





A Position Paper

Predicting Mass Cooperation: Human Reactions to Complex Systems

- by -

*Derly Andre Tijerina with A. Hughes, PhD
for the Forum 9000 Founder's Collection*

Forum 9000, LLC provides a coherent philosophy, conceptual models and technology that are aimed at the objectives set forth in the Institute of Medicine (IOM) study, *Crossing the Quality Chasm: A New Healthcare System for the 21st Century*. In that study, report authors deem information sharing as essential. At the same time, federal regulations mandate more protection for patient confidentiality than ever before. The panel urges healthcare providers to make clinical practices more standardized across diverse settings and at the same time more personalized to accommodate each patient's preferences and care decisions. There are no existing computing models in practice that can achieve these lofty objectives. Then, to make matters even more confusing they include an *Appendix B: Redesigning Health Care with Insights from the Science of Complex Adaptive Systems*. And off we go into the new millennium.

Now that information silos are politically incorrect, vendors are offering machinery with conveyor belts, tool sets and smoke stacks. It all sounds impressive but leaves an unsatisfying nostalgic aroma – big dollars, big systems, big risk. The large issues still loom; information sharing vs. protection and clinical process standardization vs. personalization. If you are uneasy about the complexity, it is no surprise. Perhaps that's why the IOM includes a non-specific glance toward the Science of Complex Adaptive Systems (CAS) in their study. In CAS, subsystems are nested into a single entity that has features that tend towards personality. The movement (evolution of the constituent parts) determines the behaviors of the whole – cell, organ, organism. We believe that this Appendix can guide a collaborative effort to establish a customer-side framework around web services that can unify ideas that seem to be in conflict. Under current philosophies, these concepts seem incompatible or mutually exclusive. Premier among them is single-source vs. best-of-breed. But we must start with existing chaos and complexity.

Members of Forum 9000 study and reason through existing technology, cultural and economic trends to shed light on the directions that healthcare information technology might go. It looks as if science may have to meet humanity on turf called quality. Along the way, the ideas behind mass cooperation evolved and are pertinent to almost all information sharing environments.



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“Civilization develops only where considerable numbers of men work together for common ends. Such unity is brought about, not so much by community of bare ideas as by community of the feelings by which ideas are ‘emotionalized’ and become beliefs and motives.”

J.H. Denison, Emotion as the Basis of Civilization [1928]

Introduction

A Complex Beginning

“There have been several past attempts to set out a complex set of rules to govern healthcare. When these have not yielded desired results, our instincts have been to create even more rules. Complex Adaptive Systems (CAS) science asserts that these instincts take us exactly in the wrong direction.” This statement appears on the last full page of the Institute of Medicine’s Report, Crossing the Quality Chasm: A New Health System for the 21st Century [1]. It continues a few paragraphs later, “It is liberating to realize that the task of complex system design does not need to be complex . . . there is no need to fall victim to chaos.” If you didn’t get to read all the way through Appendix B¹ of that study, this paper offers a punctuated and integrated assessment of what it means . . . to you . . . today.

“It is liberating to realize that the task of complex system design does not need to be complex . . . there is no need to fall victim to chaos [IOM].”

Forum 9000, LLC is predicting the emergence of a new ordering principle to guide the evolution of healthcare. Emergent behavior is one of the principles that is now a well documented part of Complex

Adaptive Systems science [7]. But in a world of healthcare, already saturated with sciences for human health, information and technology, who has time to add systems science to the mix? A better question is, how can we reduce the cyclical costs related to changing out information systems, when change is a necessary and predictable part of the process?

A Liberating Idea

The liberating idea that it “doesn’t have to be complex” is the objective. Simple rules [1] derived from universal considerations can articulate common goals for local implementation. However, this comes with a very uneasy shift in the fundamental context of our work. When it is said and done, we will no longer be designing clinical, administrative and information systems that simply plan and control work. We will be designing systems that allow us to observe and react to a complex of dynamic conditions as a natural adaptive process.

It sounds so simple – we extend plan-and-control to include observe-and-react – but then again, it involves Complex Adaptive Systems. To make that point digestible from administrative, clinical and technical vantage points, we describe the past fifty years in three stages.

¹ Crossing the Quality Chasm – Appendix B: Redesigning Health Care with Insights from the Science of Complex Adaptive Systems.



Stage one begins with the hierarchical order of the post-war era, continues through unprecedented technological improvements, and leaves us in the chaos of a post-dot.com world. Stage two considers the current conditions of a disenchanted labor force of knowledge workers, value models that are crumbling in the form of corporate valuations, and a technology sector with promise but no clear direction. Then stage three describes conditions that will emerge to establish a new ordering paradigm for evolving information technology processes to support an accelerated evolution of clinical processes.

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Our Current Condition

With a new sober complexity as a starting point, we consider quality in several dimensions. Internal quality is the traditional form to deliver software that performs without bugs or errors, external quality considers the operational context of technology and process, and then humans seeking quality want convenience, without risk, on their own terms. Most importantly, we acknowledge the evolving nature of quality and the personalized effects that are measured by individuals, work groups and communities of interest within specific work contexts.

Within the new ordering principles identified by Forum 9000, we see components in labor, technology and the economics of the software industry. Projections are based on the natural behaviors of Complex Adaptive Systems.

Specifically, we predict that labor will add a collaborative effort to solve common problems in general ways through mass cooperation. Within labor, knowledge workers and domain experts will find new

roles in which components are designed and approved by IT for local implementation that does not require direct IT involvement. The technology factors organize resources within a common component approach. This approach coordinates information storage, production and deliveries from vendors large and small, new or tenured. The approach is called web services. Smaller increments of adjustments, managed by newly aligned relationships between domain and technology specialists, change the environment into a deliberate adaptive system.

The economic shifts are realized when major vendors do not have complete control and new nimble niche vendors can participate in an integrated environment with little risk. Re-use of existing resources is an essential part of necessity. Specific caution is recommended to maintain technology independence at the operational layer to avoid deep entanglements with a technology or a vendor. The overall premise is a move to smaller changes, in shorter cycles, with a long term goal of permanently eliminating risks and costs associated with big bang changes.

The challenge is to plan and control work environments with generalized componentry that can then apply simple rules of self organizing systems. Departmental and care team work groups, serviced by their own domain experts, are observed in process audit logs and the enterprise reacts to findings. Governance is passively included at strategic levels to marry local needs and compliance mandates. The key notion is about simple rules that keep the web services paradigm from getting too complex.



Simple Rules

We both begin and conclude with guidance from the IOM study of the healthcare system. In the end, that study just points us in a direction that Forum 9000 members have carefully analyzed. Again, from the last full page of the report, “. . . the concept of simple rules . . . provides wide boundaries for beginning the work of self-organization [in subsystems.] Simple rules for human Complex Adaptive Systems tend to be of three types: (1) general direction, (2) prohibitions and (3) resource or permission providing.” In the discussion that follows, these rule types are associated with clinicians(1), administrators(2&3) and IT with policy directives(3).

After the chaos, beyond the current complexity, we look to nature to guide adaptive systems. Humanity is a part of the process and information technology cannot plan and control in cold scientific unnatural ways. The humanity of the patient must be acknowledged by the humans delivering care, and information technology must offer support to assure safety and efficacy without being invasive or inflexible.

Systems Thinking

We can't escape nature. We are individually and collectively involved. We can choose at any point to limit how much we include it in our considerations, but we cannot escape it. Natural laws governing systems are explicit in their unfolding, just like other natural laws. Like gravity, these natural laws are in effect before humanity fully understands them.

Here, we will carefully consider natural processes that govern systems. This consideration is a conscious approach to understanding what will natu-

rally flow out of the complexity that plagues every aspect of our post-modern lives. We must begin to consider systems as a way of life.

A system is anything that is made up of separate parts that interact within a given set of relationships. It is implicit that the 'system' accomplishes something that cannot be done by any of its parts by themselves. A system has wholeness. Recently, we have begun to understand that a whole system cannot be understood by studying its parts. But systems can be made up of parts that are each systems on their own – subsystems.

Ultimately, humanity is a complex system and communications, computing, and healthcare are all constituent subsystems.

Systems made up of subsystems can best be seen in the biological hierarchies of cells, organisms and organs that make human life possible. As living beings, individual human lives participate in systems

that include families, cultures, economies and societies. Humanity is a complex system.

Humans are connected in systems that make communication possible across all physical, cultural, socio-political and economic boundaries. Information systems sustain communications systems, which in turn sustain economic and cultural systems. Systems of values are encoded in behaviors and attitudes that define our societies, cultures and economies and therefore form a background context for our communities.

A Moment of Complexity

Emerging from these systems, we now find a chaotic assortment of conditions that confuse and compound every individual effect. In systems thinking, this is described as 'a moment of complexity'. This, too, is an inescapable part of nature (which humanity does not fully understand.)



Those who study systems have identified a cyclical pattern in their evolution from order to chaos and back. The cycle is best understood when order is the ruling principle. In an ordered system, there is equilibrium between the feedback loops that shape and sustain it. Positive feedback energizes and motivates the system. Negative feedback regulates and hinders the process flows that make the system what it is. Extremes in feedback cause the death of the system. A system wrought with positive feedback loses all internal bindings and evaporates like smoke. There is not enough order to keep it together as a system. When negative feedback is overbearing, the system becomes so rigid that there is no movement among its parts. Like a crystal, every element is so highly ordered there is no motion – no life. The systems we will discuss here exist between being too ordered and fatally chaotic.

In the continual evolution of systems, order in a system is moved towards complexity when that system operates far from equilibrium. Complexity introduces patterns and flows that are the accumulated effect of the feedback loops that energize or constrain them. The cycle progresses in eras of human endeavor;

“order > complexity > chaos > complexity > order[2]”

As we collectively raise our hopes out of a period of world wide economic and technological chaos, we all look for new ordering principles. Before we find order, we identify patterns that begin to recur. When human opinion or choice is involved, characteristics of the system are experienced in the form of quality. Forum 9000, LLC considers quality – in

its broadest sense – as the motivating and energizing characteristic that will define feedback loops for systems of all kinds.

Appropriate Quality

Seeking appropriate quality causes positive behaviors (feedback loops). Experiencing inadequate quality (negative feedback loops in over-regulation or dysfunctional exchanges) causes seeking behaviors. As humans, we look for quality in information systems and healthcare systems. Ultimately, humanity is a complex system and communications, computing and healthcare are all constituent sub-systems. Information technology is a composite that includes humanity, communications and computing within the healthcare industry. When a system adapts to conditions produced by its own sub-systems, it is considered a complex adaptive system (CAS).

Healthcare is a complex adaptive system in which one natural adaptive system – human health – is interdependent with a concrete complex adaptive system – information technology. Touch-points and interactions between humanity and information technology determine the quality of care, the quality of the human IT user experience and the quality of the information ‘system’. For this reason, a thorough consideration of complex adaptive systems and quality in healthcare is necessary. Consideration of this human/IT complexity offers a basis for understanding the nature of existing complexity so that new ordering principles can be identified as they emerge.



STAGE ONE

Retiring the Old Regime

Post-war financial and technology models, which provided stabilizing order for almost fifty years, have failed. The hinges of the world economy are creaking with the expectations of an eager savvy young populace and the moans of an aging remnant of a baby boom. Like tectonic plates, massive econometric trends are being recalibrated after the culture-quake. Order is lost.

Now we are stuck. The mechanistic view of computing is colliding with the metaphysics of language acquisition. Financial expectations for retiring workers are entangled with CEO shenanigans. Hollywood has emoting robots, but most 3rd grade teachers can barely get on the internet. We possess god-like ability to manipulate images that feed sensory flow-tap rhythms. Yet, we don't know how to use reason in an extended persuasive argument with high-contrast values. Through it all, we collectively witness the murkiness in a dazzling array of global communication technology.

Global Reordering

Global communication is being reordered to foster a community that depends on primal quality factors – feelings. This reordering creates a purging influence on the information technology industry and techno-financial institutions that have drifted away from street level human concerns. Vague intangible value models are being questioned. Everyday people, who participate in large economies in the form of employment, are creating enormous negative feedback loops in a system of complex adaptive structures. The flow of capital, the collapse of corporate valuations and the shuffling of labor form new eddies of influence.

In this paper, we posit that fundamentals of economics are changing to rebalance the relationships among labor, capital and entrepreneurship. In the last cycle past equilibrium into chaos, capital and entrepreneurial factors of production drifted away from labor. After all, labor saw major benefits in principles that emerged in the post-war models. Positive feedback among workers formed strong labor unions that caused negative feedback in adding regulating costs to capital machinery in corporations. Still, those corporations saw an extended period of unprecedented growth.

When there was plenty of money and all computers were mainframes, healthcare was a well-ordered system. Then a series of technical advances moved us towards complexity. The series included mini-computers, personal computers, local area networks, client/server architectures and a world wide information packaging standard in Hyper Text Markup Language (HTML) that launched the internet era.

Dis-Integrating Complexity

The Knowledge Workers

Post-industrial labor evolved throughout post-war equilibrium, placated by an improving quality of life. Labor unions peaked and began to weaken in an abundant economy. The labor market, which became well-educated due partly to the swollen college ranks of the Vietnam era, became the new middle class of the information age. Intelligent laborers in their new manifestation – the knowledge workers – are restless and dissatisfied. They began to find solace in new forms of on-line community building, a pleasant distraction, which fueled spending in the tech sector. However, this also resulted in micro-cycles of buy-and-replace that did not allow real benefits to accrue to the true growth of wealth.



A 1998 article studied the perceptions of Alan Greenspan, Chairman of the Federal Reserve. It states, "Consumers spent somewhat more freely as the stock market climbed relentlessly the last few years . . . He [Greenspan] has been ruminating about how to deal with the markets since his famous reference to 'irrational exuberance' in a speech nearly two years ago [1996]. He has tried talking the market down, with only temporary success, but seems to have concluded that there is no orderly way to deflate an asset bubble [5]."

With e-mail to provide temporal communication, web pages to handle static communications, and an explosion of microelectronic gadgetry, knowledge workers were lulled into compliance. The dot.com revolution issued unbelievable promises as a premise for order. Within this efficient, easy to reach order, the world became unified in their collective of primitive techno-etchings – web pages. We achieved community based on technological wizardry – stateless asynchronous non-local intervention-free message transactions. Whoa!

The feedback loops became so energizing that the order quickly spun into a complexity of web servers and search engines, fueled by positive financial feedback loops. Technology workers were enticed and joined the acceleration. Convention halls filled with dreamers seeking IPOs and knowledge workers shopped for the best stock option packages. Struggling for differentiation, each effort twisted available technology into new shapes. Ensuing chaos led to the collapse in all measures of value. The system was overheated. Interlocking systems of finance and technology innovation drifted into chaos.

The software industry is feeling the disorienting nature of the complexity it helped to create. The strain manifests in an accelerated evolution of buzz words around integration.

Post dot.com Chaos

In this overheated state, the information technology industry was strained at the seams by several complicating factors that are compounded. Financial woes were not yet obvious. However, there was also an emergent issue that is not quite so easy to understand. Knowledge workers, who drive innovation, became disenchanted. They were now at odds with the corporate mindset, ". . . knowledge workers are a demanding lot. They are less and less likely to want to work full-time for one company, seeing no reason to pledge their loyalty to an organization that can no longer reciprocate the favor [6]."

What are my stock options worth now? In the post-war era, long term employment was encouraged in common practices – labor was offered capital stock in the form of options. The financial technique that had steadied the work force was used chaotically to torque up the pressure. Recently, we have seen the loss of stock options as a credible enticement. Stock options offer negative feedback to constrain employer/employee relationships. The loss of stock options, as a motivating instrument, adds complexity.

More troubling are the attitude shifts as demonstrated by the open source movement, where software production occurs outside of any corporate system. As an external allure, the open source movement offered non-binding communal bliss – one more complicating factor for reordering relationships.

The loss of a binding tool (stock options) added to the influence of a new value system among software engineers, usher us into a new chaotic condi-



tion. Between capital markets and software developers, royalties are as fragile as quarterly financials.

Buyers' Dilemma

Buyers are left wondering. They are suspicious of any young company, wondering if they will have staying power. But they are also skeptical of large stable firms, who must apply controlling functions to simultaneously maintain corporate identity and encourage innovation. Buyers wonder if the big dogs can really learn new tricks to deliver enhancements and extensions fast enough. Movement towards distributed computing and information sharing are stymied by concerns about security and process integrity. Nothing is clear.

The software industry is feeling the disorienting nature of the complexity it helped to create. The strain manifests in an accelerated evolution of buzz words around integration. The chaos is stirring, everyone is trying to differentiate what is supposed to be standardized. Promised enterprise integration is complicated by the emergence of distributed computing and extra-organizational processes.

The allure of new potential gains in efficiency linger in the hum of

The world watched the explosion of static informational units (web pages), organized into hierarchical models (web sites) . . . You can't shift paradigms in a mad rush to market.

frenetic competition for the few dollars that are being spent. However, the competitive hype is so loud and confusing that few can move ahead with any confidence. Overall systems quality is unsatisfying.

Quality does not emerge easily from noise. As the Complex Adaptive System of IT simmers far from equilibrium, new momentum is forming within the chaos. Collective non-binding agreements are addressing generalized data descriptions, message

constructs and a familiar transfer protocol enhanced for security. There is near universal agreement on XML (eXtensible Markup Language), SOAP (Simple Object Access Protocol) and HTTP (Hyper Text Transfer Protocol) and its new baby brother HTTPS (HTTP with Secure Socket Layer connections). Of course, the informal agreement so far is that they *will* be used, not *how* they will be used – more confusion, more chaos.

A Matter of Independence

At the heart of the confusion, there is a significant value shift – a rebellion among knowledge workers and systems buyers alike who seek technical independence. Their first flirtation with true independence was with the liberating simplicity of HTML as a technique for publishing web pages, in web sites of independent design. Local graphical and organizational design of unlimited content equaled dot.com bonanza.

The dot.com revolution was accelerated by the use of newly tooled marketing machinery. Hot, sexy, ethereal imagery helped to oversell changes that

were more appearance than substance. The hype was joined by Wall Street, Fifth Avenue

and the NASDAQ. The world watched the explosion of static informational units (web pages), organized into hierarchical models (web sites). This meant new vigor for plan-and-control with no need for observation nor reaction – content is content. You can't shift paradigms in a mad rush to market. However, the appearance of significant change had no new foundation. Production methods below the browser did not provide anything really new except for a global information packaging paradigm – a rendering style in HTML.



The Bazaar Outside the Cathedral
Beneath the appearance of change, the software industry was still seeking to build large cathedral-like structures that could solve all of a customer's problems in that famous one-stop-shopping mode. The single-source solutions vendor reigned. Companies that emerged through the waves of progress – hardware, operating systems, databases, networks – are now pitching in the seas of change with everyone else. This leaves us conflicted. Only tenured software companies are left standing, yet large expensive central systems that sustain them, are moving to the endangered species list.

Large systems were built by large workforces of developers operating in well structured hierarchies. Negative feedback loops, in the form of internal corporate regulations, tightened and slowed the corporate machinery. Externally, legal mandates and federal regulations combined to slow the machinery even more. Big corporations, big systems and big dollars were produced in steady hierarchies. These hierarchies stand in contrast to dynamic distributed collaborative teams who form the competition for large centric systems.

Nimble Competition

The competition – small nimble companies – lacked the extra-organizational principles necessary to compete on a large scale. They produced interesting noise at low volumes. But new organizing principles are emerging, creating an environment of independent co-development. At the same time, they promote the cooperative knowledge worker as the champion of the new software regime. Value now shifts to the useful work that can be done by well-

written code instead of paying into the intellectual property barons who supplied financial backing for large scale software development in the past.

A New Value Model

In his seminal work, *The Cathedral and the Bazaar*, Eric S. Raymond introduced the world to the esoteric value model of the open source community. Cathedrals, he argued, require the coordinating authority of centralized management and enforcement of design integrity via employer/employee relationships. Bazaars, on the other hand, are cooperative work places in which workers were loosely organized in collaborative topical work spaces. Bazaars required less rigidity, but were rumored to be incapable of achieving large complex development projects. That is, until over 2,000 different code warriors developed Linux, a full-featured, production-quality operating system.

New formulas for software development can consider new forms of value protection. Here, the value to the supplier of capital contrasts with freedoms of the knowledge worker. Whereas contracts and licenses have always protected intellectual property against unlawful distribution, now copyright law is being used to guard source code against being canned or boxed.

The unwelcomed cans or boxes would prevent a developer “downstream” from using the contents of the source code freely – as (s)he wishes. In this new-regime community, freedoms to re-use the code in creative ways are deemed more important than the protection of intellectual property of those who cooperatively created it. Labor plus small doses of entrepreneurial talent could now operate

As we move through this transition, new web services systems that merely configure existing arrays of components will be built by communities of interest for common use. . . . In healthcare, this hints of care team empowerment.



creatively without capital. Value was found in sharing and the esoteric reputations that follow. Amorphous development teams started turning out software with useful general capabilities and offering that code for free.

The highly useful generalized functions of open source offerings are tempting even for software development shops that are fully capable of rewriting such baseline components. The buy-or-build decisions that are common in software designs are forcing clean functional interfaces in design componentry. Turf battles among the Titans of information age mythology – the big five – have even given way to ubiquitous standardized computing methods (XML, SOAP, HTTPs). Thus, we are introduced to a transition stage out of chaos towards the new settling complexity – a new ordering system of production with floating value.

Pushing Value Outward

This transition stage pushes value outward one more layer towards the user. The work accomplished by software components is now being subordinated by the sequencing and serialization of business process work steps [10]. As we move through this transition, new web services systems that merely configure existing arrays of components will be built by communities of interest for common use. These systems will provide all the generalized business processes necessary and a foundation for personalization by individuals, groups or organizations. In healthcare, this hints of care team empowerment.

Large corporate environments will still build cathedrals of information reverence (most obvious in data warehouses.) Large consulting firms and ven-

dors will still lead the charge and sell multi-million dollar deals. But at the edges of the network, there are needs and appetites for informational services evolving faster than the design-and-build cycles of the cathedral architects. This is where domain experts, who each represent a category of users, rely on IT staffers. So far, the domain experts are still dissatisfied with the technology suite, it doesn't work the way they do.

This weary and suspicious population, which operates mostly in roles to recommend or evaluate systems, is only frustrated by the latest tumult of buzz words. They've all heard noise before. Quality seeking domain experts, combined with the growing masses of rebellious technology workers, give you an unruly group to force anything on – even "open" standards.

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STAGE TWO

Emerging Signs

Our troubled economy causes us to rethink the organizational foundation of current business models that bind capital, labor and entrepreneurship. The Economist described it in December 2001, "They were hierarchical and bureaucratic organizations that were in the business of making long runs of standardized products. . . . That world is now dead [6]."

Specifically, emerging models will need to reflect the new ideas of value – pricing for software packages, protecting intellectual property in large complex systems, employee relations and traditional covenants between buyers and vendors. Again, from the Economist, "America's giant companies have been either eviscerated or transformed by global competition. Most have shifted their production systems from high-volume to high-value, from standardized to customized. And they have flattened their management hierarchies to make themselves nimbler and fitter. Few people these days expect to spend their lives moving up the ladder of a single organization [6]." Generalized object thinking, shared in a cross breeding labor market, settles the chaos into a new complex of encoded layers.

Ideas about tightly incorporated fix-everything solutions will get harder and harder to digest. In response, rebellious ideas are emerging as we collectively discover a new way to design, engineer and deploy information systems around a new complexity – web services.

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Edge Development

With HTML and the browser squarely fixed at the user interface, IT takes a provisioning role. Here, at the edge, this new design and deployment effort will establish clean relationships. The user is behind the interface, the domain expert designs processes with approved components, and the IT department engineers components. Patterns of components for flows of information will leverage the object thinking that has been simmering for twenty years.

Conceptually, data from all sources is available for manipulation and all applications are triggered by remote requests. Interactions that progress across distributed resources need transaction support and system/application independence. They need to be configurable with no IT intervention and must demonstrate process integrity. What used to be implemented within a single-vendor system must now be generalized in support of end user needs across the local complex adaptive system structure.

A New Challenge

With the edge of the network layered with users, domain experts and IT-supplied components, there is a new challenge. How do we transform universal technology into configurations that solve common problems in general ways? If local and personal preferences cannot be accommodated, it won't work. If each enterprise has to solve universal technology issues to support common clinical process needs, it won't work either.

That's why *mass cooperation* will become the unheralded social contract that will establish agreeable rules and informational exchange economies. Knowledge workers, suspicious of corporate



schemes, will join middle managers to welcome this change. This is the change that was promised by the dot.com revolution – consolidated access that meets content and process needs of a domain.

Graphical tools for non-technical domain experts will be attractive to the new regime of collaboration. The data structures, which feed them persistently, will now be expected to support fluid changes as close to the end user as possible. An application can be provisioned with appropriate data – on the fly, in net time – from sources that are loosely coupled. The Electronic Medical Record, as a single system, is a religion in question.

Assembly Line Thinking

Data buried in departmental silos can now be considered as generalized resource material. The assembly line thinking that aggregates it, transforms it and presents it in custom formulas comes to the foreground. As a background condition, outside of healthcare, let's consider the confluence of two growing trends, which describe the context of this shifting technology landscape.

One trend is towards mass customization of both product and service based businesses. This forces product designs that are highly modular and services that adapt to user needs (almost) on the fly. The second trend is towards distributed everything – knowledge workers, inventories, information resources, computing services, mobile devices and voice-activated touch-tone convenience. *Distributed mass customization* is a daunting thought when there are no organizational principles akin to the corporate hierarchy that can accommodate the new information dynamics. The new dynamics will have to support informational

flows among unknown numbers of suppliers and consumers in a bi-directional exchange economy.

Inhale/Exhale Processes

Loosely defined markets, perpetuating types of ad hoc usage patterns, foreshadow new processes. Information will support human activity with access-and-aggregation followed by decomposition-and-distribution. However, this inhale/exhale informational experience will tax server centric computing models and user-controlled peer-to-peer systems. Server centric models imply a plan-and-control paradigm, while peer-to-peer models lack mechanisms for observation. The goal becomes frictionless interactions, with corresponding in-flows and out-flows, that can be governed by new quality metrics guided by new eddies of influence.

Forum 9000, LLC recognizes quality as the generalizing concept in coordinated cooperative communities that will evolve from these conditions. In new headless teams, knowledge workers and domain

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experts will combine efforts. Each information consumer will determine the appropriate quality for the task at hand.

Consistent quality will yield loyalties and repeated patterns of information interactions. Inconsistent or inadequate quality will lead to new buying decisions or changes in interactions – new quality seeking behaviors. At the organizational or community level, individual users will weigh the costs of cooperation with the benefits of the interactions that cooperation engenders.



Multifaceted Quality

A new multifaceted understanding of quality is necessary to address various conditions, which may seem to be incompatible or mutually exclusive. Forum 9000 seeks to identify, evaluate, understand and perpetuate the factors that lead to quality interactions among individuals, work groups, organizations and communities. By identifying factors, we promote simple rules that lead to good process practices. In keeping with international guidelines specified in the ISO 9000 Quality Standards, Forum 9000 strives to document the principles, policies and practices that serve as the basis for high quality cooperative informational exchanges.

The Problem

As we enter the trailing edge of complexity, there is a new rich setting of relationships and potentiality. Forum 9000 predicts that a fundamental shift will emerge within the economics of the software industry. This shift will supplement, not replace, traditional software systems sales. The shift was collectively acknowledged in the "irrational exuberance" that led to the dot.com fiasco.

Leaping to a New Business Paradigm

During the dot.com chaos, technical and financial minds alike jumped at the ideals of new models for aggregating information to define marketplaces in the form of name-brand web sites. Corporate cathedrals of information were fueled by venture capitalists with high hopes. However, these cathedral-like structures were too rigid to sustain the fluidity in relationships and service responses needed to deliver on idealistic promises.

Hungry demands of nimble information browsers could not be supported by non-integrated corporate IT infrastructures. We all leapt across the canal that leads to a new business paradigm . . . and we came up short. But that doesn't mean that the canal can't be crossed, nor does it change the fact that a new business paradigm is inevitable.

The continual interpretation and re-interpretation of quality by individuals and groups of users will make it impossible for large high volume data models to adjust to the shifting needs of emerging business.

So, as we staggered among the debris of the dot.com collapse, a new chant arose from consultants, technology companies and trade rags together – integrate, integrate, integrate. And indeed, integration is a good thing. But the notion of integration comes with a cost burden of control. Federal, industry-wide and enterprise regulations slow the process-building machinery. As extra-enterprise processes begin to take center stage, governance will be distributed to balance these effects in common operational models, which share an informational universe (e.g. everything known about a patient). Integration will move to an operational layer between the overall 'system' and the user. This form of integration meets the needs of users or machine work steps in personalized ways with common techniques. Information transformations that filter, sort, organize or re-sequence data now become components for the stack instead of data storage infrastructure.

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Crumbling Cathedral Walls

The fallacy currently being pursued, is that the same corporate cathedrals that failed to support the dot.com revolution, will now be able to support the fluid demands of the new business paradigm. The Economist, while commenting on The Agenda by Michael Hammer, states, "Now companies everywhere are dissolving the boundaries with their sup-



pliers, customers and even rivals . . . the co-inventor of the re-engineering fad [Hammer], stresses the importance of firms 'losing their identity' in an extended enterprise, and 'getting past the idea' of being a self-contained unit [6].” It is unlikely, that the cathedrals of old can include a full bazaar of various informational vendors who will all accept coordination by the cathedral architects. “Nowhere was the hope greater and the reality more disappointing for collaboration than in online B2B exchanges [11] . . .”

The continual interpretation and re-interpretation of quality by individuals and groups of users will make it impossible for large high volume data models to adjust to the shifting needs of emerging business. It is apparent that federated corporate environments will integrate systems to their own benefit and to the benefit of large numbers of their own users. At the same time, the integration needs of new, temporal or ad hoc business relationships will demand fluidity that is contrary to the rigid data models produced by large scale integration efforts. The promise is that data warehouses, data marts and well managed Nth-tier content will sustain us – except for that quality thing.

Appendix B to Crossing the Quality Chasm, directly addresses the point, “[Complex Adaptive Systems] need two processes in order to evolve: (1) processes that generate variation and (2) processes that ‘prune’ the resulting evolutionary tree [1].” Since federated integration models prevent new variants from evolving and process pruning only occurs in upgrade cycles, cathedral models are inadequate.

Graphical tools and interface conventions will make it possible for non-technical workers to configure their own processes without assistance from IT staffers. Quality seeking moves to the component level.

Constellations of Web Services

As supply chain management and customer relationship management combine effects, the units of manipulation become constellations of web services. The result of graphical tools to configure component code into personal constellations make it possible – albeit impractical – to produce personal desktop informational supply chains. Natural behaviors found in Complex Adaptive Systems show recurring patterns as a clustering effect. Personal supply chains will appear in abstract types to address common problems in general ways.

In order to support the fluidity of emerging business, we predict that operational integration will consist of common generalized sets of services. This moves information customization out of the data layer of computing models and into the communications layer where real-time operations take place. This is the practical manifestation of the shift that leverages strategic plan-and-control in preparation for observe-and-react. Operational integration will turn systems thinking to focus on end user value.

Operational Integration

The prediction of a new focus on operational integration can be further supported by trends that show unused production capacity. We see steady increases in bandwidth and transmission speeds in tandem with decreases in the cost of CPU power, memory and disk space. Instead of technical constraints (negative feedback loops), maintained in the central high-performance server, we will now see the equivalent of just-in-time data provisioning in net time applications.



Here, the compounded effects of complexity blend. The control of source code demanded by open source code warriors will now migrate outward to component control for domain experts. Graphical tools and interface conventions will make it possible for non-technical workers to configure their own processes without assistance from IT staffers. Quality seeking moves to the component level.

Data constructs will need to exhibit a new degree of granularity. Granularity in common generalized solutions will determine choices downstream for the user. Choices must scale, extend and flex to meet the personalized needs of quality seeking individuals, collaborative work groups and organizations. Undue constraints (negative feedback loops) that prevent reconfiguring, re-tasking or modifying operational systems will not be tolerated for long. Competition won't allow it.

Co-evolution is a necessary characteristic of the Complex Adaptive System, "A CAS moves forward through constant tension and balance. . . Tension, paradox, uncertainty and anxiety are healthy things in a CAS. In machine thinking, they are to be avoided [IOM]."

whose principles, policies and practices are open for scrutiny. Forum 9000 intends to provide a mechanism for structured debate and peer review of coordinating entities. We will review costs and benefits implied in a set of coordinating principles and identify any hidden economic burdens in the form of protected intellectual property, software licensing or copyrights. We move from "let the buyer beware" to "let the buyer be informed."

Coordinating Principles

Coordinating principles intend to provide guidelines for cooperative interactions in which there is no dominating participant. Each application will still operate on data controlled locally, but that data may come from a combination of stored data, a sequence of dynamically acquired data via remote procedures and user input. Events trigger other data assembly events.

STAGE THREE

Mass Cooperation – Labor

Mass cooperation is the term we use to describe the quality seeking behaviors of experienced technology workers and domain experts who will yield to a cooperative authority in order to participate in an affinity group. The intent is to address common problems in general ways by defining simple rules. The hope is that generalized solutions, determined by cooperative convention, offer an expanding base of software making the local tuning and personalization easier and easier.

This move towards mass cooperation will be accelerated by fully exposed coordinating authorities,

This approach implies that there is little need to wait for the one all-satisfying data model. Single universal data models extend plan-and-control thinking but virtually eliminate the ability to react upon local observations. In the old regime machine thinking was institutionalized, the single-source vendor waited for pressure to mount from a customer base before adding generalized features. The models were too rigid, they could not accommodate co-evolution. Co-evolution is a necessary characteristic of the Complex Adaptive System, "A CAS moves forward through constant tension and balance. . . Tension, paradox, uncertainty and anxiety are healthy things in a CAS. In machine thinking, they are to be avoided [1]."



Traditional views of systems, instituted in post-war models, imply a dominant central role for knowledge workers on the server-side of the computing model. These traditional views were shaken by the implications of internet communications where new independence allowed anybody to be a server. The result is a conceptual model in which decomposed processes can be accessed as discrete work steps.

These individual work steps are now called web services. Users will access web services from a browser, domain experts will design and configure web services from an approved local library. The IT staff will concentrate on engineering and testing web services as components.

As the information industry moves towards web services, the focus will move from static data to the events in which data is accessed, aggregated, decomposed, and distributed.

Events, Patterns, Rates & Flows

As the information industry moves towards web services, the focus will move from static *data* to the *events* in which data is accessed, aggregated, decomposed and distributed. In this context, an event is any mechanism which initiates an informational response. If I swat a fly on my keyboard, there is no required informational response – no event. If I press a key on my keyboard, something is electronically received, or a file is opened, there is an informational response – an event has occurred. Web services are information processing events executed in response to a request established by a coordinating convention.

Event Patterns

Patterns of events determine business processes, even before any information technology comes into play. Information technology assists the business process by automating the rates and flows of transactional events, regardless of whether those events

are synchronous or asynchronous. Each event causes the movement of data, which inform either machine or human participants.

Events among participants can be grouped into interactions. Interactions put events into a context called a business process. In the past software regime, business process re-engineering attempted to engineer data structures that could describe evolving work processes. They wanted to re-engineer what had never been engineered in the first place.

The result was a crush of negative feedback loops from workers who couldn't exactly name their resentment in becoming cogs in the information machinery of corporate cathedrals.

Within the new post-dot.com environment, business processes are coordinating mechanisms which create, support, record, monitor or measure the movement of products and services in an exchange economy. Business process work steps are therefore coordinated across human and machine participants within standardized and ad hoc patterns. Machine work steps are web services and any business process can configure them as needed. As business processes move to the internet, web services will be the discrete units of process work steps.

Business Processes

We use web services as a general term that can describe discrete events between a requestor and a service or as a consolidated sequence of events (interactions) that support a business process. This causes a dramatic shift in computing environments. Changes in processes can occur by adjusting the selection or sequence of web services instead of



requiring new code or data constructs to be implemented – making new workflows almost immediate and the cost of new implementations near to zero. The implication here is significant. There is now an approach that can harmonize the centralized needs of a corporate federated environment and the evolving needs that occur fluidly at the edge of the network – where humans digest information.

Events can be controlled centrally by packaging web services. As needs evolve in the quality seeking behaviors of knowledge workers, a business process or interaction can be extended, flexed, redirected or re-sequenced, without altering the central coordinating authority. New workflows become manipulations of allowable work steps, instead of new products of the IT environment. This is not only important within federated computing environments, but also across non-similar computing domains. Here, non-similar applies to operating systems and computing platforms on one hand and operational domain objectives on another. This respectfully acknowledges the true complexity from which we must emerge.

Distributed Quality Metrics

Distributed automation does not mean that there is no centralized activity, it means that there is more than one centralizing concept. Each aggregate subsystem within a business process is monitored by locally defined quality metrics. Each system, each user, each organization or workgroup has its own definition of adequate quality. A community shares a centralizing concept that largely defines the quality requirements within their domain. Effec-

tive systems will allow domain quality metrics to easily combine with local preferences.

When one considers the quality of an informational experience, different factors are weighed. The first two are the internal and external quality factors.

The implication here is significant. There is now an approach that can harmonize the centralized needs of a corporate federated environment and the evolving needs that occur fluidly at the edge of the network – where humans digest information.

The software industry is most familiar with internal quality. This form of quality asks, “Does the software (system) do what it is expected to do without bugs or failures?” In contrast, the second form of quality asks, “Is this software doing the right thing?” External quality consid-

ers the context of the software within a sequence. Thirdly, we ask, “Is this thing being done in a timely basis [based on adequacy and convenience?]” Then finally, we ask, “What does this software function cost me in terms of dollars, convenience, and risk?”

This series of considerations can be seen in the recent evolution of credit card purchases over the internet. When internal and external quality factors reach adequacy, the user decision turns to cost. As costs – measured in risk and convenience – are reduced, buying events increase.

Seeking Equilibrium

In response to interpretations and re-interpretations of quality by individuals and communities of interest, we will witness a continual shifting of affinity groups and voluntary affiliations in the form of hybrid networks that offer web services in protected peer-to-peer networks. The peer-to-peer networks supply a packaging paradigm that uses negative feedback to achieve a benefit to the community. The packaging is a controlling (slowing) function to the excessive evolution that occurs on the internet.



Positive feedback loops from participants will balance against the negative feedback loops of controls that make these networks function.

A New Ordering Principle

Web services networks will provide the new order out of post-collapse financial and technological chaos. The concept leverages the rich setting that currently exists and gives direction that makes room for a lively marketplace. As this clarity emerges, cathedral bells will be ringing to bring the single vendor faithful back into the fold. Between licensing and free development tools that tilt balance back to the supplier, we will witness a struggle for customer retention.

Operational Independence

Operational independence will be key to easy migration. Centric systems, which will supply a natural center of gravity can dominate local designs but will have a hard time meeting universal or common design objectives. Independent collaborative workgroups, operating outside and across corporate structures will be able to identify the impacts of designs. The targeted interest will be upgrade cycles for centric systems versus co-evolution as predicted by complex adaptive systems behaviors.

As independent modules appear, vendors will offer new interdependencies to constrain systems in an effort to hold on to their customer base (upgrades). The centric system can act as a series of cooperative components or all supplementary services can be pulled into the main vendor's big-top. Vendors will play the fear-uncertainty-and-doubt card to justify the high costs of coordinating the centerpiece

architecture. Upgrades will be the pruning mechanism.

Equilibrium is reached by balancing the machinery that generates slight variations and assembly lines that sequence and serialize events. The degree of variability is controlled by packaging of approved business processes. Discrete independent web services, packaged in private networks, will offer the shortest path to equilibrium for collaborating teams.

Accruing Benefits

The overall economic benefits accrue when common components can be re-used for localized needs. Complex Adaptive Systems generate recurring patterns as a natural result of complexity settled by new ordering principles. The conscientious shift to observe-and-react operations can accommodate administrative and IT interests.

Healthcare administration needs to assure safety and efficacy, while monitoring for compliance, quality and cost containment (each a separate validation work step in process interactions.) IT needs to maintain operations. Packaging can be accomplished at common levels as general business processes or at local levels. Packaged web services allow capabilities to expand, while the private networks sustain process integrity needed to avoid disruption at operational levels.

We predict that new variants of peer-to-peer networks will emerge to offer trust relationships in robust web services, content sharing and collaborative work environments. As they begin, costs – in risk and convenience – may be high and usage ap-

Forum 9000 members believe that the only reasonable response to this unsettled technological and operational environment is the relentless pursuit of quality. Static quality is inadequate.



appropriately low. However, as access controls, security and distributed automation improve at increasing rates, usage will increase. As always, appropriate quality and comparative costs will determine the participation decision by each participant.

Relentless Pursuit of Quality

Forum 9000 members believe that the only reasonable response to this unsettled technological and operational environment is the relentless pursuit of quality. Static quality is inadequate. So is internal quality alone in which each component performs as intended. External quality must consider the context of each work step and the overall composite business process within the care setting. The holistic process cannot be monitored by watching the components individually.

Technology, products, services and business processes are evolving so fast that static conditions in local systems cannot capture systems behaviors. A collaborative effort can design and test common functions to minimize costs related to maintaining generalized subsystems.

In place of static data models, a better measure of quality and effectiveness for subsystems is input-output analysis [9]. This moves the focus of quality to the rates and flows of information as purposefully sequenced events in the form of business process interactions. Specifically, Forum 9000 members scrutinize methods for aggregation, packaging and distribution of web services as they become centralizing platforms (in any design, from any vendor). Any pattern of events that engenders a cooperative

community for coordinating business processes can be considered by member request.

Avoiding Barriers

Forum 9000 encourages the reasoned debates and discussions that lead to fully exposed and documented systems of broadly distributed automation processes. Both internal and external quality will be considered as well as the personalized needs of different users. Most important, are the technological barriers to building distributed systems – an affinity group must be able to extend, flex, re-direct or re-use information and work steps at all levels of interaction.

This will include, but not be limited to, the description of web services as a sequential associative aggregation of software modules, components, objects, applications, data stores and physical systems.

As a group of quality-minded professionals, we choose to participate in a collaborative effort of our own to identify, evaluate, understand and perpetuate the factors that lead to quality interactions among individuals, work groups, organizations and communities.

“With challenges that naturally fall in the zone of complexity, such as the design of the 21st-century healthcare system, it is not surprising if the system does not act like a machine [IOM].”



Conclusion

Getting to a STAGE THREE Solution

We are entering a new regime in information technology. The cold objective science of the information age is now flowing into the warm bodies of the human beings who shoulder the burden of decisions. Within the mix of humanity and information technology chaos, we find natural processes that dictate the evolution of complex adaptive systems. We must navigate in stages through complexity, but here we must consider the intimacy between human and machine adaptive systems. “With challenges that naturally fall in the zone of complexity, such as the design of the 21st-century healthcare system, it is not surprising if the system does not act like a machine [1].” Nature guides the human effort and humanity guides information technology.

As participants in nature, we are sometimes overwhelmed. We cycle through order in mindless bliss and then quickly find ourselves in an unsettling complexity that leads to chaotic conditions. As we watch the towers of our culture crumbling by distraught values, we stand shoulder-to-shoulder in shock. Post-collapse thinking dumps us into a totally new (global) moment of complexity. And yet nature is resilient. Humanity has emerged from social, cultural and economic upheavals in the past and we will journey through the reordering of financial and technology value models together in communities seeking equilibrium. We understand looking backward but must live looking ahead.

There are no easy answers and no destinations, only a journey. “CAS science suggests that we

cannot hope to understand a priori what a CAS will do or how to optimize it. A design cannot be completed on paper. Past attempts to do this in health-care have not succeeded in part because they may not have been satisfactory designs, but mainly because a new understanding of ‘design’ is needed [1].” We are headed for new information technology systems and new ways of designing quality into them.

If standards bodies, technology vendors or trade associations were able to fill this slot, there would be no need for Forum 9000. But right now, there is an ineffective blur between technology vendors, consultants, trade associations and trade publications. This blur makes solid comparative debates either temporal, shallow or incomplete.

Simple Rules to Reduce Risk

We seek simple rules and to expose flawed thinking that introduces risk. The healthcare industry offers a model for peer-reviewed literature that will be used to guide this effort, while the open source community instructs us in loosely-coupled team building. If quality remains the focus, then reasoned debate should be lively, without being harsh. Within the discussion of systems, we seek positive community feedback loops that can offer counterpoint to the negative feedback of controlling constraints. Such constraints can be the early signs of risk to be avoided in common solutions.

Communities can find problems more effectively than even highly qualified individuals, “. . . the strongest argument the open-source community has is that decentralized peer review trumps all conventional methods for trying to ensure that de-

“Despite the range of subject matter, they all reflect . . . simple frameworks, detailed sectoral specification, and parameters that can be estimated by direct observation of transactions [9].”



tails don't get slipped [12].” In community that lacks corporate control, the bonds of human interest and concern provide the cohesive force. Quality directs all efforts so that work can turn naturally to common problems. Simple rules emerge.

Work concerns and quality interests manifest in network relationships that share domain expertise. Clinical process teams in cooperation with teams made up of IT implementation specialists can monitor the context in which information technology is used at the point of care. These networks will cooperatively design, engineer and deploy satisfying constellations of web services that co-evolve with medical knowledge and technical resources.

A Way of Thinking

Web services, as a generalized notion, is a way of thinking about systems as much as it is a technological premise. Systems, applications, modules, components and objects all have a playing field in which they can interact within an effective role, based on the needs of human users.

The IT department, in its new pivotal role of engineering solid components, will need simple rules for provisioning clinical events with decision support data from existing resources. On the resource side web services thinking includes all available resources – proprietary software, open source code, existing legacy systems and custom code – will all play their parts. Web services will provide the discrete units of manipulation and packaging to manage and support information factories. Raw informational materials go in, production and processing transform them into new derivatives or composites,

and those new products are distributed or stored by value measures not yet determined.

Web services will have a broad impact with dimensions in economics and technology. More importantly, a new cultural effect will emerge in which people with common interests solve common problems in general ways – mass cooperation. The software engineer and the IT department now provision domain experts instead of end users. The user speaks in familiar business terms to a domain expert who can configure or deploy work step sequences. Patterns of work steps become manageable constellations representing business processes based on generalized software and tuned to local needs.

The order that rises out of this particular moment of complexity is measured in informational inputs and outputs at each work step. Across work steps human and machine participants interact fluidly. Governance is passive, but consistent. New peer-to-peer networks, which co-evolve with quality values of a community, will approach equilibrium. Costs – in time and efficiency – will be balanced with quality.

Technology and business opportunities should cycle fast enough to move steadily across the economic aftershocks that are likely in the post-collapse world. Ultimately, we should collectively seek the systems that can accommodate the input/output streams that optimize our own personal use of technology. The rest should take care of itself as buyers who create market forces are informed by the collaborative efforts of a few.

Let the new regime begin.



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Quality on the Edge

We all like to think that we are on the front edge of what is happening in technology. The truth is that there are many edges. Wherever facets of a complex information society intersect, there will be a unique edge. Forum 9000 lives on the edge in which healthcare will move into the promising new world of web services.

The humanity of the people supplying, scrutinizing, implementing and using web services will respond to the relentless pursuit of quality. It's the only thing we have in common – a deep desire to have things work the way we think they should. Join us.



“Our task is to understand how in fact the human mind can successfully set to work for the general definition of its habitual ideas. It is a step by step process, achieving no triumphs of finality. We cannot produce that final adjustment of well-defined generalities which constitute a complete metaphysics. But we can produce a variety of partial systems of limited generality.”

A.N. Whitehead, Adventure of Ideas [1933]

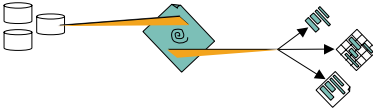


Forum 9000, LLC
Austin, Texas
Contact: Derly Tijerina, Founder/Director
(512)762-6633 or derly@4m9k.com



ShareWISE is a premier project of Forum 9000, LLC. It is a member-owned non-profit educational corporation that operates independently to foster understanding in the healthcare industry about the use of component architectures. IT professionals and clinical domain experts from Forum 9000's peer-review membership act as a standing advisory board to balance clinical, technical, administrative and regulatory objectives. Collaborative techniques are explored and evaluated in a test-bed environment that produces executable, production-worthy web services that are offered to full members at no charge and to non-members for fees based on retail pricing models. Revenues are retained to sustain support teams and extended development.

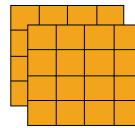
The distinction in ShareWISE is that we train in production environments and produce usable software for members in realistic settings. Members share costs on core components and learn how to localize and personalize end user processes in a manner that maintains vendor and technology independence.



The Problem



- Human beings use documents



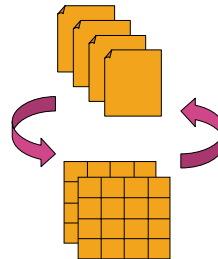
- Computers use data

- Information is derived from both

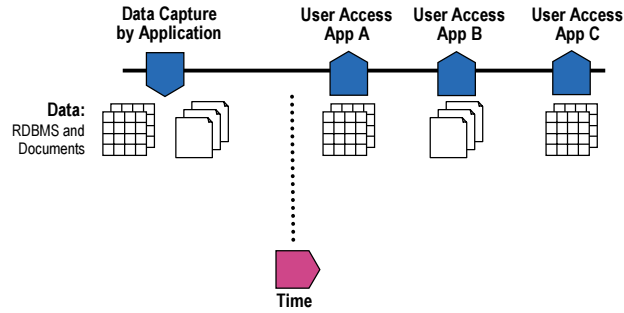
Complete Control of All of the Data



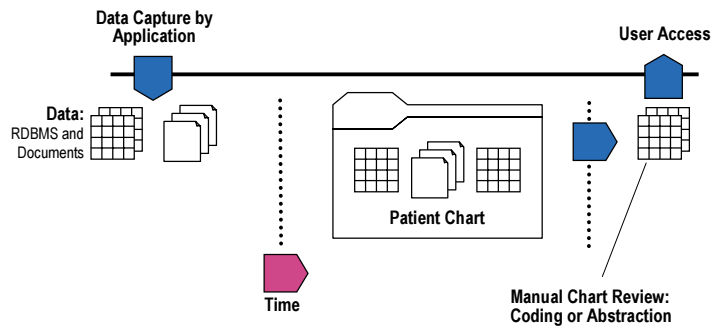
- Documents must be transformed into data
- Different database data must be as easy to use as if they were all printed in documents
- Complete control of all of the data means:
 - One can find (locate) and extract specific data from within documents into tables
 - Databases can be aggregated for analysis without re-engineering applications
 - Data capture and re-use are aligned in conceptual models and operations



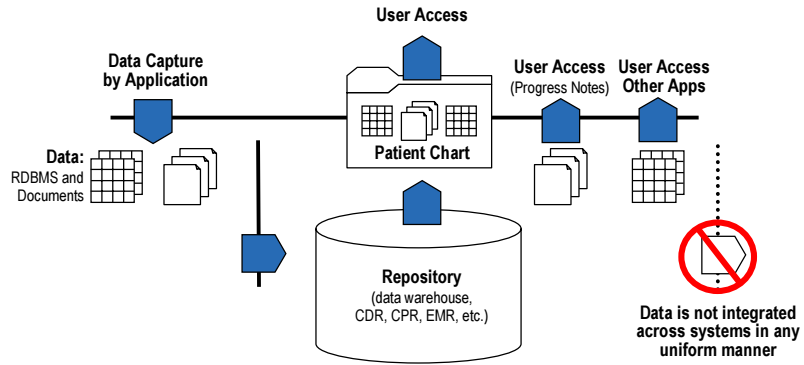
Traditional Information Architectures



Traditional Information Architectures



Current Repository Condition

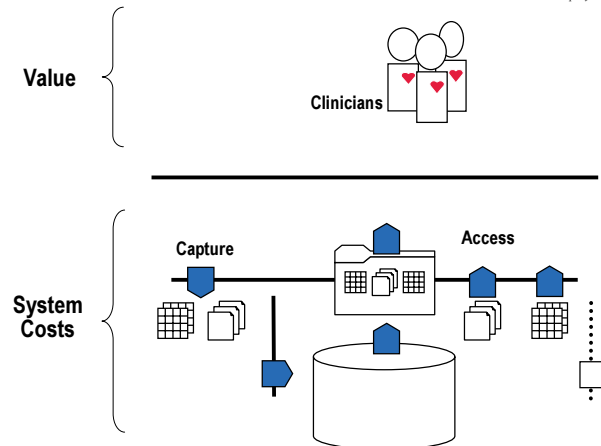


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Cost / Value Model

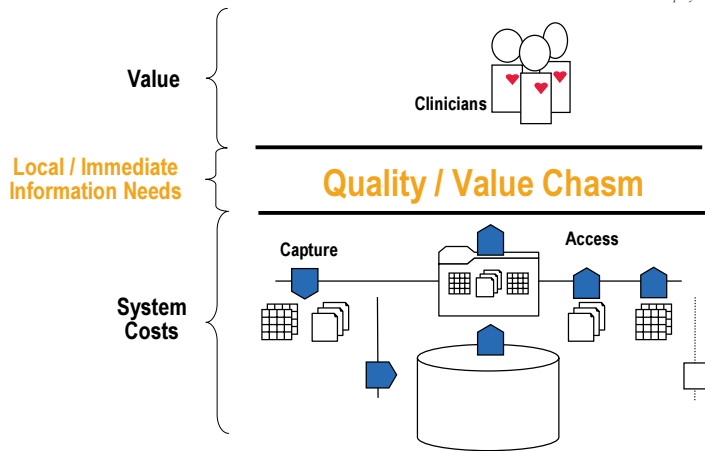


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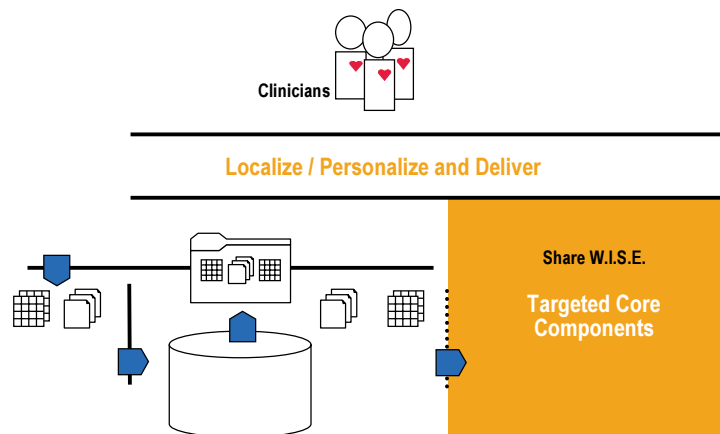
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Cost / Value Model



Cost / Value Model

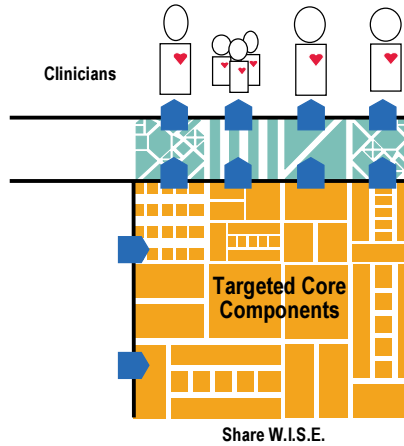


Cost / Value Model



Specific:
• Incremental Cost
• Low Risk

General:
• High Cost
• High Risk

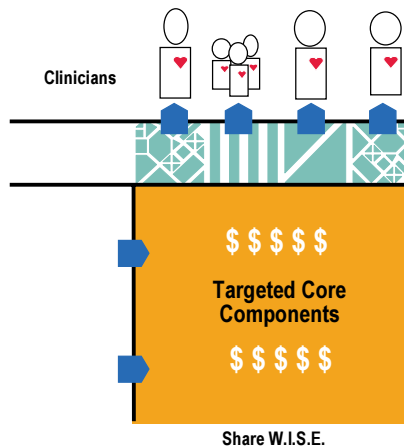


Cost / Value Model

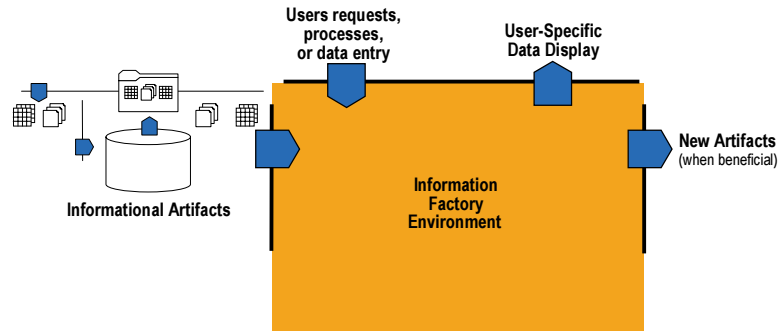


Adapt This Locally

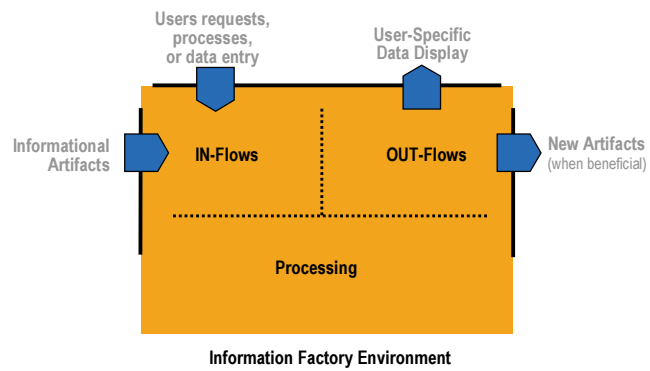
Do This Together



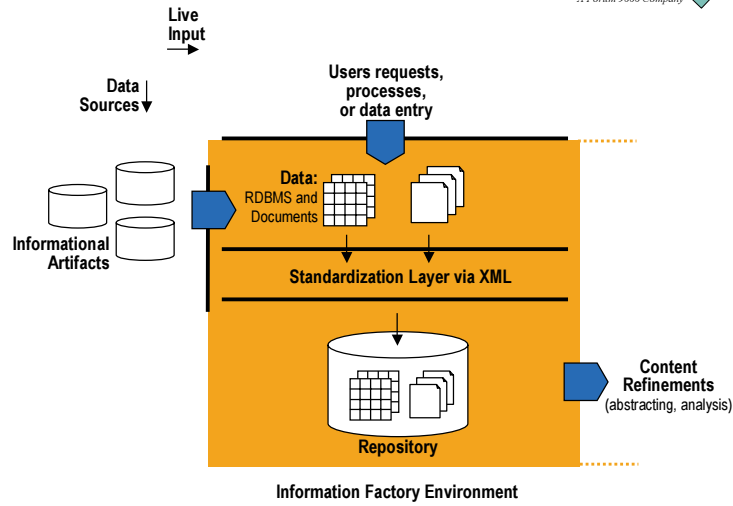
Information Factory Concept



Factory Basics for Information Manufacturing



Data Acquisition: IN-Flows

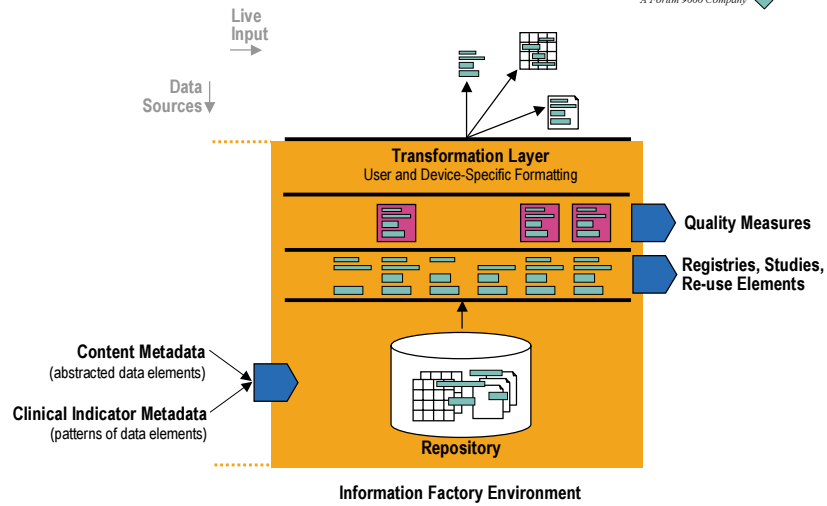


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Information Re-use: OUT-Flows

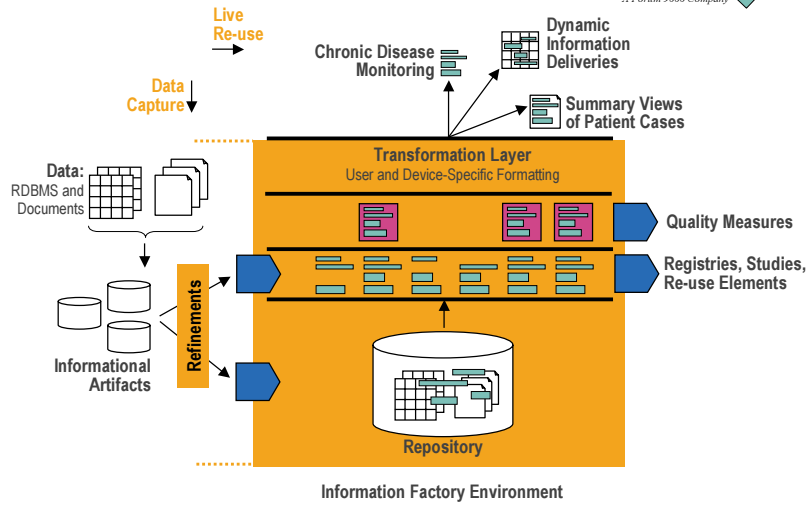


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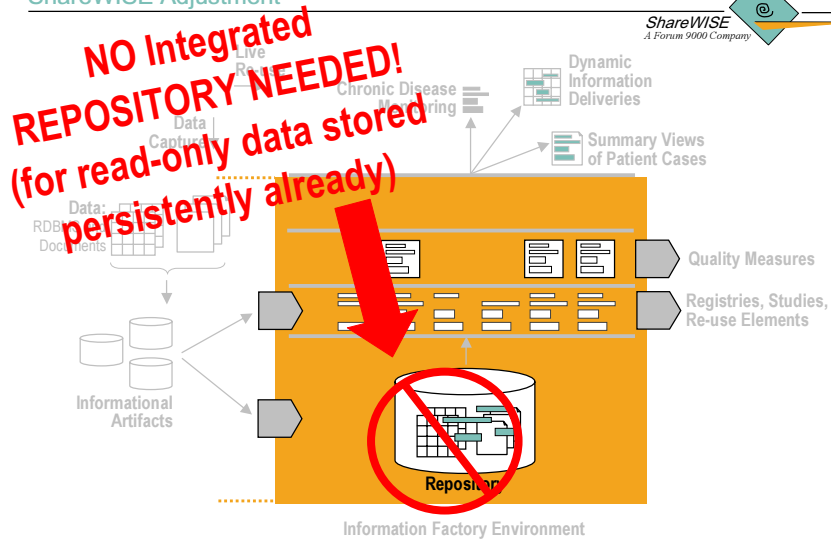
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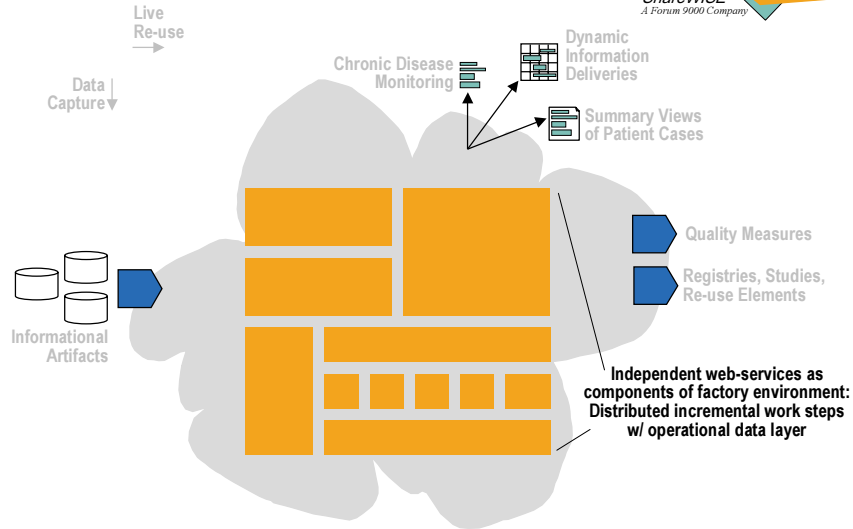
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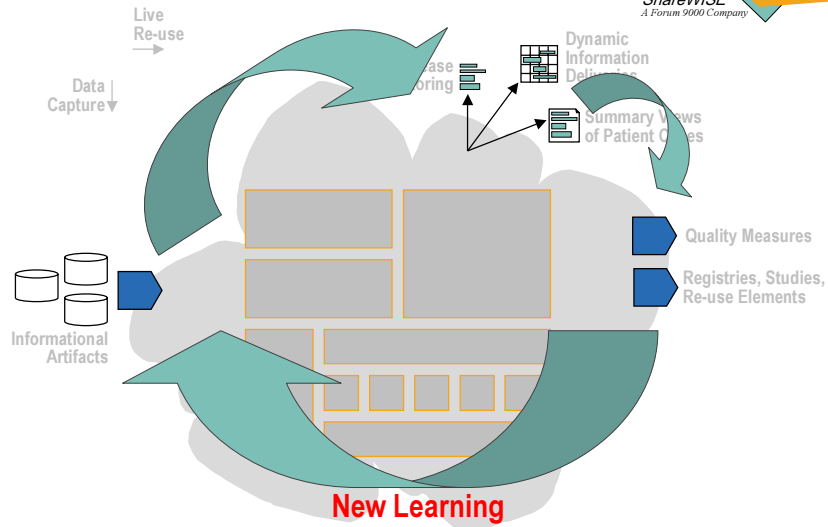
ShareWISE Adjustment



ShareWISE Adjustment



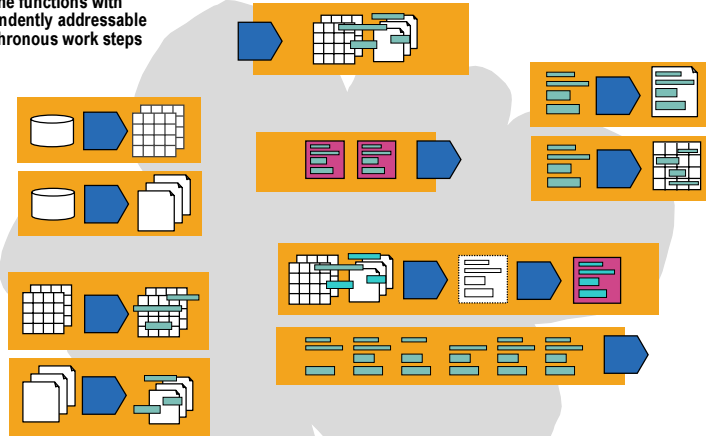
ShareWISE Adjustment



ShareWISE Adjustment



Same functions with independently addressable asynchronous work steps



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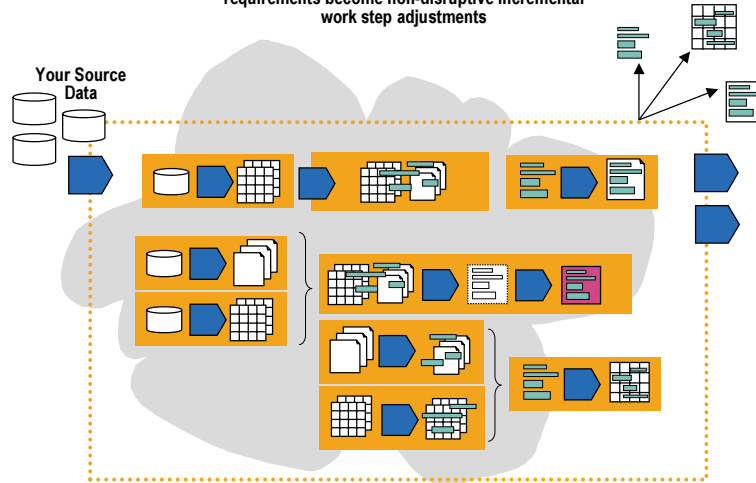
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ShareWISE Adjustment



Changes to source systems or output requirements become non-disruptive incremental work step adjustments



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