. At the limit, each work station was scaled to meet the requirements of no more than one unit's worth of product at a time. Moreover, Toyota people perceived that if each worker could design and control the steps he or she performed, then workers could perform different steps on each unit that passed by them in every time interval. Thus, variety could be achieved at no greater cost than if all units were identical. Toyota people saw low cost at the Rouge as a property of the system that emerged spontaneously from relationships among the parts -- the individual workers and the steps they performed to meet customers' needs -- and the pattern that was implicit in those relationships. Low cost was not forced by manipulating the speed at which individual workers performed their tasks. It was achieved by nurturing in each work station the conditions that maintained a balanced flow overall -- the pattern that defined the whole system. Thus, perceiving the key feature of Henry Ford's system to be its ability to pace every step of the work at the same rate that finished units flowed off the line convinced Toyota executives after World War II that variety had to be achieved in the context of continuous flow if it was to be achieved at the lowest possible cost and highest quality. The question they faced was how to accomplish this goal. To answer this question, Toyota concentrated more attention after the 1950s than did the American Big Three on exploring the implications of continuously linking and balancing steps in the system. For them, the scale and speed necessary in a batch-oriented

system that decouples work into separate compartments may have seemed to impose excessively high capital costs to achieve variety. No doubt the scarcity of capital and a concern to conserve resources prompted Toyota's executives to concentrate on resource-saving linking and balancing as their means of achieving variety. The scarcity Japanese manufacturers faced after World War II precluded Toyota achieving variety by decoupling and batch-producing because they lacked the means to store inventories in warehouses, to employ large staffs of schedulers, expeditors, and production controllers, to inspect for and rework accumulated defects, and to tolerate weeks-long lead times from order to delivery of finished vehicles. Necessity required that they work on a smaller scale than the Big Three, with smaller inventories, but still achieve low mass-production costs. Working carefully became their watchword. At Toyota, Taiichi Ohno and his colleagues identified reducing individual changeover times as the key to achieving variety of output while keeping all steps linked in a continuous flow. The System Toyota Created in Response to What It Saw at the Rouge Toyota executives in the 1950s gave no credence to the notion adopted by the American Big Three that variety could be achieved at low cost by decoupling the continuous flow into separate parts and producing varieties in batches. Such separation and batch production would subvert the continuous flow system's inherent ability to conserve resources. Variety could be achieved at low cost, Toyota believed, only in a system where material and work flowed continuously, one order at a time. Brilliantly answering the problem of how to achieve variety in such a system, Toyota's executives realized that they had to make changeover times conform as closely as possible to the rate at which finished units flowed out of final assembly. They theorized that if the time needed to change over every step in the system were actually less than the time interval between units flowing off the line, then it would be possible for every unit coming off the line to be different from every other unit, and still costs per unit would be nearly the same as if every unit were identical. Those conditions, in other words, would make it possible build a unique product for each customer, at Model-T costs. The gap between theory and practice is often gigantic, of course. To make theory coincide with reality, Toyota evidenced prolonged dedication. From the 1950s until the 1970s, they carried out an unremitting campaign to reduce changeover times in all steps of their manufacturing system. Although Toyota never achieved the goal of performing all changeovers faster than the rate at which output flows off the line, it did substantially reduce changeover times -- by orders of magnitude in many cases. It also designed expeditious ways to use inventory buffers where changeover times did not mesh perfectly with the material flow rate. Consequently, virtually all work requiring changeover was incorporated as much as possible into the continuous flow. By the mid 1970s Toyota had created a continuous flow that focused on connecting workers with customers in self-organizing relationships that are capable of continually generating unique outcomes -- diversity, in other words. A later chapter that discusses Toyota's largest American manufacturing facility, located in Georgetown, Kentucky, describes this production system in great depth. Without going into details, therefore, a few general comments at this point can show how the main features of Toyota's system contrast with features of the Big Three auto makers' system depicted in Figure 1-2. Probably the key feature of Toyota's system is to have every step in the entire process join the creative talents of a specific worker with the needs of a specific customer, forming a relationship that is not only the defining feature of a business, but is also the necessary condition to insure its long-run survival (Figure 1-3, upper panel). In a large organization such as Toyota, each worker does not necessarily interact directly with the final customer who "pays the bill." Instead, hundreds or thousands of individual employees do serve an "internal" customer -- the person in the next operation (Figure 1-3, lower panel). Those hundreds and thousands of internal connections satisfy the overall relationship between the company and the final customer. They do so because the company links all internal connections in a continuous flow and because standards that each person sets for his or her work insure that serving the needs of the internal customer ultimately fulfills the final customer's needs. The continuous flow of material and work in this system resembles the metabolic flow of matter and energy that maintains and sustains a living organism, such as a tree. Analogous to the workers in the above diagram's continuous flow are the cells in a tree that absorb energy from the sun's rays, mineral nutrients from Earth and its atmosphere, and transform them into carbohydrates, cellulose, and other substances that energize and sustain the tree's existence. Encoded in each cell's DNA and provided in the constant feedback among the tree's billions of richly interconnected cells is all the information needed to carry out the tree's metabolic activities, throughout its life. In the system depicted in Figure 1-3 it is the customer who provides energy, in the form of money. This energy enables the company to transform material into goods and services the customer desires. It also provides various forms of compensation -- such as delight with a job well done -- to those who use their talents and resources to transform material into products that satisfy a customer. Feedback is conveyed through the web of relationships in this system and by standards that are "encoded" in every step of the work, insuring that every person at every point in the web always has all the information he or she needs to do the work. This was the system that Philip Caldwell observed at Toyota City in 1982. It differed enormously from the decoupled batch-driven systems to which the American Big Three were accustomed by 1980. Those systems were characterized by a high degree of imbalance, large and unavoidable inventory buffers, large machinery, and myriad additional capital and "overhead" resources to transport, expedite, schedule, and rework in every part of the system. Notably, the system Caldwell observed at Toyota did not require the costly "information factory" that was by that time an inescapable part of almost all large-scale American manufacturing systems. This difference is not well understood by most people outside Toyota even today, nearly

twenty years later. More will be said about this in the chapter that discusses Toyota's modern U.S. facility in Georgetown, Kentucky. The point to recognize here is that in a balanced continuous flow, as one has in Toyota facilities, the work itself is the information, and all the information needed to direct operations is in the work. Operations are not driven by external information and controls such as those that have increasingly characterized the typical large-scale American manufacturing facility since the 1950s. Caldwell witnessed at Toyota a system that conserved resources, including capital, while permitting unprecedented flexibility and variety of output. The system's strength resided in the time, discipline, determination, and ingenuity of each individual worker. Reducing changeovers, for example, took the effort and imagination of everyone on the line. Toyota had discovered that it is more profitable to invest in informed, responsible workers who make decisions on the line than to invest in new capital machinery and other expensive "overhead" resources. Few American or European business leaders have ever recognized that Toyota's strategy of conserving resources by incorporating every step into a balanced continuous flow is not the same thing as cutting costs by eliminating "nonvalue activity." The latter idea is central to recently popular process improvement initiatives such as "activity-based management," "business process reengineering," and "lean manufacturing," none of which really captures the essential point of conserving resources by avoiding -- not eliminating -- waste. More will be said about this in the chapter on Toyota that follows. By the early 1980s, Toyota's system produced output at just the rate needed to satisfy current demand, as Henry Ford's system had done in 1925, but Toyota now produced that output in varieties. Their continuously linked system featured much smaller machines than those used in American Big Three plants, and each step operated at a slower rate. Indeed, virtually every step operated at just the rate needed to complete the requirements for one customer's order at a time. The steps in Toyota's system were designed "to carry small loads and make frequent trips," like the fabled water beetle in Japanese mythology. And each trip had to matter. Therefore, Toyota's employees always attempted to do things right the first time -- a strategy W. Edwards Deming taught in his famous presentations to Japanese manufacturing executives during the summer of 1951. Deming's influence, their own post-World War II circumstance, quiet resolve, willingness to invest long periods of time in the outcome, and their ingenuity are just a few qualities that helped Toyota head in a new direction. The American Big Three, also creatures of their circumstances, featured a compartmentalized system requiring large machines producing output in large batches at high speed that required storage and retrieval. BEYOND THE ROUGE: LESSONS FOR TWENTY-FIRST CENTURY MANAGERS The story about Toyota and the American Big Three automakers is background to a much larger issue than the relative performance of two groups of manufacturers. The purpose of the story is not simply to show businesses how certain techniques for organizing work will improve their profitability. Toyota, of course, stands alone among the world's auto makers for having achieved remarkable profits year in and year out for the past forty years (see the Appendix to Chapter 1). Moreover, the American Big Three and most other large auto companies in the world have enjoyed unprecedented profitability in the 1990s, in part because of lessons learned from Toyota. But no company so far has matched Toyota's success. Indeed, most companies have learned little more than how to copy various Toyota methods. None seems to have discovered and mastered the real source of the difference in performance between Toyota and the Big Three from the 1950s to the present. That source is the different thinking implicit in Toyota's methods, not just the methods themselves. The challenge that companies face today -- including Toyota itself -- is to identify and continually refine that thinking. Virtually all improvement initiatives of the past decade or so -- just-in-time, total quality management, business process reengineering, activity-based management, lean manufacturing, enterprise resource planning, scorecard management, and so on -- take for granted the quantitative and mechanistic thinking that has shaped business practices for the past fifty years or more. All those initiatives do generate some improvement, but only within narrow limits set by that prevailing mode of thinking. Locked into traditional thinking, adherents to those initiatives invariably ignore, and lose, an opportunity to achieve far greater improvement by adopting new thinking that reframes old questions in new ways that open new doors. New thinking was implicit in Toyota's perception that variety at mass-production costs requires both continuous flow and a concerted effort to nurture the pattern of continuous flow in the minute particulars of every worker's actions. Significantly, that thinking caused Toyota to create a production system with features that resemble those commonly found in living systems. For example, the information system used to guide operations in Toyota is strikingly similar to the information system found in a living organism. It is embodied within, not imposed from outside. Whether or not Toyota consciously designed its system in the light of living-system principles, its pervasive similarities to a natural organic system undoubtedly contribute to the company's legendary prosperity. The resemblance of Toyota's system to a natural life system may also help explain why no company to date has successfully imitated Toyota's success. Scientists came to understand the principles of self-organizing natural systems and the pervasive influence of those principles throughout the universe just in the last few decades. Only recently have they explained those principles in terms that would enable business leaders to understand what it means to view an organization as a living system, rather than think of it as an inert mechanism. Today this new scientific understanding of the principles that guide the evolution of all natural systems in the universe, gleaned largely from modern physics, enables us to describe the path business leaders must follow to engender those same principles in the activities of their organizations. To help chart that path is the main goal of this book. However, to follow the chart it is necessary to

describe, if only briefly, the recent revolution in science that shows how one set of principles explains the emergence and functioning of all systems in the universe -- from galaxies, stars, and carbon-based life on Earth to human business organizations. **PRINCIPLES OF NATURE TO INFORM TWENTY-FIRST CENTURY MANAGEMENT** Modern physics tells us that the universe is a self-ordering system that continually transforms a fixed budget of energy and matter according to three principles that have operated since an originating "big bang" some fifteen billion years ago. In essence, the universe is a constantly evolving system that operates according to the same few principles in all its parts, including our Earth and all organic life on it. Human organizations such as the modern global business are themselves systems that self-emerged in the context of the same three principles as all other natural systems in the universe. The thesis of this book is that to survive and prosper in the long run requires a business to follow practices that adhere to those principles. The three primary principles that scientists consider sufficient to account for all phenomena in the universe are self-organization, interdependence, and diversity. Self-organization means that everything in the universe has the power to sustain its own unique identity. Just as the universe itself creates its own order and its own identity out of homogeneous, random disorder, so each entity in nature makes real -- "actualizes" -- an inherent unique potential that defines it as utterly distinctive. By itself, the power to self-organize -- to define and sustain the unique self -- implies th