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Reflections: Sociotechnical Systems Design and Organization Change

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ABSTRACT
This paper traces the evolution of sociotechnical systems design from its origins in the coal mines of Great Britain to the present day and beyond, into our digital future. Conceived as a means of enhancing productivity while simultaneously providing more meaningful work, sociotechnical thinking gained ground in machine-driven work settings and later took a leap forward to aid the effectiveness of knowledge work. After a period of stagnation as popular fads such as total quality, reengineering and lean six sigma took hold, sociotechnical thinking is poised to reemerge as capabilities associated with new technologies are rapidly outpacing the development of new organizational designs. A recent sociotechnical systems design lab brought together a diverse group of academics, thinkers and practitioners to discuss the future of organization design, producing tantalizing insights into the world that is about to take shape. Finally, implications for change management in sociotechnical transformation are discussed.

KEYWORDS
Sociotechnical systems; design thinking; network ecosystems; organization design; organizational agility; leadership; disruption

The past

Sociotechnical systems design (STS) as conceived by Trist, Emery and others (Trist & Bamforth, 1951; Trist, Higgin, Murray, & Pollock, 1963) was intended to enhance the performance of work systems by recognizing the ways in which the behaviours of human actors affect the operation of technology. More specifically, better operational performance could be achieved when the knowledge and capabilities of workers were leveraged to help deal with technological uncertainty, variation and adaptation. By allowing those closest to the technology to input into the design of the system and to exert control over the processes involved, workers not only did a better job than those farther removed but also benefitted from the challenge, variety, feedback and teamwork that was involved in taking responsibility for the performance of the system. Work systems were viewed as open systems, meaning that they existed in a changing environment in which external forces acting on organizations required ongoing changes in operational arrangements to sustain high performance levels over time. The resulting need for the continuous redesign of work required that agility was built into the design of the

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organization. This redesign process was enhanced when workers' intimate knowledge of how the system operates was incorporated into new design solutions. The increased commitment generated by the involvement of workers in design decisions reduced resistance to change and supported high levels of goal-directed behaviour. Thus, STS design was intended to produce a 'win-win-win-win': human beings were more committed, technology operated closer to its potential and the organization performed better overall while adapting more readily to change in its environment.

Sociotechnical systems thinking had its origins in the coal mining industry in Great Britain in the 1950s. Eric Trist and his colleague at the Tavistock Institute for Human Relations were interested in founding a social science research organization that would apply Lewin's 'action research' (Lewin, 1946) to address organizational issues and opportunities. In their search for research sites, Ken Bamforth, a former coal industry executive who had joined the Tavistock staff, made Trist aware of challenges associated with applying new technology to boost postwar coal production. Different mines, it seemed, were experiencing widely variable results with the new technology, the reasons for which at the time were not clearly understood. Tavistock researchers visited the mines, spoke with leaders and workers and began a series of studies under the auspices of the British Coal Board, an industry-led association.

Because of the noise, crowding and dangers of the underground environment, Trist and his colleagues collected much of their data from workers after their shifts in local pubs. There, workers felt free to vent their frustrations with the ways technology was changing their work and how they were coping with those changes. The researchers found that unmechanized mining methods had given way to machine-driven technologies designed by engineers, some of whom had never worked in a mine. There were problems from the start with operating the technology as the engineers had intended. In some mines, management insisted that the problem was that workers, who yearned for the old days, were not complying with directives about how the technology was to be operated. Workers insisted that operating the technology as directed by the engineers was impossible given the extreme unpredictability of the underground conditions and the safety issues that resulted. Workers further said that the new work system had divided responsibilities so that teams of workers no longer controlled all the activities that were required to ensure safety and productivity. In addition, in the new system, miners were paid individually and sometimes found themselves pitted against one another to earn the maximum incentive. In the old system, miners carefully selected their mates and were paid as a team. In the new system, blaming others for not completing their work correctly or on time became widespread. Supervisors in the new system were stationed at the end of long, dark tunnels where the work was being performed, and could do little to intervene.

Not all mines experienced these difficulties. Mines where management saw the problem as a failure on the part of workers to follow direction suffered a higher rate of accidents and had lower productivity than mines where management trusted and respected workers, and asked them for advice in how to make the new technology work. In the latter, teams of multi-skilled workers formed spontaneously and took on responsibility for the entire cycle of mining operations rather than dividing the work into individual, distinct jobs that made coordination under the extreme conditions difficult or impossible. These teams were capable of self-direction, reducing the dependence on supervisors to provide constant direction to individual workers. Problems were solved by the team as they were encountered, resulting in operations running more smoothly and safely.

In reflecting on what they had learned, Trist and his colleagues asserted that organizations have a choice about how they organize labour around technical systems. The technology itself didn't dictate that one and only one way of working was possible. Instead, work systems could be devised that allowed employees to have greater control over technology, working together to enhance results while also experiencing social and psychological rewards.

Despite the careful documentation of results, the British Coal Board did not find the research compelling enough to warrant the continuance of this approach. Resistance on the part of mine owners to allowing workers to share in operational control blocked the widespread diffusion of the superior approach.

Trist was later joined at Tavistock by the Australian Fred Emery, and together they formulated and advanced STS theory. The pair found a willing host for further studies in several industries in Norway, where a movement known as 'Industrial Democracy' was taking root, based on the belief that workers were entitled to a say about how their work was performed (Emery & Thorsrud, 1964, 1976; Thorsrud, 1970). The culture in both Norway and Sweden was less hierarchical than that of Great Britain, which explained why the concept shared operational control was embraced and most notably captured in publications regarding applications in Volvo in Sweden (Aguren, Hansson, & Karlsson, 1976). Over the years, others added to the principles of sociotechnical design (Cherns, 1976; Emery, 1959; Pasmore, 1988), summarized in Table 1 below.

By the 1970s, word of the success of STS experiments had spread to the U.S., where Lou Davis at UCLA incorporated the ideas into efforts in several organizations under the banner of 'Quality of Worklife' experiments (Davis & Cherns, 1975). There was widespread concern in the U.S. that work on assembly lines and in other machine-dominated workplaces was dehumanizing. Social scientists were interested in ways to restore dignity

Table 1. Classic sociotechnical system design principles.

Principle	Explanation
Wholeness	The work system should be conceived as a set of activities making up a functioning whole, rather than a collection of individual jobs.
Teams	The work group should be considered more central than individual jobholders.
Process control	Variances (problems or deviations from expectations) should be identified and handled as close to their point of origin as possible, preferably by those who can prevent them from occurring, without requiring supervisory intervention
Self-direction	Internal regulation of the work system is preferable to external regulation of individuals by supervisors.
Multi-skilling	The underlying design philosophy should be based on a redundancy of functions rather than on a redundancy of parts (multiskilling vs. single-skilling).
Discretion	The discretionary component of work is as important to the success of the system as the prescribed component.
Joint-optimization	The individual should be viewed as complementary to the machine rather than as an extension of it.
Adaptation	The design of work should be variety increasing rather than variety decreasing, meaning that individual and organizational learning is essential to allow organizational adaptation to change.
Meaning	At the level of the individual job in a socio-technical system, there should be for each person an optimal level of variety, learning opportunities, some scope for setting decisions that affect the outcomes of work, organizational support, a job worthy of societal recognition, and the potential for a desirable future.
Incompletion	Since the context of the organization will continue to evolve over time, no design can be considered 'finished.'

and meaning to workers. STS values fit this need and promised greater efficiencies as an added incentive for management to rethink their operations. Procter & Gamble, Hewlett Packard and General Foods were early adopters of the approach, initially in new ('greenfield') manufacturing facilities and later in the redesign of existing ('brownfield') operations (Lawler, 1978). General Motors, Monsanto, Champion Paper and others followed, often running into the same problem that Trist and Rice had encountered; traditional leaders who feared giving workers greater control over the design and operation of work systems blocked diffusion of the ideas despite compelling evidence of the effectiveness of the approach.

In the early 2000s, reengineering (Hammer & Champy, 2001) offered control-minded leaders a different pathway to improve performance. Its promise was that work systems could be engineered from end to end with a focus on work processes rather than on individual departments or units, thereby greatly improving performance, eliminating wasted headcount and leaving management firmly in control. Reengineering later incorporated lean six-sigma (Womack, Jones, & Roos, 1990), applied in companies such as Motorola, Toyota, Honeywell and General Electric with great success. The 'lean' focus was on efficiency and cost cutting via reducing inventory, simplifying processes, improving quality and decreasing headcount. With efficiency experts firmly in control, the application of STS design, perhaps too closely associated with employee empowerment and the 'Quality of Work Life' concerns of the '70s, faded from the manufacturing scene.

In the 1980s, STS thinking also found its way into application in non-manufacturing settings or 'non-routine knowledge work' environments due largely to the groundbreaking work of Calvin Pava, Ron Purser, and researchers studying cross-functional knowledge based teams at the University of Southern California's Centre for Effective Organizations (Mohrman, Cohen, & Morhman, 1995; Pava, 1983; Purser & Pasmore, 1993). This work built on the tenet of STS theory that the workers themselves should identify and control 'variances', which were instances where work deviated from the expected range of high quality performance. Pava offered that 'deliberations'– the thoughtful consideration of ideas by a group of people engaged in a shared effort to find knowledge and make it useful—were the proper focus for variance control in non-routine systems.

In 1988, Shoshanna Zuboff's *In the Age of the Smart Machine: The Future of Work and Power* laid out the challenge that people would either become masters of technology or its slaves, and that work systems applying technology could be designed to fit either of these scenarios. The STS era represented a hope that technological advances and human aspirations could be achieved jointly. Recurrent findings, however, demonstrated that the machine logic of hierarchically controlled, engineered work systems prevailed.

The present: social and technical disruption

At the height of sociotechnical systems popularity, annual Ecology of Work conferences sponsored by NTL and the OD Network in the U.S. had attracted thousands of attendees from Academia, industry and labour—audiences eager to find ways to align technological systems with human meaning. Hundreds of workshops on how to design work systems using sociotechnical principles were held at UCLA, the University of Toronto and elsewhere. A recent Google Scholar reference count on the term 'sociotechnical systems' produced 2,390,000 hits. Clearly, the topic caught on and was more than a passing fad in the time it was in the spotlight from the 1950s through the 1990s. Today, a small group of members of the STS Roundtable continue to meet, advance STS thinking and incorporate its approaches into their work; several of the innovations in practice they are considering will be addressed here. Despite their efforts, the vast majority of current leaders, and many involved in the design and development of work systems, would not know what the term 'STS' means.

At a time when the landscape for the global economy and its work systems are being reshaped by the burgeoning of information technology, digitization, and advanced technologies, the precepts of STS would seem to be more relevant than ever. Nevertheless, the evolution of social systems is not keeping pace with the exponential advance of technology, let alone anticipating more pervasive changes yet to come.

During the past couple of decades the economy has hurtled through a post-industrial era characterized by the ascendancy of knowledge and service work and the automation of routine work. We are now entering into the third era of automation, in which machines develop intelligence and start to make decisions (Davenport & Kirby, 2016). Companies that were the successful inventors, developers and commercializers of digital technologies have found a fertile context for rapid expansion and growth. Microsoft, Google, Alibaba, Tencent, Amazon and many others have become the behemoths of today's economy, amassing incredible wealth for their founders and executives, and changing the expectations and habits of consumers, shareholders, the workforce and general population.

Along the way, most legacy companies have had to adapt to the new market and competitive realities by incorporating new ways of working and new technological capabilities. Many have been seriously weakened, or disappeared. Brick and mortar store retailers are succumbing to online retailers like Amazon and Alibaba. Similar disruption is happening in many other industries, including energy, the agri-food industry, retail clothing, entertainment, and even the mining industry, where robotics is providing a safer and cleaner way to extract ore but in the process is displacing the workers who used to go into the mine.

Leading companies in almost every sector are developing new business models to deliver value to customers through powerful digital platforms that have enabled end to end supply chains that are smart and coordinated (Teece & Linden, 2017). Yet many organizations are struggling to embrace these changes. Lacking agility, they face the disruption of their business models, low engagement of their workforce and demise. Very few organizations have defined and started to develop the organizational capabilities they will ultimately need. This is true at the societal level where, for example, the development of autonomous vehicles will lead to pervasive technological and social change throughout the transportation eco-system including the elimination of whole occupations. Another example is the healthcare industry that provides the livelihood for 9% of the population in the U.S. Digitization is enabling personalized and self-care approaches that move many elements of medical treatment and care out of the traditional venues of hospitals and doctors' offices and into homes, at the same time that health care systems are expanding their traditional footprints through a blitz of mergers and acquisitions. If traditional organizations knew how to apply principles and processes of sociotechnical systems design, they would have a better shot at survival. Unfortunately, few are aware that alternatives to their current ways of operating exist.

Workers who do not have relevant knowledge for the digital era are being displaced in numbers that are causing considerable social unrest. At the same time, there is a shortage of qualified IT professionals, and a renewed war for talent who are knowledgeable about all aspects of the digitalized economy. Most companies need workers who can think, innovate and apply newly available technologies to enhance the speed, quality and costs of serving customers. To attract the high caliber talent required to innovate, these organizations need not only to pay well but also to make work meaningful, challenging and even fun.

Even the successful tech firms mentioned above have not found ways to keep their social systems advancing as quickly as their technology. Although they are purveyors and rapid adopters of advanced technology, we should not make the mistake of assuming that their new organizational approaches that are being touted in the popular press have solved the problem of how to use their own technology approaches optimally to operate effectively and to meet the needs of the workforce. In fact, as they get past their startup periods, these firms are encountering many of the same challenges of staying agile while dealing with rapid growth, navigating the war for talent, accepting societal responsibility, and developing a more networked way of operating. They face the same need to continually change their business models as other companies around the world move rapidly and flexibly to challenge their ascendancy.

Meanwhile, millennials have moved into leadership positions and the digital native generation Z is not far behind. These cohorts have arrived with changed expectations, values and motivations. Placing a high value on autonomy, meaning, teamwork, personal development, self-expression, fun, and life balance, these workers decry bureaucracy and hierarchy. The needs of millennials in some ways mirror the needs of the coal-miners in Britain. Both crave choice in their work environment and prefer self-direction to being closely observed and controlled. As the pendulum swings toward a desire for fewer restrictions and greater autonomy, the work environment created by sociotechnical design will be a better fit with the talent of today than the top-down, handcuffed, narrow job, 9–5 work system of the past.

When it comes to the need to make fundamental changes in organizational design in order to become agile and adapt to new technologies, many organizations try to keep up with new technologies and business models through a series of disconnected initiatives that rarely meet their intended goals. As was the case in the coal mining companies in the 1940s Britain, these initiatives leave untouched the dominant hierarchical form in which those in power exercise control over behaviour in the workplace rather than inviting others to share power and co-design.

Rather than thinking systemically and seeing agility as an ongoing capability to be built into how the organization is designed and operated, companies continue to utilize linear change and implementation frameworks that are based on the outdated notion that the organization can be unfrozen, changed, and refrozen in a new more productive state. Although leaders still think in terms of 'from-to' the fact is that the future is always evolving, meaning that no permanent 'to' exists. Instead, change needs to be viewed as continuous and capabilities built into the organization for on-going integrated transformation (Pasmore, 2015).

This is truly a socio-technical challenge. In the rest of this reflection, we share our experience with an effort to look into the design of organizations and work systems for future.

The future: 'Next-Gen' socio technical systems insights from the STARLab

The current rate of technological advancement is exponential while advances in organizational design are almost non-existent, resulting in a wider and wider gap between the promise of technical solutions and our ability to seize them (see Figure 1). As we move toward platform based eco-systems and a network based economy of gig-workers using artificial intelligence to make decisions, 3-D printing and robotics to manufacture products, and cloud based capabilities, how do we design organizations that simultaneously address the technical and social aspects of how they operate? What role could sociotechnical systems design play in helping us to keep up?

This was the question posed in September, 2017, to an assemblage of thirty invited academics, executives, futurists, technology professionals, ethicists, social scientists and change practitioners in a two-day socio-technical action research lab (STARLab). It was convened to answer two broad questions:

In order to purposefully align the social and technical elements of how organizations are evolving and to arrive at organizational futures based on both reflection and invention:

> *How will the technologically enabled organizations of the future function and what are the implications for their design and leadership?*
>
> *What are the attributes of the change processes that can get us there?*

Developed by Spring Network, a Silicon Valley-based organization design firm, the STARLab is a rapid organization design approach that involves a multi-stakeholder group working iteratively to create design solutions to address the changing realities of the business context and to generate socio-technically optimized organization prototypes. We will spend some time here describing the lab and its outputs, since it serves the dual purpose of illuminating the future of work systems and providing clues to the way in which continuous, complex, non-linear change can be undertaken.

The agenda for the lab is captured in Figure 2 below. It consists of a quick paced series of breakouts to ensure the surfacing of divergent viewpoints, alternating with plenary sessions to share, process and interpret, and work toward convergence.

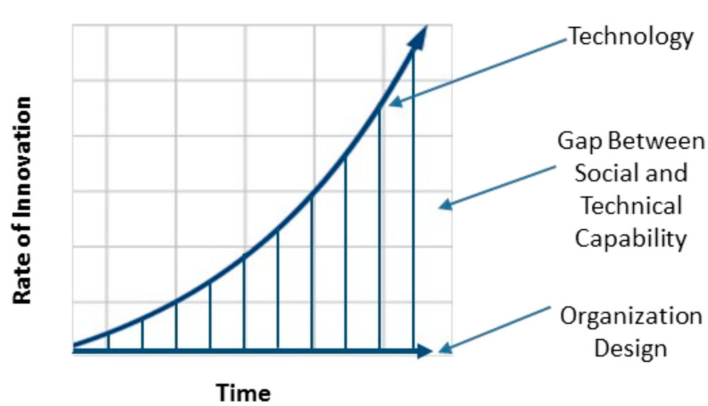

Figure 1. The increasing gap between technical and social capability caused by the lack of innovation in organizational design innovation compared to the exponential advancement of technology.

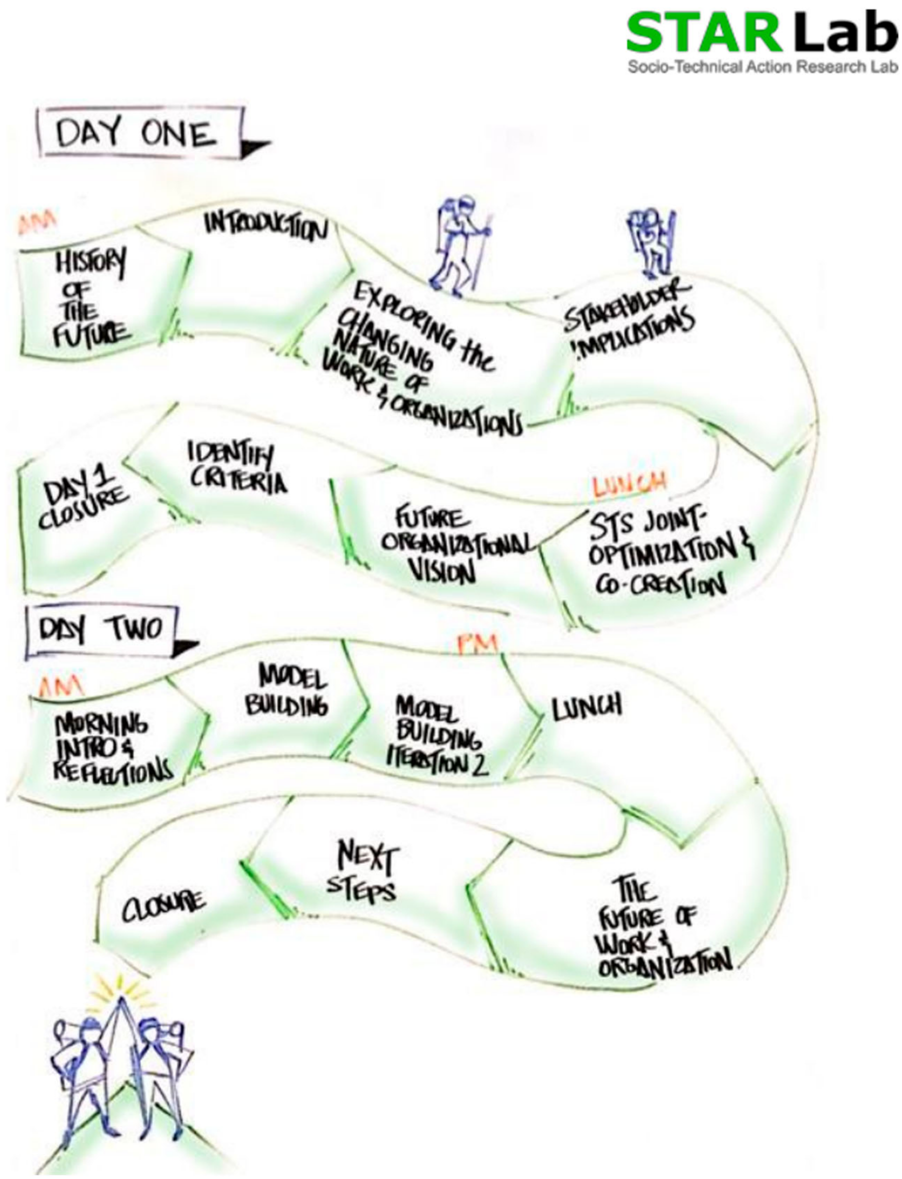

Figure 2. The Agenda for the Socio-Technical Action-Research Lab (STARLab).

Utilizing moveable whiteboards that allowed the continual reconfiguration of space and teams attacking a variety of challenging questions, participants generated visions of the future and processes to get there. Participants came prepped with common readings about current trends and future projections about technology and organization, as well as their own expertise and experience working with organizations facing digital disruption. Experts provided glimpses into the future of technology and leadership.

Starting with a glance at history and glimpse into the future, participants captured the rapid escalation of the rate and impact of change on organizations and society on a timeline extending from the 1950s to the 2030s. The participants were reminded just how much change there has been even in the most recent years of our lifetimes. Computers, iPhones, the internet, artificial intelligence, platform business models, predictive analytics, the internet of things, increased terrorism, life-extending medical advances, Blockchain, self-driving cars, genomics, cyber-warfare, and climate change were but a few of the recent changes identified. Still to come are ubiquitous robots, autonomous weapons, chip implants to enhance human intelligence, virtual reality employment, fully augmented decision making, and the evolution of an effective global governance system.

In the face of such forces and possibilities, the idea of an organization mired in a rigid organizational structure, committed to anything that is fixed and unchanging seems unimaginable. Yet what is the alternative? Worker empowerment? Absolutely necessary if we are not to be the slaves of machines. The use of carefully designed deliberations to shape the outcomes of knowledge work? Critical if we are to take into account the many contending perspectives, knowledge bases, and interests of various stakeholders and create the capability for teams to work together across complex work systems. An organization design that will allow sustained high performance in such an incredibly turbulent context? Yet to be invented.

As early as 1965, Emery and Trist wrote about organizational adaptation to turbulent environments. They spoke about the 'causal texture' of the environment, meaning the rate of change in the environment that affects how an organization operates but is beyond the organization's control (Emery & Trist, 1965). Learning how to simultaneously address the human and technical elements of what will be an incredibly turbulent future environment was the purpose of the September STARLab.

In designing organizations of the future, an overriding concern of STARLab participants was that the needs of human actors – whether they be individuals, employees as a group or society as a whole – not be run over by a technological juggernaut. As we contemplate the design of organizations to accomplish this, we can't help but be reminded of how coal miners must have felt when they learned that above-ground engineers had created a new production system to replace the one they knew. The miners were right to be concerned; there were problems with the new system that created real threats to their employment and safety. It would be foolish for us to think otherwise about the innovative technologies that are being invented today; that future technologies hold nothing but positive promise for humankind. Instead, we need to invent ways of making certain that we humans have a voice, both in how we work with new technologies but also in how technologies will impact our existence.

STARLab participants were then recombined into similar work-role groups to consider the potential benefits and challenges of the rapid advancing and embedding of technology in the way we work through the lenses of different stakeholders:. executives, employees, customers, technologists, and organizational designers. What emerged from the conversations in the various groups was greater convergence than divergence. The participants sensed that resisting technological advances, even those that threatened their continued employment, would only weaken their organizations and thereby hasten the inevitable need to change. They recognized that the current technological advances make possible organizations that will be fundamentally different from today in ways that will create new winners and losers, introduce new societal norms, define new pathways to success, pose new challenges for both organizations and individuals, and possibly threaten our definition of humanity. The shared purpose that emerged from these deeply value-laden explorations was a focus on making future organizations utilizing advanced technologies better for all.

The next activity, completed in cross-functional teams of participants, was to create a vision of the jointly optimized organizations of the future. As expected, the vision of organizations of the future stood in stark contrast to what we see as the dominant form of organizations today.

First, participants predicted that digital technologies will change our definition of *what an organization is*. Instead of a free standing, independent entity with well-defined membership, fixed locations and set goals, organizations will morph into networks that connect a diverse array of entities that shift in membership, location and purpose over time. These complex eco-systems will co-evolve, as the elements assume dynamic configurations in relationship to each other. While in traditional organizations joint optimization is an *internal* goal, in the future joint optimization will concern the *external* network ecosystem.

Second, because the technology used to perform work will constantly evolve, the idea of joint optimization between social and technical systems will require continuous change and adjustment rather designing a social system around a fixed technology. Rather than a periodic event, *organization design will take place in perpetual motion*. The futurist Bob Johansen refers to this as 'shape shifting' in his description of organizations of the future (Johansen, 2017) and views the ability to design organizations at will as a key leadership literacy for the future.

Third, the application of advanced learning capabilities, augmented by data analytics, algorithms and artificial intelligence, will change how decisions of all kinds are made and *redistribute power* from the centre to the periphery. Important deliberations will more frequently include both internal and external parties as well as virtual partners (IBM's Watson, for example) as equal contributors. Complimenting this shift toward aligning decision power with expertise will be governance processes that pulse between the periphery and the core in order to maintain direction and congruence in the overall system.

Fourth, given the interconnectedness of organizational ecosystems, change will accelerate, requiring faster innovation. That innovation will begin in many places at the same time, from the periphery to the core. The requirement for *ambidexterity* (Tushman & O'Reilly, 2002) will cause organizations to adopt new processes for change that can handle the complexity and pace demanded of them. In the future, *the ability to change* will become more important than stability for competitive advantage. The formal organization as we know it will be the least relevant and in some respects the most dangerous element of organization design.

Fifth, organizations will utilize *multiple ways of working* to accomplish their goals. The jointly optimized organization of the future will be composed of a variety of work systems that vary greatly in the degree to which those involved interact with the organization and technology in a 'designed' versus 'spontaneous' manner, and the degree to which these relationships are temporary or continuous. Beginning with suppliers and ending with customers, value chains will at any given moment consist of a multiplicity of forms of engagement by individuals within widely diversified structures, often glued together by digital platforms that define processes, provide relevant information, and enable coherency of the overall system. 'Gig-economy' contractors will work on equal footing alongside full-time employees, often providing highly specialized expertise critical to the value being delivered.

Sixth, supporting technologies will become as important to design as primary technologies. Primary technologies convert inputs into outputs. Supporting technologies allow people to collaborate effectively as they work with primary technologies. In the future, as we see the emergence of a greater number of 'platform' business models, the figure and ground of supporting and primary technologies will shift. Designing supporting systems that allow people who may not know one another to discover common interests and collaborate will become as important as designing technologically advanced primary technologies. Sociotechnical systems designers of the future will need to pay equal attention to both.

Seventh, as open systems, organizations of the future will need to interact more frequently and react more quickly to stakeholder demands and environmental pressures. To do this, organizations will need to gather and process large amounts of information leading to a continuous stream of actions designed to bring the organization into better alignment with its surroundings. Lawler (2006) asserts that in order to be sufficiently agile in today's dynamic environment, more people should be in touch with the external environment and able to use the information they gather to influence how the organization adjusts to new demands or opportunities. Practically, an organization needs a way to promote alignment of these exchanges with its purposes, to determine what information is attended to, and what information is given weight in decisions (Weick, Sutcliffe, & Obsfeld, 2005). The image of the human body with its sensors feeding information to the brain comes to mind. Architecting organizational sensors and central nervous systems will be of great concern to sociotechnical systems designers in the future.

Finally, it was clear to the STARLab participants that top-down leadership will no longer be viable. But what will take its place? What emerged from the conversation is cyber-leadership or *leadership as a platform*. Leadership will be broadly distributed rather than narrowly held. Leadership will occur spontaneously in all parts of the system based on who (individuals or groups) has the legitimacy and knowledge required to provide direction. Sometimes, 'official' leaders will step in to provide strategic direction or finalize critical decisions. At other times, gig workers will provide critical project leadership. Technological platforms will allow people to communicate more directly with one another, allowing more people to 'lead' than our current fixed social arrangements permit.

While the participants had much more to say about the future, these insights alone are enough to stand our current way of thinking about organizations on its head. Therefore, it should come as no surprise that sociotechnical systems design for future organizations is in need of rethinking, as is STS change management.

STS design for the future

The practice of socio-technical design is evolving as the reality of our changing world has taken hold. We are moving away from one-time intensive efforts to achieve the internal joint optimization of a work system toward a 'living' or 'agile' process for continuously redesigning systems within systems in the face of continuous change. The focus of the 'Next generation' sociotechnical design is captured in Figure 3 below.

As indicated, there are three levels of design work to be accomplished. The first is strategic design, which includes the definition of the system in the context of the broader environment in which it is embedded. Since the external environment will change more

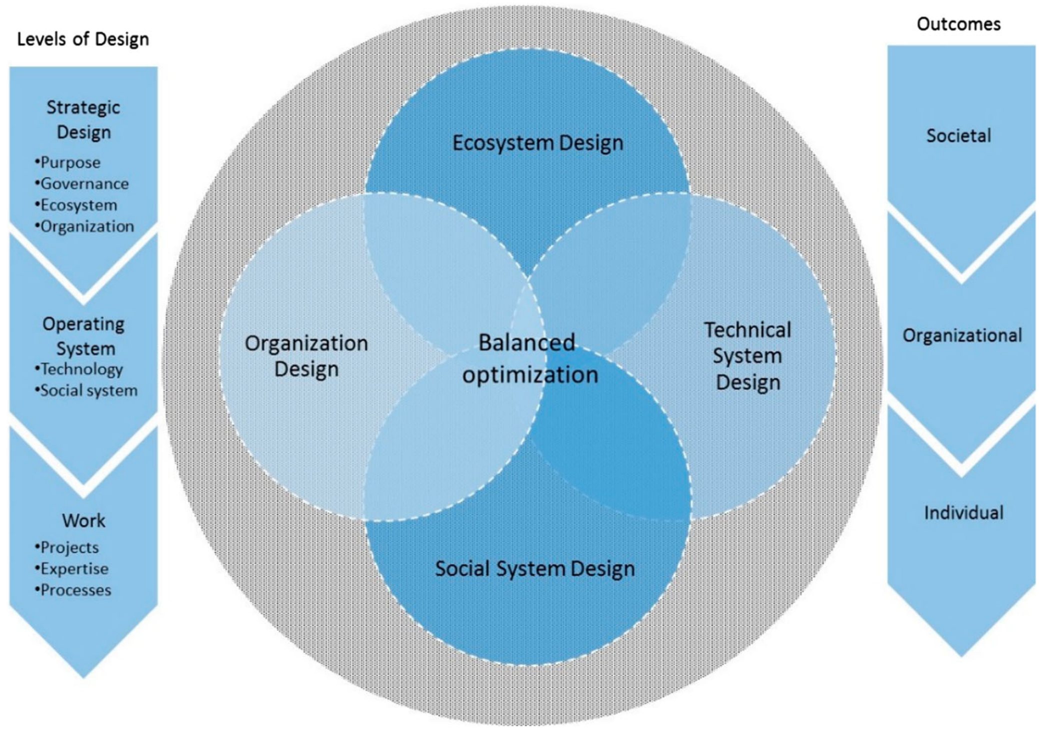

Figure 3. Sociotechnical systems design for organizations of the future.

rapidly than ever in the future, we can't assume that the purpose of the system will remain static. In the new Next Gen STS, processes will be developed that allow members of the organization to access information about the external environment from a number of internal and external sources on an ongoing basis. The goal will be to detect reasons for changing the organization's purpose; either threats to its existence or opportunities that are compelling to pursue. While it would be unusual for the purpose of the organization to change frequently, a failure to change purpose when necessary entails risk.

The second focus under strategic design is to examine the governance of the system as it needs to evolve to represent the investments and priorities of key stakeholders. This is a process that needs to be inclusive and facilitated, since the interests of various parties are often at odds. Today, the tools we have to resolve stakeholder disagreements are crude and ineffective. In the future, we will develop tools that bring resolution quickly and equitably; quickly because the environment demands speed and equitably because continued commitment to the system by key stakeholders must be preserved.

The third focus under strategic design is the ecosystem. In the past, we designed single organizations; in the future, we will design the rough outlines of an ecosystem of partners and contributors who work together in an interconnected fashion using technological platforms to achieve a shared purpose. We say 'rough outlines' of an ecosystem because we expect the ecosystem to evolve as quickly as the external environment demands. As the work changes, so will the membership in the 'organization.'

Finally, there is the design of the core or primary organization itself. The core organization is the sun in the ecosystem solar system. It attracts others to a shared purpose and governs their interactions, rewards, and ways of working. As we shall see, the design of the organization is itself constantly evolving; therefore, it must be designed as an agile, networked, living system rather than a lifeless chart on a piece of paper.

The design of the operating system will include choices that must be made, at least temporarily, in technology and social system design. Technical systems design will include the nature and deployment of both core and supporting technical systems. Aspects of social systems design include talent requirements, leadership and culture.

Last, the level of work design will attend to choices about projects to be undertaken and the expertise and processes needed to complete them. Strategic design, while ongoing, is expected to occur more slowly and deliberately than operating system design. Operating system design, due to investments in people and technology, will be updated less often than work design.

The goal of all three levels of design is balanced optimization of the ecosystem, organization, technical system and social system. In traditional STS, the goal was to design the social system around a fixed technical system in a way that maximized throughput and quality while satisfying human needs. In next generation STS, the goal of balanced optimization is predicated on the notion that everything is in motion. As the external environment changes, the design of the four components (ecosystem, organization, technical system, social system) need to evolve and align. The goal of balanced optimization is to produce a better fit between the system and the environment, thereby increasing sustainability. Success can be measured by the system's survival as well as by the contributions it makes to society, the organizational outcomes achieved and the individual needs satisfied.

Unlike in a real organization or ecosystem, the purpose of the STAR Lab was to generate ideas, not to make decisions that would define strategies, commit resources, and affect lives. When actual design labs are conducted, additional steps need to be taken to introduce processes that allow governance to be exercised in a meeting of differentially empowered parties. We have methods at our disposal that allow truth to be spoken to power and it is imperative that such methods be incorporated into future design labs or the value of diverse inputs will be lost. Table 2 captures some differences between classic sociotechnical systems design and what we will likely see in the future.

Table 2. Shifts in sociotechnical systems design we expect to see in the future.

From	To
Designing an organization	Designing an organization and its ecosystem
Designing a static system	Designing a system that is in a continuous state of change
Designing social systems around a fixed technical system to achieve joint optimization	Designing organizations, ecosystems, technical systems and social systems on an ongoing basis as each element changes to achieve balanced optimization
Using an internal design team to represent the system being designed	Using design labs that bring many voices from inside and outside the system into the design process
Designing the work system	Designing the strategic, operating and work systems
Designing a system with a fixed membership for its current members	Designing a system in which many important contributions are made by people who come and go as their expertise is needed; designing for people who are not yet members of the system
Focusing exclusively on the internal workings of the system	Perfecting collaborative work among entities that compose the value chain
Designing for high performance and variance control	Designing for innovation and agility
Design based on analysis of current systems	Design based on ideas about what is possible

Implications for sociotechnical systems change management

Because next generation STS design is both broader in scope and aimed at a moving target, the way in which we do design must change. The way the STAR Lab was conducted is more in keeping with the methods we will use in the future than what we done in the past. It brought together a diverse set of participants in a creative environment after pre-event interviews were conducted to understand the design challenge from the perspective of those attending. Pre-reading were assigned to level set the playing field and access to external subject matter experts was provided during the event itself. Participants worked in a variety of carefully planned configurations that allowed them to both represent their 'constituencies' as well as to simply be themselves. Design thinking methods applied to small group activities were combined with more standard large group discussions. Formal presentations were held to an absolute minimum. Graphic artists captured key outputs at every stage to make certain the ideas generated at each stage of the process remained easily accessible. Video and written records of the event were posted to a website so that participants could continue to access details of the event long after it was over.

As productive as it was, the STAR Lab was an event, and an expensive one at that. People traveled in; a staff was required to preset, rearrange and break down the room after the event; meals were provided; professional facilitators designed and conducted the event involving weeks of planning and preparation; graphic, video and written recorders were paid for their services; experts were retained and a website created. In the future, STS design will need to be done faster, virtually and cheaper if it is going to engage large numbers of people on an ongoing basis. Some of the technology exists to do this well today but further leaps in the technology for virtual meetings will certainly help the cause.

Given the glimpse into the future provided by participants in the STAR Lab, what are the implications for STS change management? First, our historical approach to STS change management can be traced back to Lewin's idea that change involves unfreezing, change and refreezing. Others have made the point that 'refreezing' may not be the best idea in the face of continuous change. In the future, there is no 'to' in the 'from-to' conceptualization of change. The destination is always shifting further toward the future as we approach it. Now, the idea of 'unfreezing' needs to be called into question as well. If we design organizations for agility and constant change, unfreezing isn't the right analog. Perhaps 'stimulating,' or 'reorienting,' or 'initiating' would be more accurate descriptions of what happens when people are invited to improve the alignment of the system with its evolving environment.

Our historical STS approach to change management models also view change as linear, proceeding from a defined starting point toward 'implementation.' This 'start-stop' project-oriented view of change may be easy for leaders to comprehend and for consultancies to build proposals around. Yet, it's not an accurate depiction of reality. Changes start, pause, restart, are abandoned, get redirected, are combined or replaced by other initiatives, are extended, modified, or postponed indefinitely. Furthermore, changes rarely occur in isolation. Many involve the same people and budgets that are committed to other efforts that compete for budget and attention. The current reality is that changes are messy, overlapping, and poorly thought through from a systems perspective. Should we expect anything about change to change?

Perhaps not; but our job, and we're speaking of those of us in the fortunate position to help others manage change, is to make the process of 'changing' easier, faster, and more successful. From individuals who need to develop new skills to ecosystems that need to discover and pursue new directions, we need better ways to change. What might these entail? Some of these changes are noted in Figure 4 and Table 3 below.

First, STS change management must be continuous, not episodic. An improved system of governance will be used to oversee, align and prioritize change at the systems level on an ongoing basis. Rather than being isolated, linear and fixed by budget or timeline, change efforts will be based on prototyping that allows for alignment and adaptation based on data and learning rather than blind commitment to individual plans.

Second, STS change management will be more inclusive of stakeholders in the ecosystem who play important roles in determining how the work system operates. Vendors, partners, customers, and even temporary gig-economy experts will need to be present as change is conceived, pilots are undertaken and data are interpreted. Design labs will bring parties together to use design thinking approaches and rapid prototyping to

Figure 4. Next generation STS change management.

Table 3. Shifts in STS change management we expect to see in the future.

From	To
Project-based	Continuous
Focus and involvement is primarily internal	Focus is both internal and on the ecosystem; using a 'whole systems' approach that includes representatives of the ecosystem as well as relevant experts providing knowledge input
Multiple disconnected change efforts not prioritized and competing for resources	Governance system provides strategic direction, alignment and prioritization
Linear, driven by budget and timeline	Iterative prototyping, adaptive, driven by data and learning
Fixed organizational structure and associated territoriality constrain change opportunities	Agile structure more readily permits redeployment of resources and opens up creative potential
Change led by experts working with people in power; top-down	Change leadership is inclusive and varies depending on experience and expertise needed; top-down, bottom-up, inside-out and outside-in
Spreading change slowly relying on traditional training and communication methods	Taking advantage of new technologies to permit blitz-scaling

move toward viable solutions which are then scaled-up extremely rapidly – what Silicon Valley firms refer to as 'blitz-scaling.'

Third, in contrast to traditional STS design in which changes are made to bring the social system into better alignment with a fixed technical system, social and technical systems will co-evolve in service of better performance against the purpose of the system over time. We will still examine variances – deviations from how the system is designed to operate – in order to understand where redesign is needed. The difference is that because we are designing social and technical systems in parallel, we will *anticipate* variances rather than waiting for them to manifest. Variances can occur in the technical system – as errors, production problems, workflow issues, or operational measures indicate. Or, variances can occur in the social system as we measure regretted turnover, lower than expected engagement, or the effects of poor teamwork/ deliberations. Overall, the system needs to perform in accordance with the expectations of the environment; so the combined effects of social and technical arrangements on outputs, adaptability, innovation, environmental impact, customer satisfaction and risk will need to be assessed and fed back into the next round of design.

The co-evolution of social and technical systems will not stop; therefore, the capacity to co-evolve must be built into the way the system is designed and operates. Change must become a core competency for leaders and the system as a whole. Glimpses of this can be seen in both the Alegent and Fairview health cases (Winby, Worley, & Martinson, 2014; Worley, 2012), where physical structures and advanced change processes prepared these organizations to change and keep on changing their sociotechnical arrangements.

Fourth, using design thinking tools, we will iterate our way forward, learning as we go, correcting course more frequently and refusing to follow the path we are on just because it has been laid. We will talk about change more with one another. We will not let some people lead the rest of us to ruin. We will disagree with our leaders and with one another and know that disagreement about anything as uncertain as change is to be expected.

On the subject of technology, we must learn to avail ourselves of the best that technology, including artificial intelligence, has to offer. Few individuals or teams in the future will undertake change without consulting data bases to understand what has been learned by those who have gone before. Nor will they issue broad communications that speak to no one in particular when powerful, personalized channels reach others in their own 'language' of preferences and concerns. Virtual technology will allow larger, more diverse and geographically dispersed groups to work together effectively in real time or asynchronously. Programmes and algorithms will allow insights into social networks, work activities, team interaction patterns, emotional responses, movements within physical spaces and health predictors. Change management professionals will adapt these and other tools to speed change, base decisions on better data, engage broader populations, and make necessary adjustments faster. These are the tools and methods that will allow rapid, evidence-based redesign and 'blitz-scaling' to occur.

Conclusion

In the years since sociotechnical systems theory and practice first appeared, there have been dramatic advances in technology and developments in society that demand that we reconsider what we know about organization design. In this paper, we have presented our view of the how the goals and practice of organization design need to shift utilizing a sociotechnical systems perspective. From our vantage point, there has never been a greater need to insure that the needs of human beings and social systems are respected and brought into balance with the advantages that technology offers. There is also a need, we believe, to view organizational arrangements as temporary rather than fixed, despite the angst that adopting this philosophy creates for leaders who crave certainty and predictability.

Although STS theory and practice has been in the background for a while, the rapid advance of technology and the comparatively slow advance of ideas about how to organize may portend a resurgence in the sociotechnical paradigm. Human beings are benefitting from and being threatened by technological advances at the same time. These were the exact conditions in the British coal mines that gave rise to the STS paradigm in the first place. What's old is new again.

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