Adaptive Work Systems

A Perspective on the Evolution of Socio-Technical Systems

By Stu Winby

This paper provides a perspective on the evolution of Socio-Technical Systems as a new emerging form of work organization, and introduces the concepts and practices of the adaptive work system as the next generation model.

The skilled artisans in the late eighteenth century could only make a handful of products a day when working alone in their small craft shops. However, when that labor was divided among a team of 10 or more, each performing one or two of the steps using specialized tools, literally hundreds of times that amount could be produced. By allocating the work components of a complex process to many different individuals, working in parallel, the division of labor produces returns many times over. So profound were the economic returns to organizing work based on specialization and the division of labor that it became the fundamental distinguishing feature of a civilized society, as a contributing factor to the industrial revolution.

As this approach to organizing work became the most economical and efficient approach to business, the issue of workforce organization came into play. Work was initially organized by division of labor and job specialization managed by the owner of the business, forming a simple hierarchy. Businesses grew by the process of vertical integration: one hierarchy effectively gets absorbed into another, generating a larger, vertically integrated hierarchy. Rather than each individual having a separate transaction with the market, the industrial organization was designed to serve the purpose of eliminating costs associated with market transactions, replacing them with a single contract of employment. Inside this new vertically integrated organization, the skills, resources and time of its employees were coordinated through a strict authority structure targeted at specific markets. This authority structure would generally become a hierarchy and would be perceived as management and the driver of economic wealth.

The vertically integrated model of factories, with specialized production lines, and unskilled labor nearly eliminated the previously dominated craft system of highly skilled craftsmen. For the next century industrial organizations followed the hierarchy model.

By the late 1970s, however, the world started to change. The rapid growth of the world's postwar industrialized economies had begun to reach the limits of what their domestic consumer markets could demand, and further growth required a dramatic globalization of both production and trade. The new playing field was the globalized economy.

When industry economies started to turn towards globalization, many of the working assumptions that sustained successful business performance for the past half century started to change dramatically. From an organizational perspective new multi-dimensional organizational designs emerged. The simple hierarchy was undergoing dramatic change. The complexity of global organizations required the creation of new horizontal processes using cross-functional, cross-company teams that work through common business processes. In addition, due to globalization simple legacy business models have a difficult time surviving an increasingly digitized, globalized, and virtual economy.

It is important to note that several important trends emerged during the early stages of globalization in the late 1970s. Craft production continued to survive

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and was rapidly finding a foothold in manufacturing based industries. In many cases, craft-based production outperformed vertically integrated economies in fast-moving and unpredictable industries like fabric production in northern Italy and parts of France. The essential capability of these craft systems was its flexibility and adaptability to change. Even in the most intensive economies-of-scale industries, these new flexible work systems were being used. For example, the steel industry in the early 80s was abandoning its traditional blast furnace technology in favor of smaller more flexible mini-mills.

These flexible adaptive work systems are the anti-thesis of a vertically integrated hierarchy in that they exploit economies of scope rather than economies of scale. They rely on general purpose machinery and skilled workers to produce a wide range of products in small batches, compared to specialized production with a restricted line of products. In slowly changing environments, in which generic products appeal to a large number of consumers and the range of competing choices is limited, economies of scale are optimal. But in the rapidly globalizing world of the late 20th Century, organizations are pinned between uncertain economies, on the one hand, and increasingly heterogeneous consumer requirement on the other. This, is where economies of scope gained a critical advantage. It was evident that uncertainty and rapid change favor flexibility and adaptability over sheer scale.

The other significant trend in the late 70s was the rapid spread of an approach to work design called socio-technical systems (STS). Research showed that high performance resulted when the design of the technical system (tools and techniques) and the design of the social system (division of labor and methods of coordination) were congruent. In other words, where a high degree of socio-technical fit was achieved, performance increased. These systems later became known as *high performance systems*. By the late 70's, several hundred new plant designs and just as many redesigns were underway.

The design of socio-technical systems and craft-based flexible work systems were very similar in principle and design, employing team-based work systems that are self- regulating using feedback and high engagement goal setting, which resulted in fewer levels of hierarchy, and greater discretion with workers.

The work design and processes of both STS and flexible manufacturing have been successfully integrated into most organizations today. It is difficult to find an organization that does not encourage team work, employee participation, and decision making, and is organized in a more decentralized fashion than its past hierarchal structure.

Globalization and Uncertainty

Globalization has matured to where many growth markets come from the developing economies, not the developed economies. First generation successful enterprises coming out of the developing world are growing by penetrating mature markets with low cost offerings. New technology continues to shift to a more digitized global economy. Technology, specifically the internet and social media technologies, have fueled the leveraging of worldwide access to knowledge and rapid information processing, leveling the playing field for US companies.

The ability to rapidly access and process information is contributing to the increasing reliance on innovation for new solutions and markets. The past as a solution set is becoming no longer a viable option. Solutions are increasingly not found in prescribed processes from the past, but newly discovered and designed. Companies must be capable of both efficient operations and innovating new products and services.

Uncertainty and Problem Solving

When environmental uncertainty is low and change occurs slowly, and the future is predictable - then task uncertainty is low, effectively allowing the design / learning and production phases to be completed separately. The assumption is that even when a complex task is a decentralized process, requiring the simultaneous, coordinated efforts of many specialized workers, its design is somehow centralized, imposed from the above hierarchy. However, the level of task uncertainty has increased dramatically, so not only do organizations face uncertainty over which particular task is required by the external marketplace, they are also uncertain about precisely how they should go

about completing any task or what the corresponding criteria for success might be. In today's environment, it is common for no one person to precisely know the specified work requirements in advance. Rather, each person starts with a general notion of what is required and refines that notion only by interacting with other problem solvers, who possess different expertise that is pertinent to the problem

The amount of task uncertainty is triggered by the environmental uncertainties often requiring redesign of the production process as well as the design itself. This means that an equally important task must focus on innovation and variance control, which is performed, at the same time as the task of production and in the same decentralized fashion. This requires a different model of work organization.

When the environment cranks up the rate of change required for a new strategic choice and competitive action, the complex task must be organized, and available human capital reallocated. Instead of some individual or group that serves as overseer, this task organization and resource allocation problem is best solved by the same individuals who have to perform the task of production. The result is a continued swirl of problem-solving activity and ever shifting interactions between the problem solvers, each of whom has information relevant to the solution of a particular aspect or dimension of the problem, but none who knows enough to act in isolation. Nor does any one person know precisely who knows what, hence problem-solving is not just performing the necessary combinations of resources (this is what flexible work systems are about) but searching for and discovering those resources in the first place

The central idea underlying flexible production work and socio-technical systems is that the tasks required of most organizations are subject to significant unpredictability and rapid change. The environmental turbulence, rapid rate of change and the shifts mentioned above strongly suggests our ways of leading, learning, working, innovating and organizing must be reframed. A basic proposition is that uncertainty, problem solving, and work design are central to the behavior of the modern organization, and should be reflected in the next generation work system design.

To sum up, the rate of change fueled by intense globalization, quicker access to knowledge and technology, is driving the management and organization of work. We have moved from an era of equilibrium to an era of constant dis-equilibrium. The rate of change will only increase, thus fueling ongoing industry discontinuities, innovation, and the need to engage problem solvers responsible for production or service tasks in finding new solutions.

Social Production

In the Silicon Valley, a new model of economic production, referred to as social production, is being discussed with a moderate amount of start-up examples in progress. In social production the creative energy of numbers of people are coordinated (typically through the Internet) into sometimes large, significant projects mostly without a traditional hierarchical organization. People use their own tools for production, many of which are based in various software applications. Tasks are not delegated based on a central decision-making process but self organized. A market mechanism tags different prices to different tasks serving as an incentive to anyone interested in performing a task.

The point of mentioning this emerging trend of social production is that work is increasingly becoming more decentralized, more network focused, and more market driven. The firm, or company structure, that came into existence to eliminate cost associated with market transactions with a single employment contract, may compete against alternative network organizations that employ a social production model.

Production work has gone through various transformations since the early craft work. Although new ways of working are introduced, they don't necessarily eliminate the previous approaches to work organization. An evolution of various work systems is provided below:

1. Small Guild Based Production – *Craft Production*
2. Scientific Mgmt Production – *Industrial Production System*
3. Small Batch Production – *Flexible Specialization System / STS*
4. Optimized "lean" Production – *Toyoda Production System*
5. Net Work Production - *Adaptive Work System /*
6. social Production – *Networked production*

Organizations and Work Systems

The term *work system*, as it is used here, refers to an organizational design and alignment of people, processes, technology and information as compared to earlier definitions of a particular combination of job tasks, technology, skills, management style, and policies and practices. The work system design determines how work is organized and managed, how people will experience work, and how they will perform.

The term *work system* is also positioned as an evolving extension or next generation socio-technical systems theory and model.

The concept of work system is not limited to a small group or work unit, but as an organizational architecture, specifically a type of network organization that is scalable from the small work unit level to an enterprise organizational design. Given that work organizations are moving towards smaller decentralized "production units," the notion of work systems is useful. The term *adaptable work-system* is used more at the operating level and *adaptable organization* used at the macro level.

This adaptable network model has also been deployed in larger ecosystems, where, for example, a company was a single node in a value chain sharing a common value proposition with other companies who collaboratively deliver value to a common customer base. This "value net" arrangement exemplifies the scalability of the work system model.

The following section of this paper will provide a brief overview of key concepts and definitions associated with an adaptive organization, followed by a set of design principles and design methodology. Examples of how this new work will be provided as well as key questions regarding its evolution.

Adaptive Work Systems

An adaptable work system is agile and dynamically changeable. Adaptable work systems, frequently referred to as *network organizations*, are better suited to complex, rapidly changing, and turbulent environments than hierarchal structures, which do better in stable, simple routine environments. The adaptive work system is a type of organizational network that is configured to operate as a high performing work system (socio-technical system) at multiple levels of global, enterprise or unit levels of design.

Performance characteristics such as agility, speed, flexibility, and re-configurability are typically delivered by the adaptive work system. This work system incorporates into its design the principles of innovation, network sciences, and socio-technical systems theory and practice into a new model of work organization.

A distinguishing feature of this type of work systems is its approach to the planning and performance of work. Adaptive work systems approach planning and development /production work as evolving and refined over a series of iterations, rather than fully defined or "frozen" before the iteration begins. These work systems are consistent with the pattern of unpredictable discovery-driven planning, flexible manufacturing, and design thinking approaches to product and service development.

Adaptable work systems can be characterized as follows:

A balance of optimization and adaption processes through an ambidextrous approach to management and organization.

Optimization processes focus on efficiency and cost reduction. They are documented, measured, refined, and repeated. Adaption processes focus on innovation, exploration, speed, and response external changes. Optimizing processes thrive in low-change, predictable environments, whereas adaptive processes thrive in high change, uncertain ones

One solution to the execution versus adaption dichotomy has been organizational ambidexterity (OA) referring to an organization's ability to do two different things at the same time. An "ambidextrous organization" refers to an organizational design containing not only separate structural subunits for adaption (exploration) and execution (exploitation), but also different competencies, systems, incentives, processes, and cultures for each unit.

A balance of hierarchy and networks

An extension of the ambidextrous organizational design is the balance of hierarchy and networks. Most companies have hierarchies that dominate the organizational structure along with lateral networks

that run horizontal across the verticals. Cross unit teams and matrix arrangements best represent this typical organizational design. In adaptive organizations, verticals and laterals still co-exist, but over time verticals move to the background and lateral more to the foreground. This is similar to a professional services organization where employees have homerooms but spend most of their time on client projects that involve a mix of functions.

Business Objectives

Adaptive work system performance is driven by five business objectives:

1. Continuous innovation
2. Strategic and organizational adaptability
3. Socio-technical optimization
4. Improved time to value
5. Reliable results – constantly adapting to meet a goal (on-time/ quality) typically qualified by the customer's acceptance of value.

Design Principles

An adaptive work system is a set of principles put to some purposeful application and situation. Adaptive work system design principles represent the basic assumptions that guide the organizational design process and affect design decisions and the arrangement of design element. These principles are both extensions of the early foundational work done in socio-technical systems and new emerging design principles based on current theory and application of adaptive work systems. Also, an adaptive work system is principal-based not rules-based. Rather than a defined set of rules regarding roles, responsibilities and activities, the process is primarily guided by a set of principles.

The core purpose of design is to enable a network of people to efficiently, effectively, and innovatively produce and deliver product and service outputs that meet customer expectations in the context of a rapidly changing environments. Some of the guiding principles used to frame the organizational design process are described below:

1. *Open Systems Design*

   Design starts from outside the organizational network by enabling its members to jointly gather information and learn from environmental conditions, context, and customer expectations. Through a process of foresight-insight and discovering the deep needs of customers, the network constructs a vision of its solution to meet customer needs and accommodate environmental constraints and opportunities. The open systems design principle is realized through a number of adaptive work system processes and tools.

2. *Empirical Process Control*

   Variance control has historically centered on correction rather than learning. Plans and processes were viewed as reasonably correct and therefore control focuses on fixing mistakes and explaining mistakes, not learning something new that might legitimately alter the plan. A key process of adaptive work systems is to execute on its task vision, not to develop plans or schedules. This emphasis on task vision puts the focus on progress, adjustment, and learning.

   Empirical process control means the work process is highly visible and the process detects real time unacceptable social and technical variances. When variances are detected, adaption occurs as quickly as possible to minimize further deviation. The work process is self-managed on a daily basis. At different intervals, everyone's work is subject to variance control, as well the entire system and the work context. Context design involves removing variances outside the work process. The heart of empirical process control is learning. How can the team learn at a faster rate following each iteration?

3. *Information processing*

   Adaptive work systems are purposely designed for high levels of information processing. Organizational performance is optimal when the information processing capabilities of the organization fit the information processing requirements of the work. This was recognized by Jay Galbraith in 1974 by noting "the greater the task uncertainty, the greater the amount of information that must be processed among decision makers during task execution in order to

achieve a given level of performance". Decision making among network members is accelerated through various information processing work designs and technologies. For each project the corresponding design of the work system focuses heavily on information processing design, because this drives cycle time, productivity, and quality of output.

4. *Purposeful Networks*

   The network structure is defined by the problem that needs to be solved or the product or service that needs to be designed and developed. It is important to identify a critical mass of people who possess the required experience, knowledge, information, and skills that when combined will enable the task to be completed. The work design challenge is to ensure that the right people have the right conversation to produce the right output. The interaction of those individuals is defined as the work design task.

5. *Design for Interactions*

   Design for people and interaction, not structure and processes. Design for interaction is the new work design. It is exemplified by the phrase "design for the right people, right information, right interactions, right knowledge, right conversation, and right outcomes". The work process establishes roles and infrastructure to capture and process information real time as parallel interactions are taking place. People are expected to interact, collaborate, be imaginative, solve problems, and develop product outputs. Large group methodologies like a decision accelerator are used for the design of interactions, as well an iteration reviews and reconfigurable sessions where design for interaction occurs.

6. *Complex adaptive systems*

   A complex adaptive system is one that consists of elements, called agents, whose relationships may be changing all the time. Agents are capable of self organizing, often following a set of rules. In adaptive work systems, similar properties are at play, where individuals get work done through reconfigurable interactions and self organization. Practices are used to drive "emergence" similar to complex adaptive systems.

7. *Integrated Practices*

   A system of practices exist which are mutually supportive and reinforce each other as they align with principles and values. Practices are geared to be simple, aligned with socio-technical values, generative and not prescriptive, minimal (just enough to get the job done, and focus on delivery of value to the customer.

8. *Self organizing units*

   Empowered self organizing units or teams are developed around whole pieces or key elements of the output product. This is determined by amounts of functionality it can design and produce during an iteration of work. Typically, multiple nodes or teams work during the same iteration, each focused on a different set of functionality. At the end of the iteration, the work units, review output, identify interdependencies, social and technical variances, and develop the required re-configurability for better adaptability and iteration execution.

9. *Re-configurability*

   Adaptive work systems have the capability of a dynamically reconfigurable system that can dynamically change its behavior in response to dynamic changes in its environment. The work system has the capacity to reconfigure as required. One key objective of re-configurability is to create a variety-increasing work system that embodies the principle of redundant functions (network members take on multiple, redundant functions)

10. *Values*

    Key values are collaboration, diversity, learning, commitment, and empowerment - (the act of pushing authority, skills, information, and knowledge into the work unit and to the individual -). Positional power is limited, information and fact base discussions drive

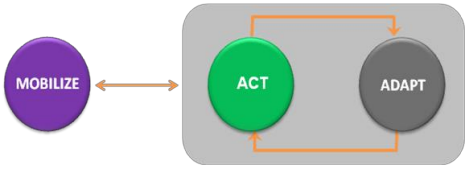
decision making, and diversity of thought is encouraged,

11. *Feed-Forward and Feedback*

    Adaptive work systems have both feed-forward and feedback systems. Feed-forward passes a signal from a source in the work system's external environment which allows anticipation and greater problem solving capability, and feedback allows for learning and adjustment based on output and customer information. Feed forward used various crowd sourcing tools and methods.

Framework

The simple framework for the adaptive work system is presented below.



The model deploys three steps – mobilize, act, and adapt.

Step one is to MOBILIZE the network and collectively define the problem, solution, and design the work system to implement the solution.

Step two is to create one or more nodes or teams to ACT by working through a series of work iteration to produce an agreed upon output. Multiple nodes continue to integrate their work as they produce their outputs. Frequently an integration team integrates in process work and drives emergence. This serves as a fly wheel of sorts in providing high leverage iteration to work in process.

In *step three* outputs produced in the iteration along with customer and environment data are reviewed and the work system reconfigures to ADAPT. The act and adapt steps continue until the customer is satisfied with the output.

The work system framework serves as a platform for various applications. Applications are design processes. Some of the most deployed applications are:

1. Business model design
2. Product design
3. Service design
4. Experience design
5. Work design
6. Transformational design

Performance and Results

The adaptive work system continues to be tested as an action research work innovation. Initial implementation was first started in 2008. Most implementation has been in the health care industry and technology sector. In general, the results are positive and suggest the adaptive work system is an organizational capability whose characteristics and benefits do not exist in traditional organizations and thus provides a source of advantage.

- *Reduced time to value (speed).* Customers continue to comment on the reduced cycle time in getting to a defined desired outcome. A number of SPRING case examples support this finding.

- *Maximizes productivity of resources (costs).* The methods of parallel processing and retrospectives continue to eliminate waste, and produce scale and leverage opportunities by maximizing productivity of resources.

- *Scale and leverage:* The ability of adaptive work systems to scale and leverage has had a significant impact on company results. An innovation and optimization rapid diffusion process, referred to as the *Work Innovation Network at* Hewlett Packard in the 90s is an example of the adaptive model which secured similar improvements in multiple sites at the same time.

- *Customer co-creation and on-going engagement.* The work process is driven by the customer. Ethnographic data as well as customer requirements drive the output. Typically, as work is completed, the customer is also learning and changes are

made to accommodate this learning. This process therefore has strong customer commitment and satisfaction for results produced.

- *Increased and continuous innovation*. Adaptive work systems bring the discipline and practices of design and innovation to all work challenges.

- *Accelerates stakeholder commitment (empowerment).* All key stakeholders are actively engaged in the definition of the problem and solution and work design. Customers drive the work product.

- *Significantly increases social capital (integration).* The network rapidly develops relationships with each other which are developed over the period of the work project.

- *Increased learning*. Probably the single most important driver of performance is that organizations develop capability to learn. Most work is defined as low cost rapid learning cycles in order to reduce risk and design/develop output.

- *Increased capacity to adapt*. Increases in the organization's ability to respond to change more quickly and to adapt to shift in the environment (customer needs and market/ competitor moves).

- *Increased and continuous innovation*. Adaptive work systems bring the discipline and practices of design and innovation to all work challenges.

Summary

The early work of Trist and Emery, who founded socio-technical systems (STS), has provided the theoretical, practical, and values based foundation for future work systems to be built. In the late 80s early 90s, STS began to disappear both academically and in practice, but was successfully adopted into mainstream organizations. Today, for example, the word "engagement "is overused at the shop floor level as well as in the board room, and back in the 80s it was referred to as "employee involvement", and earlier it was termed "participation". These were key principles in STS when there was no room for employee voice in the work process.

STS was initially conceptualized as a shop floor manufacturing process and then moved to knowledge worker office environments. Today, the adaptive work system model as an evolution of STS creates value at all levels of the enterprise and ecosystem. The model also operationalizes network organizations which have been limited by the notion of informal social network or high level "value nets". The adaptive work systems define networks as production systems, which is a much different capability then previously defined as a network organization.

Now with the emergence of the digital world, technology again co-ops organizational structure by driving the decentralization of information to the lowest level of the organization, thus reducing the reliance on hierarchy for information exchange and coordination. Decentralizing information processing with more self-organizing social processes is on the rise, especially if one takes a close look at Silicon Valley companies like Google, Facebook, and Linked-in. The emergence of the digital work system sometimes called "smart teams" makes for an organizational capability at the heart of many digital disruption stories. The focus is on the end user, consumer, and customer. In the health industry, for example, understanding the patient journey--the new throughput system--where the ecosystem is mapped, along with an analysis of types of technology devises and types of interaction, has become an important focus for understanding the needs of the end user.

The ecosystem is becoming the new organization unit of analysis. In the smart team model, the ecosystem becomes the work system typically around a specific customer segment. Wearables and other devises are used to link the customer to the smart team, who coordinate its work to continuously improve the customer experience. This is particularly effective in healthcare smart teams with the focus on patients with specific diseases or ailments. Information from patients goes to a large data base to provide analytical data to the smart team relative to a specific

patient. The smart teams are adaptive work systems which continually reconfigure and learn through continuous data, action, and feedback. It is this organizational capability which provides a superior way to allocate and utilize resources to achieve defined outcomes that add value for consumers, employees and the enterprise. It is a real time mechanism for reducing risk in all applications, including product/process innovation and strategy or program execution. It is a capability that is faster in achieving desired results than linear, traditional contemporary disciplines e.g. program/ project management.

This work is still in its early stages and as with all innovations will take on-going learning and action research to find its true value.

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