

Title: The 21s Century Manufacturing Enterprise Strategy
or
What Is All This Talk About Agility?

Abstract: This paper, written in December 1992, provides a digestable synopsis of the vision contained in the original “The 21st Century Manufacturing Enterprise Strategy” published in 1991 by the Iacocca Institute. Key issues are identified, as well as the foundation for justifying the findings.

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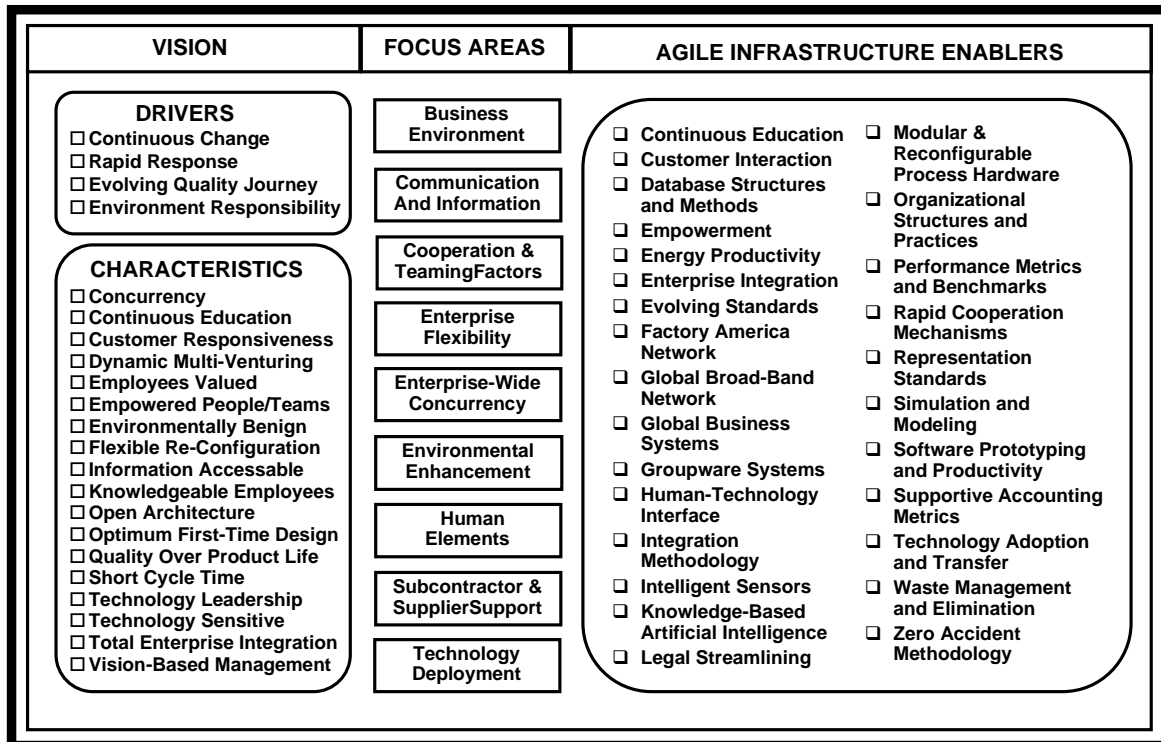


Table: The Agile Enterprise

In 1991 a dedicated group of executives from thirteen companies in the USA compiled a vision-based strategy for the emerging global competitive environment. Attempting to articulate rather than invent the national consensus, this group listened to more than forty advisors from various national priority studies and activities, and another 150 corporate representative in a series of traveling workshops. The results have been published as "The 21st Century Manufacturing Enterprise Strategy" and are available from Lehigh University's Iacocca Institute, which acted as the facilitator under a government contract administered by the Navy.

Thus was born the concept of the agile manufacturing enterprise, with agility pegged as the single most important characteristic an enterprise will have when entering the 21st century. Simply stated, agility is that characteristic which allows an organization to thrive in an environment of constant and unpredictable change.

At this writing agility seems to have supplanted all other buzz-words for frequency of usage. But one gets the distinctive impression that it is more than just the latest buzz-word. By the summer of 1992 the original thirteen company core had swelled to over 150 companies and organizations, with more joining every day. Working together as part of the newly formed and commercially-led Agile Manufacturing Enterprise Forum, these organizations began exploring and defining the metrics, benchmarks, technologies, structures, human roles, justifications, and migration paths that will make the agile enterprise a commonplace reality.

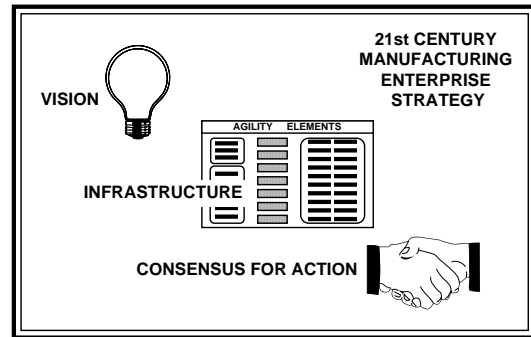
Government and academe are also joining the band-wagon. Lehigh University has agreed to act as the current secretariat for the Agile Manufacturing Enterprise Forum, and in fact invested directly in the critical start-up phase before commercial funding was a reality. On the government side, bipartisan support for the vision appears to be taking hold in congress as well as among various government agencies including the administration, Department of Defense (DoD), Department of Commerce (DoC), and Department of Energy (DoE). Some congressional forces have even suggested that an "AgileTech", patterned after SemaTech, be given serious consideration for government co-funding.

But all of this is preliminary and unpredictable, and needs time to shake out. Here we will give the principal findings of the 21st Century

Manufacturing Enterprise Strategy in perspective, and explore the nature of agility in particular. Perhaps most importantly, we will conclude with a discussion of what these understandings mean to companies right now. To think that this vision is of the future and not of the present can be a very costly misunderstanding.

A Commercially-Developed View

First, articulate a vision of the emerging competitive manufacturing enterprise - understandable by people unskilled in the manufacturing arts: CEOs, congresspersons, generals, and other key decision makers. Second, define the elements of an industry-independent enabling infrastructure that supports the vision. And third, catalyze a national consensus for action in pursuit of the vision.

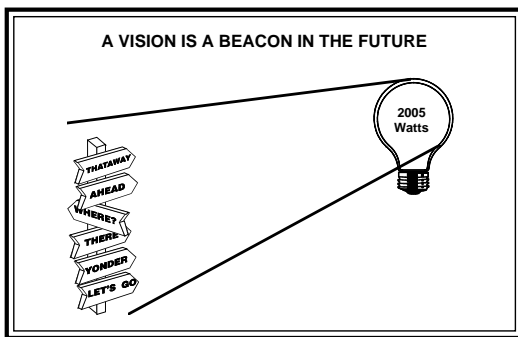


These were the goals laid down by the Department of Defense. Suspecting a large overlap of strategic investment needed among defense and commercial industries alike, DoD reasoned that a commercially-developed vision would be useful in developing a long-term investment strategy for defense manufacturing technology. Lehigh University's Iacocca Institute was chosen to facilitate the commercial activity needed to accomplish the goals, and its Director of Operations, Roger Nagel, along with the author were selected to co-chair the activity.

Of the many companies contacted, thirteen were able to commit executive's with the requested profiles in the short period allowed. We asked for visionaries with breadth and depth in manufacturing who were influential in their corporation. And we asked for people vital to the operation - meaning they didn't have a clean desk nor the rest of the year off. For the record, these companies were Air Products, AT&T, Boeing Helicopter, Chrysler, FMC, GE Aircraft Engines, General Motors, IBM, Kingsbury Corporation,

Motorola, Texas Instruments, TRW, and Westinghouse.

We established a time period 10-15 years in the future as the setting for the vision. This was done for very practical reasons that have become important to understand, as we will see in the concluding remarks. Firstly, it had to be far enough ahead that we could ignore how it would happen - else we would get stuck by the existing paradigm rules. Secondly, it had to be close enough so we wouldn't postulate cold fusion and other wishful thinking. Thus, the vision would be based on seed ideas that could already be pointed to, yet it would be unconstrained by today's "the-way-it-is" rules.



The important part to understand is that this was just a mind trick. We used it to break out of our own thought constraints. The vision has nothing really to do with 10 years or even 15 years from now. It could just as easily be describing next year or even today in some sectors. It is for the most part an amalgam of the best bits and scattered pieces already being practiced in industry right here in the USA. The future part has to do with the time it will take to extend, mature and coalesce all of these bits and pieces into a critical mass of widely-accepted corporate operating strategy.

I will not attempt to duplicate here all of the thoughts and nuances expressed in almost 200 pages of the two-volume report. Instead, I will put that body of thought into perspective by condensing it into its driving forces, major concepts, and key enablers.

Driving Forces

Rather than base the vision purely on current popular opinion, we reasoned that it should be the compelling conclusion of obvious driving forces. We wrestled with a long list over many months as the rest of the effort proceeded in parallel. In the end there were four basic drivers that remained unquestioned and were clearly major shapers of

the future. We will discuss these as they are the foundation of the vision. With agreement on a small but significant set of forces that will shape the characteristics of successful companies, we can say some things about how these companies must operate. The four are:

- Continuous Change
- Rapid Response
- Evolving Definition of Quality
- Environmental Responsibility

The four driving forces identified and discussed here are not expected to be the only driving forces that will shape the future. After establishing these forces we can predict many of the characteristics that must exist as a result in successful companies. And from those characteristics, we can infer the underlying infrastructure that these companies must have available to them.

Continuous Change is the first major driving force we will discuss. Anyone who has purchased a personal computer recently understands the impact that rapid technological advancement is having on the marketplace. If the purchasing decision can be postponed by two weeks a lower cost and better featured product will be available. As consumers, we have all seen our music collection change from records, to 8-track tape, to cassette tape, to cd, and now to DAT and a new cd format. Though electronic products seem to have the fastest cycle of obsolescence, rapid innovation and shrinking cycle times are affecting virtually all fields.

It is a mistake to think that this accelerating pace of innovation only affects products. New technology, materials, and methods also affect the processes used to build products. Already, we see the plant that was built six months ago is unable to compete in cost and quality with the competitive plant just built with newer processing technologies and methods.

Markets and competition are also undoing continuous and dramatic change. Where many of us eagerly await the new market opportunities that China and the Eastern Bloc promise, we will also have to contend with the new and significant competition that these markets will bring. Their abilities to purchase goods and services will be directly related to their abilities to generate currency. And right behind them will come South America, Africa, and others.

Newly industrialized countries do not have to go through all of the stages that established coun-

tries have taken. Because they have no entrenched industrial base, they can take immediate advantage of the latest methods and production technologies. Competing on the basis of low labor rate alone is no longer the only threat these new entries pose. With a growing global focus on quality of life and living standard, industrial balance will shift continually for many decades.

CONTINUOUS CHANGE	
In Product Innovation	<input type="checkbox"/> New Technology in Shorter Cycles.
In Process Cost, Quality, & Time	<input type="checkbox"/> Global Competition Brings New Methods.
In Competitive Environment	<input type="checkbox"/> Newly Industrialized Countries Emerging.
In Customer Expectations	<input type="checkbox"/> New Consumers Expect Technology. <input type="checkbox"/> Global Sources Offer Wider Variety.

The consumer is also part of this rapid and continuous change. Global marketing has brought more choices and raised expectations for quality and innovation. Brand loyalty is a dying concept, giving way to an immediate shift to brands with better features, lower costs, and higher qualities. In the USA where conventional marketing wisdom is focused on the aging population a profound change is occurring in the younger consumers: they are becoming technologically adept - they expect products to speak to them, have keyboards and remote controls, and provide programmable customization.

Rapid Response is the second major driving force we will discuss. By itself this can be a formidable competitive advantage - the ability to respond quickly to competitive threat and to market opportunity. Looked at with a backdrop of continuous change, however, it becomes part of a cycle that provides a new set of market dynamics.

A great deal of current activity in industry is focused on reducing cycle times: moving customer desires and product ideas into product deliveries faster. When a competitor becomes better at this it is necessary to improve quickly or find yourself with late market entries, shrinking market share, and lost leadership. In an age of continuous and rapid change, rapid response by your competition will drive you out of business in only a few cycles if you too cannot respond rapidly.

An important question arises: are we moving into an age where we will be constantly responding to threats? Will the growing global competitive arena

throw new ideas, new competitors, new technologies, and new customer demands at us from new places faster than we can anticipate? In an age of continuous and unrelenting change, rapid response must be a core competency and not just a stroke of good-luck or herculean effort.

Must we be buffeted by unexpected change, or is it possible to thrive in this emerging competitive arena? More to the point, is it possible to exist at all if one is responding with effort rather than with ease? Competition based on rapid response is a predictable outcome of continuous and unrelenting change, and becomes a driving force itself when wielded by others.

An Evolving Definition of Quality is the third major driving force we will discuss. Japan is credited with the current world-wide emphasis on defect-free products. Acting on customer unhappiness over products that require excess maintenance, become useless too soon, or cost too much to own seems an obvious move today. While many USA companies are still mastering this capability, however, Japan has moved on to a new frontier: *miriyokuteki hinshitsu* - making products right so they delight the user and cause a positive emotional reaction. This second phase of quality employs subtle but impression-forming engineering decisions that create a personality and aura for the product that emotionally bonds the user.

All very well for today, but what about tomorrow when an equivalent product can be bought for half the price with twice the functionality and emotional enjoyment? In an age of continuous and unrelenting change the things we buy become obsolete too quickly. Even today, the new laptop computer I purchase is a disappointment before I take it on my first trip, the investment I made in CDs will have to be repeated in a few months for a smaller format, and the car I just bought really should have a passenger-side air bag now that they are available.

Basically, the things we buy are making us unhappy with them sooner and sooner. It is already becoming difficult in many product areas to feel value in proportion to cost. This is because the utility and value of a product in many cases is not inherent and static, but relative to alternative possibilities in a highly dynamic marketplace. The definition of quality continues to change like everything else. Life-cycle value becomes an important quality dimension when continuous change and rapid response alter our perceptions of the things we have just purchased.

Product design will probably deal with this third quality phase through a platform approach. New designs will provide field alterable products that can be changed or improved during the course of ownership. These may include concepts such as automobiles designed for constant upgrade of dashboard accessories, music recordings sold independent of temporary storage media, or extensible robots that will accept additional axis of motion.

It has already begun in the personal computer field with Tandon Corp's field upgradable models. In the USA, the Department of Defense is now demanding that weapons systems be designed to expect and facilitate constant sub-system upgrade. Texas Instruments has introduced a semi-conductor manufacturing concept with modular and reconfigurable processing stations.

It will not be long before successful companies will either have a short life or will have products and services that address life-cycle values in a continuous change environment. Thus, products as well as companies must be structured to thrive on change.

Environmental Responsibility is the fourth and final major driving force we will discuss. Today, corporate environmental activities are generally motivated by the regulatory actions of governments. Oil tanker construction, automobile engine emissions, container recycling, waste disposal, even toxic cleanup have required the intervention of governments before corporations are willing to apply resources or appreciate the consequences. This is changing quickly.

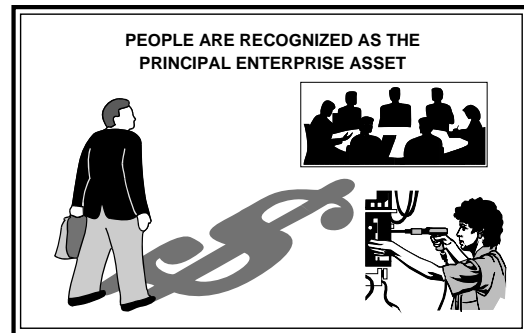
Just as I as a youngster blamed my parents and their peers for unleashing the fear of nuclear destruction on the human race, so my children blame my generation for polluting and depleting the natural resources we live in and on and with. How it happened and who's to blame is not the issue with them. They simply recognize that an unacceptable inheritance is being handed to them, and they must rectify it or live as lesser beings than their predecessors.

Today's youngsters are tomorrow's consumers and employees. Environment is an ethical and moral issue with them. They will not buy products from companies that are less than environmentally benign. They will not work for companies that contribute in any way to a deteriorating environment. The penalty of today's regulatory infraction is generally a fine and temporary. The

penalty in tomorrow's marketplace will be exile and permanent.

Major Concepts

The four driving forces we have discussed will be major shapers of successful companies. As a result, we can predict many of the characteristics that most of these successful companies will exhibit. We can't be sure about all companies, nor about all characteristics; but a sufficient picture emerges to shed light on the underlying infrastructure that must be there to support this profile.



The left-most column in the opening table lists the successful enterprise's characteristics. The center column then lists the nine major areas where significant change must be introduced in most companies in order to develop these characteristics. The right-most area of the figure then lists the sub-elements of an underlying infrastructure that will support these nine enterprise areas. All of these are discussed in great detail in the two volume "21st Century Manufacturing Enterprise Strategy" report, and are not the subject matter of this article.

Here, we will discuss five major concepts that represent the core of the vision:

- The Agile Enterprise
- Factory America Net
- Human Assets
- Plug Compatible Companies
- Virtual Corporations

The Agile Enterprise is the concept that encompasses everything expressed in the vision, and captures the essence of the emerging enterprise paradigm. A rapid and continuously changing environment is the emerging competitive enterprise arena. The nature of eminent change in technology, markets, customer expect-

tations, and competitors is becoming impossible to predict.

Many companies will find themselves in a constant reaction state - buffeted by events they had not foreseen. They will be no match for the new competitor.

The new competitor will be the enterprise that thrives on continuous and rapid change. The principal characteristic of these successful enterprises will be agility - the ability to move fast in all ways. An agile company maintains leadership by constantly introducing improvements to its own markets, by instantly seizing unexpected opportunities, and with rapid response to unforeseen threats.

The principal impediments to change are structural in nature, and generally form the architecture of such "systems" as the organizational hierarchy, corporate decision making process, customer-company relationship, MIS software,

plant control software, process hardware flexibility, even business relationships and the process that develops them.

These systems must be structured to allow decisions at the point of knowledge, to encourage the flow of information, to foster concurrent cooperative activity, and to localize the side-effects of sub-system change.

FactoryAmerica Net is a concept that takes two of the strongest assets of the USA and marries them: the world's largest diversified supplier base and a ubiquitous information science infrastructure. This electronic network will link the manufacturing base of the USA just as the InterNet links the research community.

Though it is called Factory America Net (FAN) in the 21st Century Manufacturing Enterprise Strategy reports, there is nothing about the borders of the USA that will confine this capability.

There is simply a recognition that it will start in the USA and receive its largest subscription in the USA. In these days of multi-national corporations and satellite communications a resource of this type will quickly span all geographical boundaries.

The needs of business are different from those of the research community, of course, and will require many value-added services as well as very secure communications. For instance, FAN will offer concurrent engineering services well beyond simple connectivity and information exchange standards. These might include CAD file translators, interactive design group-ware, and simulation and analysis tools to just name a few that are already being considered at this writing.

Since partnering will be a frequent occurrence in the age of agility, we expect to see services that help find and evaluate potential partners as well as work with them once a team is formed. Much like we use Dunn & Bradstreet services today to evaluate the financial stability of potential clients, we expect services that provide historical and rating information on a potential partner's integrity, their ability to work collaboratively, their track record on meeting commitments, their frequency of repeat partnering, the frequency of partner disputes, etc.

The ink wasn't even dry on the reports before the MCC (Microcomputer and Electronic Technology Corporation) consortia introduced a project called EINet (Enterprise Integration Network) with similar scope and focus. As the major industrial consortia in the microcomputer and electronics area in the USA this was a natural starting point. NCMS (National Center for Manufacturing Sciences) and SEMATECH, the other two major industrial consortia in the USA, have now joined MCC in this endeavor, and collectively represent over 200 manufacturers. Still in a very early stage of definition, this combined effort is taking shape much faster than envisioned by those who only a year earlier had identified this key infrastructural element.

Human Assets recognized as a key value of the corporation is the third major concept we will discuss. When continuous and unrelenting change in all aspects and every level of corporate activity is the norm, a corporation will be faced with a never-ending requirement to evaluate the impact of new technologies and new methods. The accuracy of these evaluations and the speed of incorporating new advantages in the work environment will determine corporate viability.



Corporations don't do these evaluations, people do. A person's ability to evaluate objectively and accurately will be determined by their currency in the area. A person's ability to utilize and deploy a new technology quickly will also be determined by their currency in the area. Currency will be maintained by an ongoing active corporate investment in the personal knowledge-base of each employee.

Once, corporations viewed employee education as an employee benefit. Some have already recognized that their core competencies rely on a continuous training investment. Soon, the financial community will demand a way to see and measure the maintenance of this asset in order to judge long term viability.

There is also the effect of "empowerment" to deal with. An agile corporation must make decisions quickly. Whether decisions are made by people or programmed machines one thing is true, they can only be made quickly and accurately if they are made at the point of maximum information. Consequently, where people are involved, truly agile enterprises will push most of the decision making process down to the lowest employee ranks, where the work is actually done. This requires that the investment in continuous training be broadly based across the corporation's entire scope of human resources.

Plug Compatible Companies are a concept very similar to plug compatible component stereo systems. When opportunities come and go so fast that companies either partner with others or get left behind, the efficiency of working with others and the time it takes to actually get started become extremely important.

Early stage activities in this direction have started with EDI (Electronic Data Interchange), and most notably include DoD's CALS (Computer Aided Logistics and Supply) initiative in the USA. These programs to standardize the transactions of electronic commerce will be augmented to include standardized engineering and manufacturing transactions among a community of suppliers and business partners. All of these approaches are, however, aimed at streamlining the traditional interactions of businesses.

In the agile age, companies will maintain maximum

fluidity with a core set of employees that are augmented with expertise and resources from speciality and surge resource companies as and when required. Empowered work teams will be formed with employees from diverse parts of an organization, with employees from partnering organizations, and with employees from these specialty and surge resource companies. New forms of plug-compatibility will be developed to streamline the work-team formation and operation in the areas of work methods, employee compensation, team structures, accounting and reporting, and proprietary confidentiality.

Virtual Corporations are the fifth and final concept we will discuss. Think of them as a "pick-up" team of just the right resources for a compelling opportunity. The virtual corporation is a temporal entity that is created in response to an opportunity and is dissolved when the entity is no longer useful. It may be composed of people gathered from various parts of a large organization or It may include people from many different organizations.

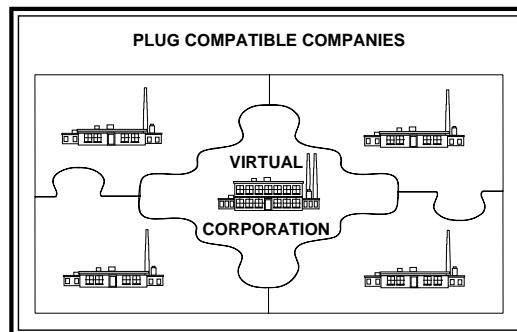
It is an operating concept that is facilitated by plug compatibility and Factory America Net, allowing the virtual corporation to form quickly and operate effectively even when distributed among many physical locations. It is compelled by the need to respond immediately to opportunities and threats with resources that come from many places. As a phrase, the virtual corporation captures the notion of a corporate division formed and dissolved with the same ease that a functional work team is assembled and later dispersed.

Change Is Here To Stay

Things keep happening faster and faster. The technology alternatives we have for our products and our manufacturing processes continues to grow at an increasing rate. In some markets this already means a product bought six weeks ago costs more than a better featured product available today. Soon this will mean that a factory

built last quarter cannot compete in cost and quality with a factory built next quarter.

Though globalization of markets is still in its infancy, we are moving rapidly from a barely industrialized world to one where an improved standard of living is becoming the focus. The



Eastern Bloc and China offer two new and immense potential markets. But they are also adding significant competition into the global marketplace.

Agile companies will be asking questions that illuminate the impediments to change: How fast can you restructure a plant for new product? Can you safely improve your process control software on a daily basis? How many signatures are required to approve a product idea? How long does it take from concept to product delivery? How often do you partner with others? How long does it take to hammer-out a partnership arrangement. How much is invested in employee growth?

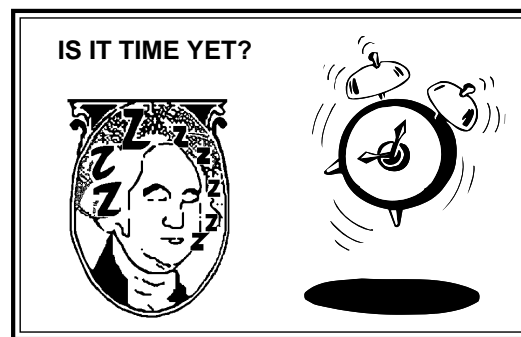
In an age of continuous and unrelenting change it becomes impossible to anticipate even a small fraction of the potential challenges, opportunities and threats that a company will face. Enterprises that succeed will be those that master broken-field running, that are capable of changing course quickly and economically, and that systematically adopt strategies and build infrastructure for thriving in an unpredictable environment.

Recently we have seen manufacturing understandings move from a "push" orientation, where

product technology drives what the customer is offered, to one we now call "pull", where we ask the customer what he wants. The coming paradigm of agile response will accelerate pull to the point of "yank".

Because the agile enterprise paradigm requires individual initiative and decision making in the broadest form, there are some who think that it may be better suited to the cultural environment of the USA than elsewhere.

But that remains to be seen.



References:

- 1) 21st Century Manufacturing Enterprise Strategy, An Industry-Led View, Volume 1, November, 1991, Iacocca Institute, Lehigh University, 200 W. Packer Ave., Bethlehem, PA, USA, 215-758-5510.
- 2) 21st Century Manufacturing Enterprise Strategy, Infrastructure, Volume 2, November, 1991, Iacocca Institute, Lehigh University, 200 W. Packer Ave., Bethlehem, PA, USA, 215-758-5510.