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BEST AGILE PRACTICE REFERENCE BASE - 1994: **CHALLENGE MODELS AND BENCHMARKS**

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Abstract

The Agility Forum's Best Agile Practice Reference Base began in 1994, and is an ongoing project to build a data base of Agility reference models in a variety of important business areas. It is the first attempt to utilize a qualification procedure and metric framework to identify practices in industry as being Agile. This document is meant as a companion to the reference base, guiding the user with background tutorial material that discusses the reference base concept, the definition of Agility, structure that enables Agility, metric qualification framework, a qualifying taxonomy of change, early emergent patterns, and the reference base reporting format.

Introduction

The Best Agile Practice Reference Base is an ongoing project to build a data base of Agility reference models in a variety of important business areas. It is the first attempt to utilize a qualification procedure and metric framework to identify practices in industry as being Agile. Though the initial phase in 1994 has not had the rigor that mature benchmarking processes impose, the activity has followed a consistent practice of investigation, qualification, and documentation, and does provide useful quantitative and qualitative case-to-case comparisons.

This document is meant as a companion to the reference base, guiding the user with background tutorial material that discusses the reference base concept, the definition of Agility, structure that enables Agility, metric qualification framework, a qualifying taxonomy of change, early emergent patterns, and the reference base reporting format.

The initial phase of the project lasted five months, beginning in mid-September of 1994 and continuing through final case documentation in mid-February 1995. Six teams of participants in the Agility Forum's focus groups investigated six different areas important to business Agility: people issues, legal issues, virtual enterprise, process and equipment, information and control, and product realization.

Team leaders were engaged to guide the teams of volunteers, ensure a common process, and bring the initial phase to documented closure in February. All told there were approximately 150 team people involved in the efforts to define, find, evaluate, and qualify the 80+ case examples in the initial phase. Almost all cases were investigated on-site face-to-face.

In times past a project like this would not publish such early results. Agility and its benchmarking has no history, no established metrics, no commonly-understood business modes, and no enterprise reference models. This project is feeling its way through a process that is being designed and refined as it goes. Everyone involved with the effort feels vulnerable in its early exposure -- they know it's not comprehensive, they know the initial reference base does not contain "best" Agile practices (just good ones), they know the initial case reports have inconsistencies and omissions; and they know how more time would have improved all of this. But they also know that there are lessons and values in what's been done already, and that these can be leveraged and utilized immediately if they are broadly accessible.

The reference base of case examples will continue to grow; this publication point is only a snap shot of the initial entries. At publication time in February '95 all teams had additional cases scheduled and in process that will find their way into the reference base eventually. In the meantime, it is hoped that the initial reference base will act as a challenge model; causing other companies to come forward with cases they believe to be even more Agile.

Reference Base Concept

It is painfully obvious that there are no role models for the Agile enterprise. Some companies are clearly better than others at short-cycle product realization, some are quicker to outsource and partner, some excel at low-volume, high-variety production, some have harnessed the commitment and involvement of empowered teams, others have instilled customer responsiveness in every employee -- but none have put it all together in a pre-emptive operating strategy.

Chrysler's platform teams have moved them to the front of their industry, Motorola's leverage on people gives them a clear advantage in their markets, and Hewlett Packard's first-to-market capability gets the highest margins among their competitors.

Each of these companies has pioneered new operating capabilities with powerful results. Competitive success has come from leveraging these unique operating capabilities with well chosen market strategies.

But we sit at the beginning of a new business era driven by decreasing innovation cycles and increasing globalism. One where continuous and unpredictable change are the emerging dominant forces. In these early days a few companies have found a few ways to put them in front of the pack; but none are masters of change.

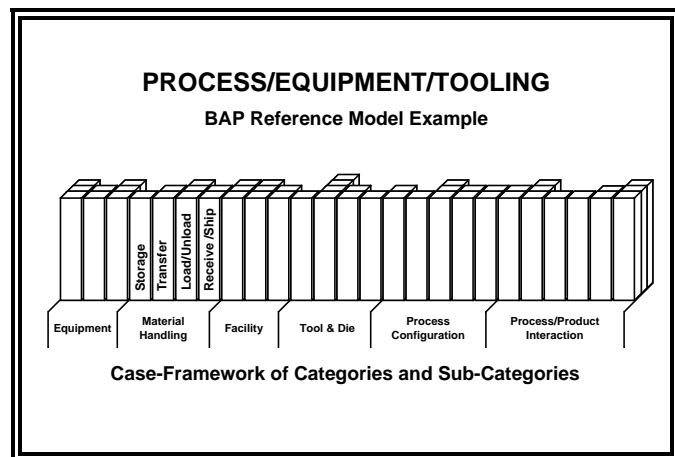
The Agile enterprise by definition is the one that will thrive in this new unpredictable and uncontrollable environment. Business is an experimental science. We learn what works by examining the survivors. To write the construction manual we can simply wait a decade or two and then catalog the operating procedures of those that are left standing -- or we can examine the pieces that already exist now, extract some principles, and try to fill in the missing parts. This is unprecedented, but so are the times. It's a choice between natural selection and genetic intervention. But before we can manipulate the genome of business we must map it first.

This mapping process began at the Forum with cornerstone reference models defined in 3rd quarter of '94, and initial case investigations completed in the 1st quarter of '95. Industry already has experience with benchmarking and best-manufacturing-practices survey work. BAP (Best Agile Practice) reference models focus on Agile concepts only, using proficiency across eight change domains as the qualifier.

It's one thing to gather pieces of best performance practice from a diversity of operating environments, and another to ask that they all occur in the same operation. Some will be mutually exclusive, others will have coupled interactions. A more important combinatorial understanding is to know that putting a number of Agile practices together in one place will not necessarily result in an Agile enterprise. It is not the intention that this reference base be viewed as the bricks from which Agile enterprise is made, though many will indeed be found here.

These reference models are defined by the Forum's focus group participants. Specialist for each model were engaged by the Forum to take responsibility for process completion and documentation. Focus group participants assisted in the benchmarking exercises. The expectation by many is that these models or portions of them will offer deployable ideas for immediate benefit as well as for subsequent analysis to extract Agile enabling principles.

Modeling all of the key practices needed for the Agile enterprise will be a large effort, and will not be done all at once. Initial models started in '94 were chosen for their immediate value to the participating focus group members. Any reader disappointed in not finding practices of personal value in



the reference base as yet can change this fact by joining the effort. As one newscaster in California used to say in his sign off - "If you don't like the news, go out and make some of your own".

The initial Best Agile Practice reference models are:

- q Agile Virtual Enterprise.
- q Agile People (partial).
- q Agile Process and Equipment (partial).
- q Agile Information and Control Systems
- q Agile Business Practices - IPPD
- q Agile Contracting - Barriers

These reference models will be further developed in the following years, with an emphasis in 1995 on analysis; and will eventually (already in some cases) contain sufficient information and metrics to be used effectively as both business decision-making tools and as experimental implementation design strategies. In short, these reference models will provide a knowledge base for leadership guidance by showing what is possible and where the business values lie.

Best Agile Practice Qualified on Proficiency in Eight Agile Change Domains	
Creation	Build something new.
Capacity Fluctuation	Increase/decrease existing capability.
Capability Fluctuation	Add/delete capability types.
Reconfiguration	Change relationships among functional modules.
Migration	Event-based change of fundamental concepts.
Performance Response	Real-time operating surprise.
Improvement	Continuous, incremental upgrade.
Recovery	Reincorporate corrected failures or alternatives.

Definition of Agility

The Agile manufacturing concept is gaining considerable interest, even though it is hidden in a mass of confusing explanations and interpretations.

Agile is a very seductive word. One that finds immediate and personal definition for almost everyone. It can capture cycle time reduction -- with everything faster. It can encompass mass customization -- with customer responsiveness. It can embrace virtual enterprise -- with streamlined supplier networks and joint ventures. It can echo reengineering -- with continual process transformation. It can demand a learning organization -- with systemic training and education. It can build on Lean production -- with high resource productivity.

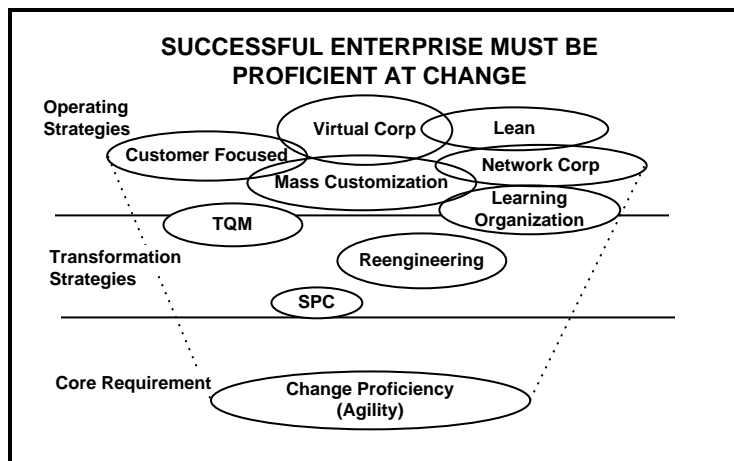
As a descriptive word, Agility can embrace almost any of our current competitiveness interests with considerable intuitive appeal.

Agility is presented by some as an amplification of one of these concepts, and by some others as a superset of many. Casual investigation of Agility can easily lead to greater fuzziness as a greater number of sources are heard from.

Confusion is evidenced in many ways. Some people ask for the difference between Agile and Lean, Agile and TQM, Agile and Mass Customization. Others say that Agility is their next priority after completing their transformation to Lean production, or whatever else they are currently embarked upon.

It is time to crystallize the understanding of this very useful and important concept.

Agility was born in 1991 when an industry group observed that the increasing rate of change in the business environment was outpacing the adaptability of traditional manufacturing organizations. Dominant organizations were suddenly failing when continuously changing markets and customer interests found new sources of satisfaction.



Though some of these organizations were simply late to wake up, many could see a need but were unable to institute internal change quickly enough.

Agility is the word that describes the missing characteristic in these organizations. They could not adapt at the same pace as their changing environment -- neither to counter a threat nor take advantage of a major opportunity.

This adaptability idea for organizations is not anything new, however. Organizations have always existed in a changing environment and have always had to adapt -- ever since the first humans banded together for purpose.

Organizational adaptability is a core viability requirement -- just like profitability. In order to continue as a viable entity an organization must meet two conditions for existence: it must satisfy some purpose (profitability) and it must continuously adapt as necessary to changing environmental conditions. When either of these conditions is not met the organization is threatened with extinction. In this sense an organization is just like an organism - both lead a transitory life in a hostile environment that requires the consumption of energy and constant vigilance.

In the life metaphor we talk about evolution and mutation as ways to accommodate a changing environment. We look for the mechanics of this characteristic in the genome of life. Equivalently in the organization we must look to see how the organization is organized -- both statically and dynamically.

To mix metaphors, Agility is a plumbing issue first and foremost. Operating strategies like lean production, and transformation strategies like process reengineering are all facilitated by an underlying proficiency at change. If the organization is "proficient" at change it can and will adapt to take advantage of unpredictable opportunity as well as counter the unpredictable threat.

Being Agile means being proficient at change -- and allows an organization to do anything it wants to do whenever it wants to. Thus, an Agile organization can employ business process reengineering as a core competency when transformation is called for. It can hasten its conversion to Lean production while that is still useful. And importantly, it can continue to succeed when constant innovation becomes the dominate competitive strategy.

Trying to differentiate mass customization or Lean from Agile miscasts all as operating strategies. And asking for the differences between TQM and Agile misclasses both as transformation strategies.

Holding off Agile programs until a transformation to Lean production is completed incorrectly assumes that these are sequentially dependent concepts. Rather than close the barn door after the horse has left, a transformation to Lean production will happen faster and with less expense as the organization becomes more Agile.

Agility is a core fundamental requirement for all organizations. It was not interesting as a focused concept when the business environment changed slowly and predictably. Now it gains considerable attention and a growing number of proponents.

Confusion in this early stage of understanding is introduced principally from two sources: indiscriminate use of the word to promote narrowly related technologies, and a seductive focus on the business strategic advantages and manifestations. The nature and reality of an Agile organization is determined by how it is organized -- it is a systems and structural issue.

Structures that Enable Agility

Adaptability in a living organism is built into its genes and expressed in a system of separate interacting organs. Adaptability in a living organization is also determined in its plumbing.

Though Agility is a broad enterprise issue, looking at the production impact of product realization will provide some fundamental insights into these plumbing issues that can be generalized later.

Decreasing innovation cycles in all market sectors are increasing the product introduction frequency. The process of bringing new or improved products to market involves changes in the production area. Whether these changes are fairly small or quite sweeping, there is usually a transition period of adjustment and settling-in.

During this transition period two principle sources of turmoil are at work: 1) as changed items are put to the test of actual use, some fine-tuning is required before they satisfy their purpose, and 2) the interaction of the changed item with its environment has some undesirable side affects that need to be resolved.

Change is spoken of here in the total production-environment sense. Thus, it is not limited to the modification of some item that exists, but includes both the addition of something new and the elimination of something old, as these too are changes in the total production environment.

Simply stated, after a change is designed, built, and installed, there is a transition period that must be dealt with before we have what we want, or decide to settle for what we have. In the Agile ideal we strive for, this transition period takes no time, incurs no cost, is not artificially terminated, and is not an inhibiting factor on the latitude of change we are willing to consider.

A closer look is revealing. Introducing a new product requires that the production environment be changed. Making this change incurs cost and takes time. Some of this cost and time is pure design, acquisition, and development; and some is transition turmoil from integration and shakeout.

In the past these changes occurred infrequently and the transition costs were easy to ignore. But product introduction frequency in all markets continues to rise, and in many markets has already passed the point where continued ignorance of transition cost and time is tolerable.

A new machine or production cell introduced into the production environment requires shakeout of the machine itself, integration of the machine into its interactive environment, operator training, maintenance training, and service training, to name the easy parts of the turmoil. Then we have the operational idiosyncrasies and failure modes that get learned the hard way with surprises and experience.

This discussion has been about production machinery so far; but everything said applies to changes of any type: new procedures, new personnel, different personnel, introduction of teaming concepts, a change in work instructions, etc. All incur a transition period of integration and fine-tuning before the turmoil is settled.

And the toll of the transition period for each of these changes affects product cost, product quality, and market responsiveness.

An obvious way to reduce the toll of transition is to reduce the quantity of things in transition. If we want to do this while accommodating more new product than ever before, we have to learn how to build new product with old proven process -- reusable process, reconfigurable for a new purpose.

Reusability and reconfigurableness are construction concepts -- they have to do with the way things are built -- no matter whether these things are manufacturing cells, work procedures, supplier networks, business relationships, production teams, or information automation systems.

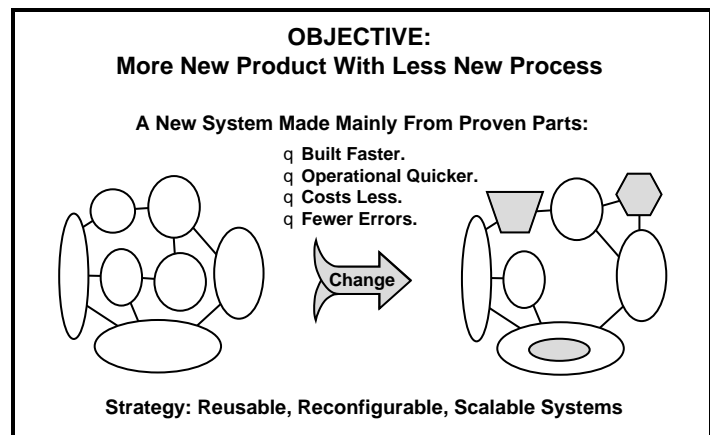
To bring a new or improved product to market we want to introduce as little new process as possible. For instance, instead of designing and building a completely new welding cell we might duplicate and modify an existing well-understood cell. This cell will surely have some new elements in it to accommodate the variations of the new product, but a good bit of the cell will be time tested and familiar. It may not be as technically appealing as a completely new design -- but it will be up and running a lot faster, a lot cheaper, with less scrap and rework, and more predictably.

This does not mean an end to capital investment or a continuous cannibalism of used equipment. It means an important new focus on the structure of the production elements which must be reconfigurable. And it is physical reconfigurableness we need, not programmed reconfigurableness. We need the ability to make unanticipated new things from reusable pieces, not simply select some predefined subset of flexible capability or imbedded options.

Reconfigurable structures, whether they organize sub-units in a piece of equipment, equipment relationships in a cell, cell relationships in a production area, or production areas in a plant require some form of module reusability.

For maximum change proficiency these structures must be scalable as well as reconfigurable and reusable. Scalability eliminates size restrictions imposed by the structure, allowing any number of reusable modules to be included or omitted as desired.

Our objective of change proficiency has led us to an "RRS" organizational strategy of reconfigurable, reusable, scalable systems.



Metric Qualification Framework

The Agile enterprise is defined as one that is proficient at change, and Agility defined as change proficiency. Very interesting word, this proficiency -- Webster says it means "highly competent".

Competency is one of those umbrella words often used to encompass qualities that are hard to quantify. Nevertheless, a practical measure of Agility is needed before we can talk meaningfully about getting more of it, or even getting some of it.

Naive discussions of Agility often confuse it with quickness -- which reduces simply to cycle-time reduction. Time, as the metric for Agility, shows its inadequacy when we test it and other candidates against extreme conditions.

Would you call it Agile if a short-notice change was completed in the time required, but at a cost that eventually bankrupted the company? Or if the changed environment thereafter required the special wizardry and constant attention of a specific employee to keep it operational? Is it Agile if the change is virtually free and painless, but out-of-synch with market opportunity timing? Is it Agile if it can readily accommodate a broad latitude of change that is no longer needed, or too narrow for the latest tricks thrown at us by the business environment?

These questions help us tease apart this thing called Agility into four change-proficiency metrics: cost, time, robustness, and scope. Exploring the interrelations of these four shows a need to score sufficiently well in each.

You can change virtually anything if **cost** is no object. However, if your cost of change is too much relative to your competitor's costs, there will be a steady erosion of working capital, or at least a higher tax on shareholder profits. Change at any cost is not viable, else we need not restructure anything ever - we can simply throw out the old and buy a new capability; assuming, of course, that we can bring something new to the operational level quick enough.

But the cost of change alone does not provide a metric for agility. Completing a change in a timely manner is the only effective way to respond at all. Thus, **time** of change becomes an equally important factor, especially in an environment of continuous and unrelenting change. After all, we do need some time in-between changes for a little value-added work.

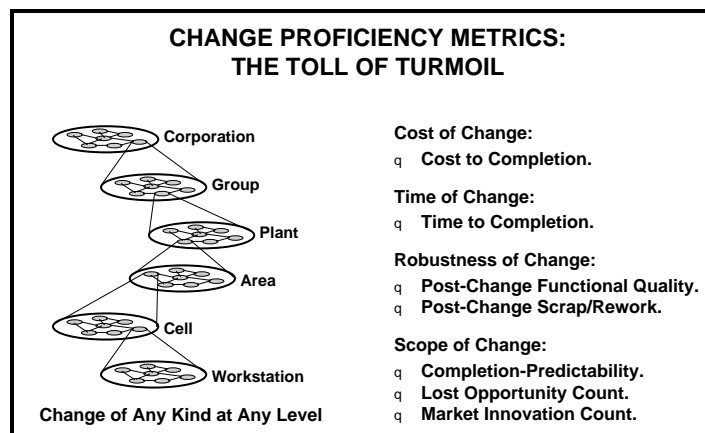
Quick, economical change, however, is still not a sufficient profile for proficiency. If after a change the result is balanced on the head of a pin and requires 24-hour-a-day baby-sitting to remain functional, the change process was insufficiently **robust**. If we cut corners in the process of changing in order to do it quickly and economically, we end up with a fragile, spit-and-bailing-wire result.

Finally, something is considered Agile precisely because it is prepared to thrive on unpredictable change. This unpredictability might be with when a known change will occur, or with what an unknown change will look like. Change is a transitional term that implies a starting point and some new ending point. How far away can the ending point be from the starting point? The dimension of **scope** addresses this question. Are we Agile if we can accommodate any change that comes our way so long as it is within 10% of where we already are?

Scope is the principal difference between flexibility and agility. Flexibility is that characteristic you fix at specification time. It is the planned response to anticipated contingencies. Agility, on the other hand, repositions the fundamental approach in order to minimize the inhibitions to change in any direction. The frequency and unpredictable nature of required change has reached the point where contingency lists are outdated virtually as soon as the ink dries.

At the heart of scope is the architectural issue: rather than build something that anticipates a defined range of requirements, or ten or twelve contingencies, build it so it can be deconstructed and reconstructed as needed. Build it with a reconfigurable, reusable, scalable design strategy.

Scope captures so much of the essence of Agility that it would appear to be the principle differentiation of this concept from others, and be a sufficient metric for change proficiency. But we must remember that scope is only a statement about the magnitude of change that can be



accommodated. The amount of change that can be accommodated is useless if it can't be done in time to matter, at a cost that is reasonable, and with a surety of robustness.

Thus, for any element to be truly proficient at change, it must have a balanced capability across all four metrics of cost, time, robustness, and scope.

To measure proficiency at change we need quantified statements for each of the four proficiency metrics. Ideally, in order to analyze existing situations, we want to find quantities that are already in our books, or can be constructed from historical records.

The cost of a change can be likened to the cost-to-market of a new product. In this case we are talking about the change activity associated with creating a new cash-generating customer transaction. Cost-to-market is that cost associated with product and process design and implementation that results in a deliverable cash transaction with a customer.

Similarly, time-to-market of a change is the elapsed time required for completion; or in our new product example, that first cash transaction.

Continuing with our new product metaphor, though new products may be rolling off the line, we all know that neither the product nor the process design is rock solid in the early days of delivery. There is some rework and scrap beyond our desired levels. During this early period we are generally incurring a scrap and rework rate higher than our targets, and haven't yet hit our quality levels.

The time it takes us to hit our quality targets is a direct measure of the robustness of our change activity. Robustness basically measures the strength and competency of our change process.

Finally, we want some indication of how much latitude for change we can competently accommodate. If it is too little, we are perhaps just flexible and have not really entered the realm of Agility. Scope is difficult to measure precisely as you never know where the edges really are - but you do know when you attempt something that falls outside - just as you do know when you successfully complete something comfortably.

A good indicator for scope can be found in our ability to predict the completion of a change activity. How often have we been on time, on budget, on spec? Or at least within acceptable variances of our original predictions. If we are generally correct then we are fielding all of the changes fairly well and must be doing so within the scope of our capabilities. If we are generally wrong then we are probably working outside our envelop most of the time and brute forcing the results. Of course, we might have a good predictability record simply because we pass over anything that looks too difficult. To counter this effect we should also measure "opportunities lost" and "innovations".

Lost opportunities are those occasions when a change could have provided some useful advantage but was declined. Opportunities are presented to producers by prospective customers. An opportunity must fit within the producer's vision and mission to qualify as an opportunity. A refusal to go after the opportunity is akin to a no-bid. Going after the opportunity and failing to secure it is basically a bad-bid, and is considered equivalent to a no-bid, as the producer is unable to capitalize on the opportunity.

Opportunities exist independent of any action or recognition on the part of the producer - resulting in a growing score of bad points for any producer who simply ignores or is deaf to the realities of the market. Thus, opportunities require successful response or extract a point payment.

An innovation is a self-initiated change on the part of a producer, and is presented to the customer. It might be in the form of a new product, a lower cost product, a higher quality product, or a faster product. Some innovations are bigger than others - a 20% cost reduction is twice as big as a 10% cost reduction. The customer provides the "innovation points" according to how innovative they feel it is. There is no incentive to leak out three successive innovations that are equivalent to one leaping innovation which encompasses all three if somewhere in the succession a competitor establishes a new benchmark. Catching up is not innovation - and should score as negative innovation points.

Making use of these metrics in practical situations requires the establishment of a set of accounting rules appropriate to the enterprise, to the organizational level within the enterprise, and to the nature of the functional unit that is being measured.

This general metric framework is applicable to workstation changes just as it is to new product introductions at the corporate level. A workstation is a producer with a customer up the line in the production area. When the workstation accepts an opportunity to make a change it will have a time- and cost-to-market for that change, and will exhibit the robustness of the change when it begins production again.

This metric framework is equally useful for things outside the production hardware category. A team of people defined by their collective task interest will undergo a change when they agree to accept a new team member with additional skills. There will be a period of turmoil as this new team member and skill

set is absorbed and put to productive use. The Agility of an organization's teaming methods will figure importantly in its overall viability, but this is a subject for considerable discussion later.

As Agility increases, the turmoil caused by change-transition decreases, approaching an ideal where it takes no time, incurs no cost, is not artificially terminated, and is not an inhibiting factor on the latitude of opportunity and innovation we are willing to consider. Developing metrics for change proficiency has led right back to the key performance metrics of any corporation: the toll of change-transition is directly reflected in product cost, product quality, and market responsiveness.

Now that we have a measure for change proficiency, we can ask about the varieties of change important for Agility.

A Qualifying Taxonomy of Change

Downsizing and reengineering are two of the more visible and unpleasant examples of change in today's environment. Unpleasant because they are painful, cost too much, take too long, and the results are often disappointing. Though there is a lot of both going on, there is very little proficiency at either being shown.

This lack of proficiency is equally true in many more types of current change activities. Here, we will introduce a classification for types of change that will help us benchmark proficient practices. We will do this by looking at a few examples to develop a working model of change and its currency. In the process, we will see that Agility has significant advantages today, and is not a paradigm restricted to the custom configured products of tomorrow.

The current wave of downsizing is a technical adjustment that recognizes a decade or two of productivity gains; but that doesn't mean it won't happen again. On the contrary, fluctuations in a company's workforce **capacity**, both up and down, will be more frequent under Lean operating strategies as demand for any one product fluctuates. And demand fluctuation is on the increase -- old market drivers of seasonality and economic cycle are joined with new market-share drivers of technological obsolescence and customer opportunism.

Meeting production demand variation is another major issue today, whether we are talking about short term surge **capacity** or the ability to track longer term market demand changes. In the auto industry, for example, a high fixed break-even point for a car plant is an example of a downside barrier to **capacity** change, and the inability of one plant to make another plant's product is an upside barrier.

Business reengineering is another high profile change activity with poor general proficiency. Recent studies indicate that about 20% of these activities achieve desired ends, even though billions of dollars are involved on a national scale. Generally a company that is unsuccessful with a reengineering project will try again, and again, until it gets it right. Studies explain that this is part of the learning process; but the principle lesson seems to be that you can't stop until you're done, whereas a better lesson is the knowledge that you are never done. Unfortunately, companies feel successful when they have **migrated**

from an old mode of operation to a new entrenched position.

Organizational learning is another vital but elusive capability today. It is the mechanism that develops new core competency. The knowledge base that is the substance of core competency is vulnerable to both personnel loss and rapid obsolescence. Captured and constantly renewed, an effective knowledge base will steadily **migrate** the organization's core competencies in synch with changing technologies.

Production changeover is a current issue in most industries. Major auto companies are moving from an 8-12 week plant shut-down for retooling to a targeted 1-3 week cycle over the next few years, driven by competitors who are already there. Semiconductor manufacturers with

AGILITY	CURRENT CHALLENGES
<p>The Ability of an Organization</p> <p>to</p> <p>Adapt Proficiently (Thrive)</p> <p>in a</p> <p>Continuously Changing,</p> <p>Unpredictable</p> <p>Business Environment.</p>	<p>Product Realization</p> <p>Contract Agreement</p> <p>Staff Up/Downsizing</p> <p>Technology Diffusion</p> <p>Expedited Production</p> <p>Skill and Tool Training</p> <p>Demand/Surge Tracking</p> <p>Organizational Learning</p> <p>Production Changeover</p> <p>Computer Virus Cleanup</p> <p>Small-Lot Manufacturing</p> <p>Business Reengineering</p> <p>New Process Installation</p> <p>Continuous Improvement</p> <p>Software System Upgrade</p> <p>Process/Equipment Failure</p>

a higher frequency of new model introductions are trying to squeeze small prototype runs through their production facilities with minimal disruption to the revenue stream. Defense manufacturers often win or lose contracts on the basis of changeover costs and times. In its best form, changeover is a **reconfiguration** issue; taking existing resources and configuring them differently for a different purpose.

We can look at technology diffusion within an organization as another **reconfiguration** issue. Examples of proven process and product advantages that never get leveraged company-wide abound -- too much hand-wringing and discussion but little else.

Virtually all companies talk about training and continuous learning -- some are even doing a little. The value of serious skill training is even evident in white collar ranks, where office automation, decision support, and engineering tools offer new productivity advantages each year. Most companies are doing better at training than they were before they started talking about it, but few will claim proficiency. Serious difficulties are arising in production equipment maintenance where technologies change faster than service knowledge. Though some training is simply improvement of existing skills, most adds new **capability**.

Adding a new **capability** in production is another key current issue, and generally involves the installation and commissioning of a new piece of production equipment, as well as the integration of that equipment into a larger production system. And all of it done while an impatient market waits. With increasing complexity from technology and integration effects, seamless equipment insertion is becoming more difficult and more necessary at the same time.

At this point we have discussed eight major Agility issues that companies wrestle with today. They are issues precisely because there is big money involved and competitive positioning at stake. They are Agile issues because they are change-based. In this discussion these eight examples have been used to emphasize four inherently different types of change: **Capacity Fluctuation, Capability Fluctuation, Reconfiguration, and Migration**. There are an additional four types of change that we find useful to distinguish, which we call: **Creation, Performance Response, Improvement, and Recovery**.

Creating a contract that defines and fosters a functioning business relationship is a hot issue today. Contract procedures and negotiations that outlive opportunity windows, inhibit opportunity consideration, or consume resources without value have been recognized as pernicious for some time now.

The process of **creating** a product is receiving the lion's share of attention in most industries today. Concurrent engineering has given way to "product realization", which encompasses the entire concept-to-cash process. This area gains in importance as the competitive focus moves from cost to innovation.

High variety, small-lot manufacturing and mass customization are issues popularly associated with Agility. Both are examples of real-time change-proficiency during the **performance** of production operations. Expedited production orders are another example of change during the performance of the production operation. Though all are major issues in defense industries where small quantity and job-shop practices prevail, mass producers are valuing the advantages of proficiency in the **performance-time** change area as well.

Continuous **improvement** seems at first blush to belong to the concerns of Lean manufacturing; but the principles of Agile systems enable and facilitate continuous improvement rather than simply mandating it.

Software is taking an increasing role in the operation of our factories and the infrastructure of the company - yet making a simple upgrade or **improvement** is postponed as long as possible -- unpredictable disruption to service is all too inevitable.

Increasing process and equipment complexity along with increasing productivity has put a spotlight on the issue of process and equipment failure **recovery**. Perhaps a more crippling recovery issue, however, is the nightmare of computer virus.

EXAMPLE	TYPE OF CHANGE
Product Realization Contract Agreement	Creation: Make (or eliminate) something.
Staff Up/Downsizing Demand/Surge Tracking	Capacity Fluctuation: Increase/decrease existing capability.
Skill and Tool Training New Process Installation	Capability Fluctuation: Add/subtract unique capability.
Technology Diffusion Production Changeover	Reconfiguration: Change resource relationships.
Organizational Learning Business Reengineering	Migration: Major fundamental change.
Expedited Production Small-Lot Manufacturing	Performance Response: Real-time operating change.
Continuous Improvement Software System Upgrade	Improvement: Minor incremental change.
Computer Virus Cleanup Process/Equipment Failure	Recovery: Rectify dysfunctional resource.

FRAMEWORK FOR ANALYZING CHANGE PROFICIENCY

The sixteen current challenges that exemplify the eight change types are not meant to be comprehensive -- but look at the list in the figure and guess how much money and time in your company are devoted to the issues shown. Ask yourself how much of your company's competitive position is defined in that list. And ask how proficient your company is at each of these challenges. Agility is today's priority.

Early Emergent Patterns

Remember the child's round-peg, square-hole hammer toy? It had a framework with 6 or 8 uniquely shaped holes and a set of individually shaped wooden pegs. The trick was to integrate each of the pegs into a completed system by finding its uniquely compatible hole. These toys taught us valuable lessons about compatibility.

A more valuable lesson might have been about incompatibility, however. The framework had a fixed number of holes that demanded filling. A missing peg rendered the system incomplete. Spare pegs could not be bought separately, and trying to replace a lost peg with one from a friend's set generally found a different peg geometry.

Contrast that system with the Legos that younger generations are growing up with. The framework has a simple repetition of identical sockets on a standard grid pattern, and can be extended indefinitely by simply attaching additional framework sheets together. The modules come in various simple forms, all with an identical socket structure. Macro-modules can be assembled from basic pieces and replicated as often as needed to build or expand complex systems quickly. Losing a few pieces is hardly noticeable. The framework is so simple that compatible modules from competitors are readily available with special characteristics and pricing advantages. And the observed useful lifetime of the reconfigurable Lego set far exceeds the peg-pounder.

Legos even eclipsed Erector Sets. Though you could build almost anything with an Erector set, without a framework every project was a custom construction effort that consumed too much time in the piece-interfacing activity.

A design strategy of reusable modules, reconfigurable within a scalable framework can engineer Agility into a wide variety of Agile systems. Framework and module are the two distinct key objects here, and reconfigurableness is the key desirable characteristic. Though this may be oversimplified for some, and too mechanistic for others, it is a useful way to begin examining our business Agility-engineering task.

The accompanying table shows a cross section of enterprise elements, and suggests how specific systems within these elements might be viewed as modules and frameworks. Simply looking at these systems as modules and frameworks does not make them Agile of course. From this viewpoint, however, we can engineer the nature of the modules and frameworks to give us the desired reconfigurableness.

Certain corporations in Japan have put these concepts to fruitful technical use. The "software factory" is

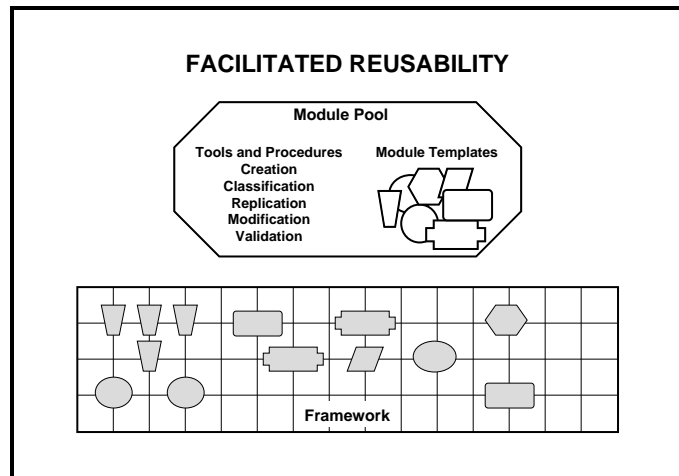
SAMPLE SYSTEMS VIEWED AS MODULES AND FRAMEWORKS				
Enterprise Element	Specific System	Case	Modules	Framework
Organization	Cross Functional Teams	Xerox*	Multi-Skilled Workers	Labor Contract
People	Learning	J. Doe	Skills	Prior Knowledge
Procedure	Dual-Use Accounting	Defense Contractor	Data Capture Software	MIS Legacy Wrapper
Information System	Order Entry	Rover*	Application Programs	Module Message Protocol
Control System	Adaptive Feedback	Saginaw Machine*	Sensors & Machines	Generic Machine Model
Plant Facility	Reconfigurable Factory	Texas Instruments*	Workstations	Physical Facility
Material Handling	Global JIT Production	Global Transpark	Planes/Trains/Ships/Trucks	Operating Contracts
Production Process	Flexible Machining	Saturn Corp*	LeBlond Makino Equipment	LeBlond Makino Standard
Production Equipment	Modular Fixtures	Watervleit*	Clamps/Components	Fixture Base Plate
Change-Over Process	Electronic Assembly	Solectron*	Assemblers/Machines	Culture/Info-System
Supply-Chain	Pre-Qualified Pool	Collins Avionics*	Component Suppliers	Qualification Program
Distribution-Chain	Brand Market	General Motors	Dealers/Customers	Product Positioning

*Case details contained in the 1994 Best Agile Practice Reference Base.

a Japanese approach to creating very large software systems in very short times, at very low costs, and with a remarkable lack of “bugs” (see Japan’s Software Factories: A Challenge to US Management, Michael A. Cusomano, Oxford Press, 1991). They do this by constructing new systems from previously used and proven modules that are readily drawn from a well-maintained pool. They have established a standard framework so that all modules are plug compatible. Though they have not employed object-oriented programming environments, they build their modules as stand-alone encapsulated units to minimize side-effects when modules are combined in new systems. Though American programmers scorn the approach as non-creative and lacking in elegance, the fact is that these “engineered” systems get up and running bug free to satisfy a need in a fraction of the cost and time of traditional hand crafted systems.

Closer to home, Sun Microsystems describes their corporate “strategy for change” based on five S’s: Small, Simple, Separable, Scalable, Stateless. Production Magazine’s January 1995 issue reports this on page 61 as: “When you do a project, do one that’s small and simple, one that has elements that can be removed and reused (i.e., separable) elsewhere (i.e., stateless) and expanded if necessary (i.e., scalable)”. Sun is described as a \$5-billion workstation manufacturer with 95% of its revenues from products less than 18 months old, with a 30% change in production techniques annually.

It should come as no surprise that Agile operating modes are beginning to emerge informally from many companies in the high-flux industries of electronics and software. As we try to formalize these understandings we look across all industries for emerging patterns like the RRS strategy, and we analyze these patterns for their contributions to change proficiency.



We recognize a need for change proficiently in a variety of ways -- all of which we loosely call reconfigurableness: increase in capacity (e.g. add more modules), increase in capability (e.g. add different modules), continuous improvement (e.g. modify a module), migration to a different operational foundation (e.g. modify the framework), creation of new capability (e.g. develop a new module type), reconfiguration of relationships (e.g. change the groupings of modules that interact directly with each other), recovery from a module dysfunction (e.g. reconfigure module relationships during operational performance), and respond to a performance-time surprise (e.g. change operating priorities).

The framework in our RRS strategy is basically a set of standards that defines a plug compatible environment. The concept of standards in the world of Agility is a two edged sword, and a central engineering issue. Standards are necessary to eliminate module interfacing as a problem; yet they will also determine and restrict the range of employable modules. So the framework must facilitate its own migration with time, and will probably benefit from simplicity as well.

If we provide embedded utility services within the framework we will benefit if they are implemented as modules - constructed as plug compatible self-contained modular units that provide fundamental common services to other modules. In the production environment MRP is a good example of something that should be implemented as a module rather than as an integral inseparable part of the framework. In the organizational environment teaming is a good example - especially as we learn about the pitfalls of early teaming approaches and recognize the need to evolve these systems over time.

There is much more to be said about design principles for RRS systems that will have to wait for another time. But we have said a little about frameworks, so we will also say a little about modules.

A key issue with modules is “facilitated” reusability. Modularity by itself does not provide the degree of reusability we look for. A support capability is needed that facilitates the creation, replication, and modification of modules. This will include some sort of repository for unused modules or templates for reproducing them; procedures for cataloging and finding modules; and tools for replicating, modifying, creating, and testing modules. This support capability is the engine of Agility, and the domain of the business engineer. And it becomes the seat of organizational learning and knowledge.

Westinghouse Electric and AT&T have both created a corporate consulting pool containing a wealth of proven skilled personnel. These pools were formed initially when downsizing in various business units liberated valued competencies and skills that the corporation was afraid to lose. The concept in both companies has since evolved into a valued resource that can provide a "plug compatible module" with immediate effectiveness to any hot spot in the organization. The framework for these modules is best described as the corporate culture.

With the increasing complexity of global economic systems and business environments, the metaphor of management at the helm is passé. Piloting a ship through troubled waters is the wrong picture when even the waters are changing; demanding that the ship change accordingly as it goes. We find less use for the MBA on board and more need for a new MBE - the Master in Business Engineering.

We have covered a lot of ground in a small space here and will plumb the depths with a more narrow focus in later segments. In the meantime, the Agility Forum (610-758-5510) has published an initial "Best Agile Practice Reference Base" that can shed more light on this area with industrial examples. Resource management is the enablement foundation for Agile enterprise - it is what change proficiency is all about - and it is what we have been focusing on in this series. By itself it does not guarantee an Agile enterprise, which also requires Agile opportunity management and Agile innovation management - concepts we will put in perspective at another time.

Reference Base Definitions and Reporting Format

An attempt has been made in this initial Reference Base activity to have the case reporting format constrained to fill both sides of a single page exactly. The purpose of this constraint is to force a crispness of reporting so that the principal features and benefits of Agility will stand out. In this way we hope that the reference base will promote an emergent understanding of what makes Agility occur by encouraging the reader to explore many cases. We also want to ensure that the unique attributes of Agility not get lost among the broader issues of generally good practice.

The report attempts to summarize the principle qualifications of each case in two ways:

- 1) On the top of the front page of each case presentation will be a summary of the change-proficiency analysis and manifestations of Reconfigurable-Reusable-Scalable structural concepts.
- 2) On the bottom of the front page of each case presentation will be a summary of the important types of change affecting the case.

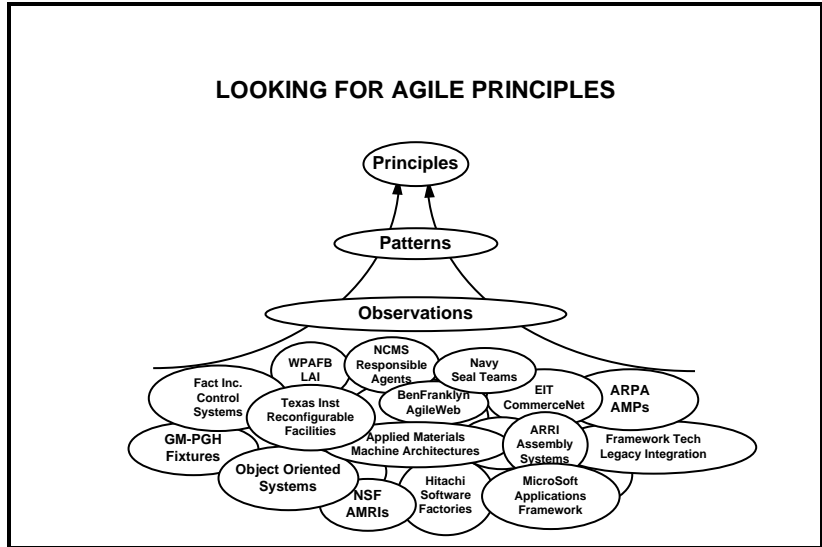
In this initial phase these summaries have not yet had the benefit of comprehensive debate and analysis - an exercise for intense work in 1995 by the Forum's focus groups. The summaries at this point should be viewed as a first attempt to find the essence of Agility within the case - and is subject of course to the interpretations and perceptions of the case writer.

We are concerned that some readers might take offense, or take too much guidance, from what might appear as an endorsement for the occasional commercially available product that was analyzed. After considerable debate we decided that a good example should not be discarded simply because it is for sale. Nevertheless the reader should understand that the reference base in this initial version focuses on the positive Agility aspects and does not pretend to offer a comprehensive up-side, down-side analysis. Serious analytical work is scheduled in the next phase of continued activity.

Defining Terms:

- q Reference Base: A data base of Agile practice cases, organized in collections that form reference models for various business areas.
- q Reference Model: A comprehensive taxonomy of categories and subcategories for an area of business that designates the key Agility issues. For instance, the Agile Virtual Enterprise reference model contains six categories that encompass all Agility issues throughout its life cycle from concept, through operation, to dissolution. Each category is divided into subcategories that represent specific key Agility issues. A reference model is also a case framework.
- q Case-Framework: Similar to a reference model but not necessarily comprehensive. A taxonomy of categories and subcategories for an area of business that designates key Agility issues.

We are attempting to keep things as simple as possible with a simple structure: Base, models, categories, subcategories. There is a temptation to nest deeply in the subcategory area, just as there is a temptation to classify and subclassify, for instance, under Product Realization all those issues that are its constituent parts. Unfortunately, these issues also belong to other categories. In these early days when we have partial reference models and missing reference models we are bound to build structure around our starting points. With time and maturity, cases will look more like equal-level modules in the sea of enterprise, with perhaps a single indexing/agglomerating level of categories to collect the cases of interest. This view is in keeping with our views on Agile systems composed of modules and frameworks.



Best Agile Practice Reference Model

OBJECTIVES

Repository of Implementation Examples.

Promote an Emergent Picture of Agility.

Observe Patterns and Discover Principles.

Identify Gaps that Need to be Addressed.

Eventually

Develop Self Administered Benchmarking Procedure.