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An Integrated SS-VSA Analysis of Changing Job Roles

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This paper presents a first attempt at an integrated Service Science (SS) and Viable Systems Approach (VSA) analysis of the real-world phenomenon of changing jobs roles. Changing job roles is important to quality of life and yet understudied by systems scientists. Today, individuals changing jobs multiple times during their working life is the norm. The average person born in the later years of the US baby boom held 10.8 jobs from age 18 to age 42 (BLS 2008). The viability of societal systems depends on both entities changing job roles offered and individuals changing job roles filled (Spohrer and Maglio, 2010b). Societal systems interact with their environment via individuals in job roles, and the behaviors and dynamics of these diverse types of viable systems are not easy to explain and predict (Beer, 1972).

Both Service Science (SS) and Viable Systems Approach (VSA) can be seen as less well known specializations of General Systems Theory (von Bertalanffy, 1968, Spohrer and Kwan, 2009, Barile 2009, Golinelli, 2010). Like General Systems Theory, these emerging analytic frameworks advocate a worldview and specialized vocabulary that provide a framework for analysis and decision making. Also, these nascent analytic frameworks aim to improve our understanding of complex systems and improve their design.

By refining the concept of the identity of a system from SS and VSA perspectives, the contributions of this paper include providing an abstract framework for enumerating all job roles and transitions between job roles as well as a practical recommendation to prepare a next-generation of individuals to compete better in a world of accelerating job role change. Specifically, our analysis of changing job roles will result in a recommendation for increasing the ratio of T-Shaped Professionals (T-SP possess both broad communication skills and deep problem solving skills) to I-Shaped Professional (I-SP possess only deep problem solving skills) in the labor force of nations and businesses to improve their viability in a complex environment of accelerating change (Donofrio *et al.*, 2010).

Key words: Service Science (SS); Viable Systems Approach (VSA); complex systems; job roles; viability; identity; T-Shaped Professional (T-SP); I-Shaped Professional (ISP)

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1. Importance of Job Role Change in Society

Both Service Science (SS) and Viable Systems Approach (VSA) take a systems science approach to the study of human society, and moreover both seek to identify and clarify mechanisms for the continuous improvement of quality of life in society (Spohrer and Maglio, 2010b; Golinelli, 2010). Quality of life is a function of both the (1) Quality-of-Service (QoS) experienced by customers of societal systems, and the (2) Quality-of-Opportunity (QoO) experienced by workers in job roles in those same societal systems. Societal systems can exist for centuries, much longer than the life spans of individual people (e.g., see Milgrom and Roberts' (1992) analysis of the Hudson Bay

Company; Jaikumar's (1988) analysis of Beretta from filing to fitting to flexible manufacturing). National constitutions, and governance documents of businesses, universities, and even religions, describe mechanisms for jobs roles to be filled and refilled over multiple generations of people (e.g., see Simon's (1995) discussion of the design of the United States of America by the authors of the Federalist papers). Of course, many specific job roles are likely to change over time, and individuals who seek to fill those job roles must prepare and compete. Nations establish policies and incentives to encourage focus on creating the "right jobs and skilled workers" needed for the future prosperity and security of their citizens (Augustine, 2005). Few mechanisms are as important to quality of life in human society, and yet as understudied by systems scientists, as the mechanisms associated with job role change. Technological change and organizational change are two key drivers of both entities changing job roles they offer and individuals changing job roles they fill (Levy and Murnane, 2004; Smith, 1776; Darr, 2006; Barley and Orr, 1997; Milgrom and Roberts, 1992; Moulton-Reger, 2006).

The contribution of this paper is to make systems scientists aware of two emerging analytic frameworks (i.e., Service Science and Viable Systems Approach) in the context of an extremely important and yet understudied area of accelerating societal change, namely the phenomenon of *changing job roles* (i.e., entities changing job roles they offer and individuals changing job roles they fill). The integrated Service Science (SS) and Viable Systems Approach (VSA) analysis will: (1) first situate SS and VSA within the broader evolution of systems science, and describe SS and VSA in more detail, (2) then develop the concept of the "identity of a system" as central to both SS and VSA analysis of changing job roles, (3) next provide a framework for enumerating all job roles and transitions between job roles, (4) next provide a practical recommendation to prepare a next-generation of individuals to compete better in a world of accelerating job role change, and (5) finally summarize the results, limitations, and areas for future research to further integrate SS and VSA analysis and decision making frameworks.

Before situating SS and VSA in the broader context of the history and evolution of systems science, we want to briefly review the cost of not changing. The cost of not changing is well captured in the phrase of Deutschman (2005) "Change or die." Especially in an environment of accelerating change, when entities do not change or do not change appropriately, they fail:

"Failure is all around us. Failure is pervasive. Failure is everywhere, across time, across place and across all aspects of life. Ninety-nine point nine percent of all biological species which have ever existed are now extinct. Failure in this context is measured over hundreds of millions of years. On a dramatically shorter timescale, more than 10 percent of all companies in America disappear each year. Large and small, from corporate giants to the tiniest one-person business, they fail." (Omerod, 2005, Pg. ix);

To thrive, an organizational entity must change - and change appropriately. *Appropriate change maintains or enhances identity while preserving viable relationship within the context of an ever changing environment of other entities.* SS calls the environment the *service system ecology*, and VSA calls the environment (where the viable system operates) the *context* (see Appendix for table of concepts and definitions).

Today, the performance of strategy and change (S&C) organizations in enterprises depends on their ability to interpret an ever changing world. This is not easy, considering the number of entities involved, their mutual dependence and the contingent difficulties in schematising the whole. No one wants another global financial crisis or something worse. Given the dynamism and potential instability of the global service system ecology or context, decision makers have to plan structural adaptation to guarantee the viability of the whole as well as individual entities (Piciocchi, 2003). We, in the service science community, refer to these entities as *service system entities*, such as people, families, universities, businesses, cities, and nations. Therefore, decision makers constantly formulate new interpretative models of the world (i.e., the service system ecology) to find an appropriate change for their business or government enterprise (i.e., the focal service system entity of which they are a part), implementing, where necessary, activities for structural and behavior systems change in the logical, strategic and operational assets. Meanwhile, individual people are changing job roles within these entities, entering and leaving established job roles, as well as entering and leaving newly created types of job roles.

In this paper, our purpose is to highlight how an integrated SS-VSA analysis of changing job roles can inform decision makers with a novel and useful interpretive framework to guide their thinking about appropriate change, and encourage more systems scientists to focus on this important and understudied area. However, since this is a first integration of these two approaches, we will use the first part of this paper to provide a necessary introduction to the two approaches. We do this by showing that both Service Science and Viable Systems Approach are different but related as specializations of the more broadly studied approach known as General Systems Theory (von Bertalanffy, 1968; Golinelli, 2000; Barile, 2009). Unlike General Systems Theory which seeks to discover the mechanisms that underlie all types of systems, SS and VSA focus on human societal systems in which people and

their concepts, technologies, and organisations are the primary building blocks. These types of systems include complex enterprise systems such as transportation and supply chain, water and waste recycling, food and product manufacturing, energy and electricity, information and communication technologies, building and construction, retail and hospital/media and entertainment, banking and finance, healthcare and family, education and professions, city government and security, state/regional government and development, national government and laws/policies (Spohrer and Maglio, 2010).

Table 1 From Science to Systems to a First Attempt at Integrated SS- VSA Analysis

Pioneers Of Scientific Thought	The Scope of Foundational Distinctions	Systems Science Pioneers	More Recent Distinctions	Service Science (SS) and Viable Systems Approach (VSA)
Aristotle (384-322 B.C.)	Practical Theoretical Poetic	Taylor F.W., 1911 Vernadskij V.I., 1926 Wiener N., 1948 Emery F.E., 1956 Katz D., Kahn R.L., 1956 Simon H.A., 1957 March J.G., Simon H.A., 1958 Kuhn T., 1962 Von Bertalanffy L., 1968 Beer S., 1973 Hannan M.H., Freeman J., 1977 Weik K., 1979 Maturana H., Varela F., 1984 Bogdanov A., 1988 Capra F., 1997	Value Model Creativity Entities Measurements Relationships	Spohrer&Maglio,2006-2010 Vargo&Lusch,2004-2010
Bacon (1561-1626) Liebniz (1646-1716)	Form Nature Cause		Systems Concept Verifiable Value	☒ Poietic ☒ Reason ☒ Logic ☒ Nature ☒ Mathematics ☒ Organisational Science
Hegel (1770-1831)	Being Logic Spirit			
Comte (1798-1857)	Theological Metaphysical Scientific		Trust Abstract Verifiable	Golinelli, 2000-2010 Barile, 2000-2010

Source: our elaboration, based on Golinelli (2010)

To begin to engage systems scientists to focus on the phenomenon of changing job roles, Table 1 summarizes a core subset of systems science pioneers (center column). Table 1 depicts an evolution in people's thinking over the ages about science, about systems, and finally to our focus on integrating two emerging analytic frameworks in this paper. To Aristotle, all areas of science were in one of three categories: practical (such as ethics and politics, which in our terms today might be called value-oriented disciplines - see the fourth column in Table 1), theoretical (model-oriented), or poetical (creativity-oriented). To Bacon, phenomenon could be understood through a method of isolating in sequence form (natural entities and their constituents), nature (especially quantitative and measureable qualities of entities), and finally cause (relations represented as mathematical laws of nature); later, Liebniz would work to formalize human reasoning about phenomenon to calculations with appropriate notation systems. To Hegel, the progression consisted of being (concept-oriented and able to be represented in human communication and reasoning), logic (quality-oriented and formally verifiable or measurable), and spirit (value-oriented and associated with human purpose). To Comte, all areas of human knowledge evolved through three stages, theological (fictitious or faith-based or trust-based, communication of knowledge handed down through the ages by authorities, tied to an observation that some things work effectively in human systems largely because people believe they do work), metaphysical (abstract, related to symbolic representation and logically consistent lines of reasoning, and observation that some things work in artificial worlds because that is the way the system designer has engineered them to work in a symbolic system), and scientific (positive, related to verifiable measurement and proof in physical systems).

The fifth column of Table 1 summarizes the emergence of SS and VSA. Specifically, SS and VSA must integrate symbolic systems (Logic, Mathematics), physical systems (Nature), computational systems (Reasoning,

Organizational Science), and add value-creation systems (Creativity). Symbolic systems can help us understand what is possible to know in a self-consistent fashion. Physical systems and computational systems together can help us understand the cost of knowing (e.g., space, time, energy costs). Service Science (SS) and Viable Systems Approach (VSA) together can help us understand the value of an entity knowing about the world, and taking actions to create change and realize value. In order to inform decision-making and problem-solving that might continuously improve quality of life for entities and individuals, an integrated SS and VSA analytic framework should shed light on many real-world phenomena, including the value of changing job roles. Of course, a central theme in systems science is that “to manage complex phenomena means to manage the whole system and not to manage its entities or components” (Christopher, 2007).

In the remainder of this introductory section, we summarize both Service Science (SS) and Viable Systems Approach (VSA).

1.1. Service Science (SS)

The concept of service pervades many disciplines, from marketing to computer science, so much so that the concept of “service” has an aura of ambiguity which it is difficult to eliminate. The roots of service or value cocreation interactions lie in division of labor and differential development of capabilities in entities that compete and cooperate.

Service Science is built on top of the Service Dominant Logic (SDL) worldview (Spohrer and Maglio, 2009; Vargo and Lusch, 2004). SDL defines service as the application of competence (knowledge, resources, etc.) for the benefit of another entity. SDL’s ten foundational propositions begin with the premise that service is the fundamental basis of all exchange. Service Science defines service as *value cocreation phenomena* that occur when service system entities interact according to value propositions that guide the application of competence for mutual benefit.

Service Science is a specialization of Systems Science, in which service system entities interact and create outcomes (Spohrer and Maglio, 2009). The *service system ecology* is the population of all types of service system entities. A *service system entity* is a *dynamic configuration of resources* (at least one of which, the focal resources is a person). The four types of *resources* include people, technology, organizations, and shared information. The dynamics result from the interactions of four types of *stakeholder* service system entities; customers, providers, authority, and competitors. Stakeholders are typically concerned with specific *measures*, such a quality, productivity, compliance, and sustainable innovation. *Value-proposition-based interactions* reconfigure *access rights* to resources. Larger service system entities, such as a business, may be composed of many resources, including many people in job roles. Even larger service system entities, such as nations, states, or cities, may include other large service system entities within them.

Service Science recognizes three stages in the evolution of service system entities and value cocreation mechanism (Spohrer and Maglio, 2009). Stage 1, informal entities correspond to early human culture, with the family or clan being the dominant type of entity. Stage 2, formal entities correspond to human culture after the advent of written laws and money, with the nation being the dominant type of entity supporting the legal and monetary structures. Stage 3, globally integrated formal entities corresponds to human culture after the advent of near instantaneous global electronic communications, with businesses being one of the dominant types of entities supporting organized value cocreation. Many evolutionary accounts of the rise of mutual benefits, non-zero-sum win-win interactions, or value cocreation mechanisms have begun to appear. For example, Friedman (2008) presents an evolutionary view of markets and morals, and mechanisms to address the social dilemma - what’s good for the individual may not be what’s good for society. Wright (2000) presents an evolutionary view of win-win or non-zero-sum interactions.

In broad outline (Maglio *et al.*, 2007), the Service Science analysis approach is to (1) identify all the stakeholders service system entities in a network under study (a network analysis is always done in the context of the entire service system ecology), (2) examine existing relationships, value cocreation mechanisms, and understand the problems and opportunities the stakeholders have identified, (3) next try to improve existing value cocreation mechanisms (this may involve freeing up resources from existing service system entities and redistributing them), (4) if problems and opportunities remain, create new service system entities to address them. Ultimately, a Computer-Aided Design (CAD) tool is proposed to facilitate the analysis and re-engineering, and the tool will include a model of all major service systems (e.g., nations and their import/export patterns). A tool that models all service systems may seem unrealistic, but it is worth noting that just the top 2000 publically traded companies with just under 100 million employees total create over \$30 trillion in revenue per year, which is over half of the Gross Domestic Product (GDP) of the world (Forbes Global 2000 list).

There are thirteen main types of service systems (sometimes viewed as segments of the economy) in today’s service system ecology. In a city, people depend on all of them every day, and considerable hardship results when

they fail. They cluster into three groups: (1) Systems that move, store, harvest, and process (transportation and supply chain, water and waste, food and product manufacturing, energy and electricity, information and communication technology infrastructures), (2) Systems for healthy, wealthy, and wise people (building and construction, retail and hospitality/media and entertainment, finance and banking, healthcare and family, education and professions), and (3) Systems that govern and serve the public (city and security, region/state and development, nation and laws/policies). Within each of these systems there are three main categories of job roles, those that deal with run (operations, maintenance, and incremental process improvements), transform/copy (identifying and implementing significant changes based on what others are doing - copy best practices from others), and innovate (significant changes based on innovative new ideas, which often yields best practices other will copy). For example, in a hospital, an X-ray technician is very often a Run-type job, a department head working to upgrade a unit to best practice level is a Transform-type job, and a Researcher is a Innovate-type job.

Each service system entity is able to co-create value with other entities if its component resources can be appropriately coordinated to contribute to the purpose of the value proposition that defines the expected outcomes of the interaction. In a service system network the coordination of the entities is fundamental to guarantee the right interaction, the right agreement, the right communication takes place to realize a value cocreation outcome.

In summary, the foundations of service systems are:

- 1) a dynamic configuration of resources;
- 2) a set of value cocreation mechanism between suitable entities;
- 3) an application of competencies-skills-knowledge any person(s) in job or stakeholder roles;
- 4) an adaptive internal organization responding to the dynamic external environment;
- 5) learning and feedback to ensure mutual benefits or value cocreation outcomes.

Thus “service systems are open systems capable of improving:

- a) the state of another system through sharing or applying its resources;
- b) its own state by acquiring external resources” (Spohrer *et al.*, 2009).

In this view, service systems respond to their environment, known as the service system ecology, to improve quality, productivity, compliance, and sustainable innovation measures. The service science worldview is that of an evolving ecology of types of service system entities. Over time, the entities, interactions, and outcomes change. Service science, as the science of value cocreation phenomena, seeks to understand the mechanisms that account both for the structure of the entities, the patterns of their interactions, and how these structures and patterns evolve over time.

1.2. Viable Systems Approach (VSA)

VSA is an approach to study the viability of systems in a complex environment. *Viability* is both objective survival and subjective ability to respond to environmental change, where environmental change is mostly generated by other viable systems. Viability depends first and foremost on a *government capability*, for both internal self governance and external relationship governance that creates value for the stakeholders or suprasystems (Golinelli, 2010). In fact, each system has to attain *consonance* (a potential for value creation) and *resonance* (the realization of value creation) with its environment to be viable. In other words, the survival of a system depends on its decision-making and problem-solving *process coherence* (consonance and resonance) with the complexity and change in the environment, known as the context in VSA view, that is the subjective representation of the reality created by the government (see Appendix for Table of concepts and definitions).

At this point, we need to clarify the meanings of the innovative concepts of consonance and resonance. While the former means the structural compatibility or adequacy between different entities, the latter is the effect of the interaction between these consonant entities.

In other words, the *consonance* measures the capability of the system to achieve mutual benefits (value cocreation) based on their structure (accessible resources) and the limits to sharing and coordinating information between different entities (viable systems); the *resonance* measures the results of interactions in context, producing and sharing value for and with stakeholders or suprasystems. If consonance (potential) increases with time, then resonance can be grounded (performance).

In VSA perspective, the researcher looking at complex phenomena has to realise that he can never achieve complete and fully objective, but only approximate, knowledge (Golinelli, 2000, 2001, 2002, 2005, 2008, 2010). This means that:

- 1) the observer cannot understand problems and phenomena in isolation. They are all interconnected and interdependent;

- 2) the observer is neither extraneous nor neutral to observed reality. In other words, he is part of the observed reality and plays a part in influencing it;
- 3) the observer, depending on his characteristics and specific standpoint, can only ever achieve a partial, and never a definitive representation of observed reality (some number of unknown unknowns must always remain).

These three aspects suggest that to manage complexity each organization – as a system – has to be in relation with others to ensure its viability and to co-create value for the stakeholders or suprasystems.

In complex environments of other entities, the search for viability means the capability of the government component of a viable system entity to make decisions on the basis of approximate knowledge. In fact, the government component of an entity has two main types of knowledge that we refer to as Decision-Making (D-M) and Problem-Solving (P-S) knowledge. D-M provides guidance about which ends (“know what”) to achieve, and P-S provides means (“know how”) to those ends. Both types of knowledge are the fundamental capabilities (cognitive assets) required to attain and maintain viability (Piciocchi *et al.*, 2009). While both are required, D-M is the primary capability. Without knowing “how to make a decision” about the ends to pursue, all the effort applied on “how to solve a problem” may in fact be wasted effort.

Because viable system entities change and learn, the resource allocation problem is the fundamental decision that repeatedly must be made to remain viable (March, 1991). Both D-M and P-S knowledge may be required, but D-M is primary. To reduce the decision ambiguity isn’t useful to focus on problem solving at all, but it is more necessary to focus on decision making. In other words, dealing with new levels of complexity requires new types of decision making in which we cannot necessarily use fixed models or stochastic methods to find a solution, but we need a pattern or schema suitable to a particular problem’s complexity level (Barile, 2009).

An integrated SS-VSA analysis will emphasize: (1) the connectivity between consonant and resonant entities, and (2) value cocreation mechanisms used by entities according to internal and external networks.

2. A Fundamental SS-VSA Bridge: Identity

Consider the following two very different individual job role change situations:

“To survive and provide for my family, I took the only job I could find.”

“To continue on my career development plan as my last manager and I designed it, I took the new job. Now my new manager and I will continue to revise the plan as well as keep an eye out for unexpected better opportunities in the coming years.”

Also consider the following two very different business network role change situations:

“To survive, we had to sell off two divisions, and dramatically restructure what remained.”

“To continue our growth plan, we acquired our #4 and #5 competitors.”

These examples are interesting because in all four instances, an entity is changing, either in desperation or according to a plan. From certain perspectives the reputations of the entities are being diminished or enhanced, but from other perspectives the core identities remain fundamentally unchanged - survival or enhancement notwithstanding.

Service system entities and viable system entities, whether people or organizations, have both an *identity* and a *life cycle* with a beginning and an end. When change occurs over the course of an entity’s life cycle, on a basic level the core identity of the entity remains the same, although the history of the entity has changed. At other levels, the role and resource identity of the entity has changed; the entity may fill a different role in an external network and/or have dramatically changed resources/capabilities in its internal networks. A person is the most atomic resource from a service science perspective and the most atomic bundle of capabilities from a VSA perspective. A person may belong to any number of other service system or viable systems entities, filling job roles in those entities, as those entities change through fission (divestitures) and fusion (mergers and acquisitions) or other change processes. Since all entities must change to remain viable, changes can impact the history, role (external network), and resources/capabilities (internal network) aspects of the identity of an entity.

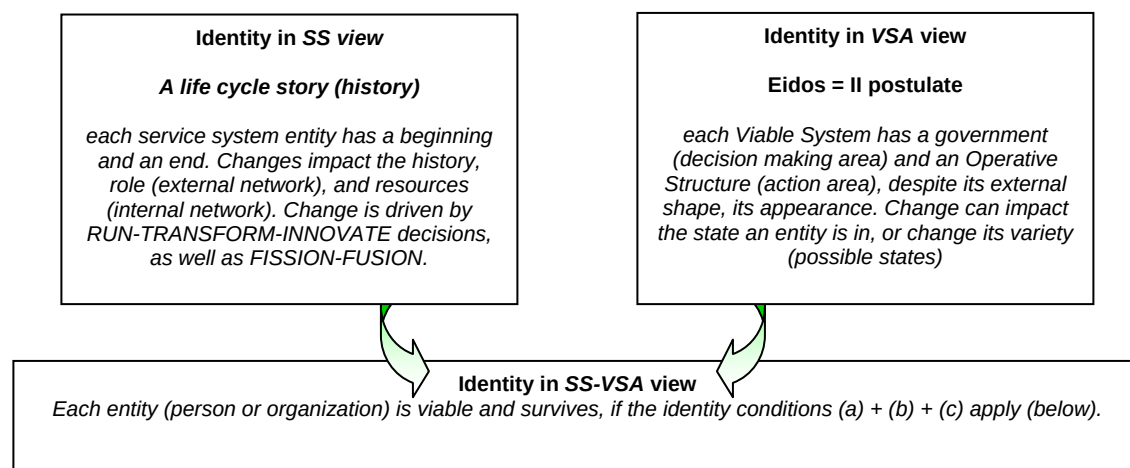
All entities capable of change (learning) must make a fundamental resource allocation decision known as exploitation and exploration (March, 1991). Exploitation is investing resources in using existing knowledge. Incremental improvements from learning may be possible, but if the environment changes too much, a catastrophic

event could occur as the system becomes non-viable. However, the non-viability of the system is an effect of a process of degeneration in time. This means that the condition of stalemate and/or synchronic instability, determined by environmental change, can degenerate into unstable diachronic conditions and/or fade (crisis) if the system fails to correct the imbalance with the environment through turnaround processes (Picicocchi, 2005).

Exploration is investing resources in adopting or creating new knowledge. The entity adopts modified or completely different means-and-ends with the potential of substantial improvement. However, exploration is risky, and the catastrophic event is the exploration fails and the entity becomes non-viable. In service science, RUN-TRANSFORM/COPY-INNOVATE is the way entities change: RUN being exploitation, TRANSFORM/COPY being a copy-type of exploration change (potentially less risk because another entity has validated it), and INNOVATE being an invent-type of exploration change. FISSION-FUSION is also possible for complex entities to TRANSFORM, and this can have a profound impact on identity.

Given the importance of change, we can assert that a fundamental bridge (or link) between SS and VSA is identity preserving or enhancing changes (Figure 1).

Figure 1 Identity conceptualization according to SS-VSA



Source: our elaboration

An entity is viable and survives if the following three identity conditions apply:

- Self-Identity:** the entity (internal employee) recognizes itself and its history as a continuous story for the purpose of future change. This is the most personal form of identity to self.
- Role-Identity:** external entities (customers and providers) recognize the entity for value cocreation interaction purposes. This is the most practical form of identity to others.
- System-Identity:** an external authority or suprasystems (say for taxation purposes) can validate the boundaries of property, rights and responsibilities of the entity for legal purposes. This is the most formal form of identity.

Identity is a central concept to both SS and VSA analysis of changing job roles because it directly impacts role-identity and indirectly impacts self-identity and system-identity of individuals.

3. Framework: Drivers and Opportunities

People change job roles because of two main reasons or drivers: (1) entities come and go, creating opportunity and necessity, and (2) job roles come and go, creating similar opportunity and necessity. When a person leaves a job role, the governing authority (government component) can choose to refill the role with another entity (which can set off a cascade of job role changes) or they may choose to abandon the job role or merge the role, in part or in whole, into another role.

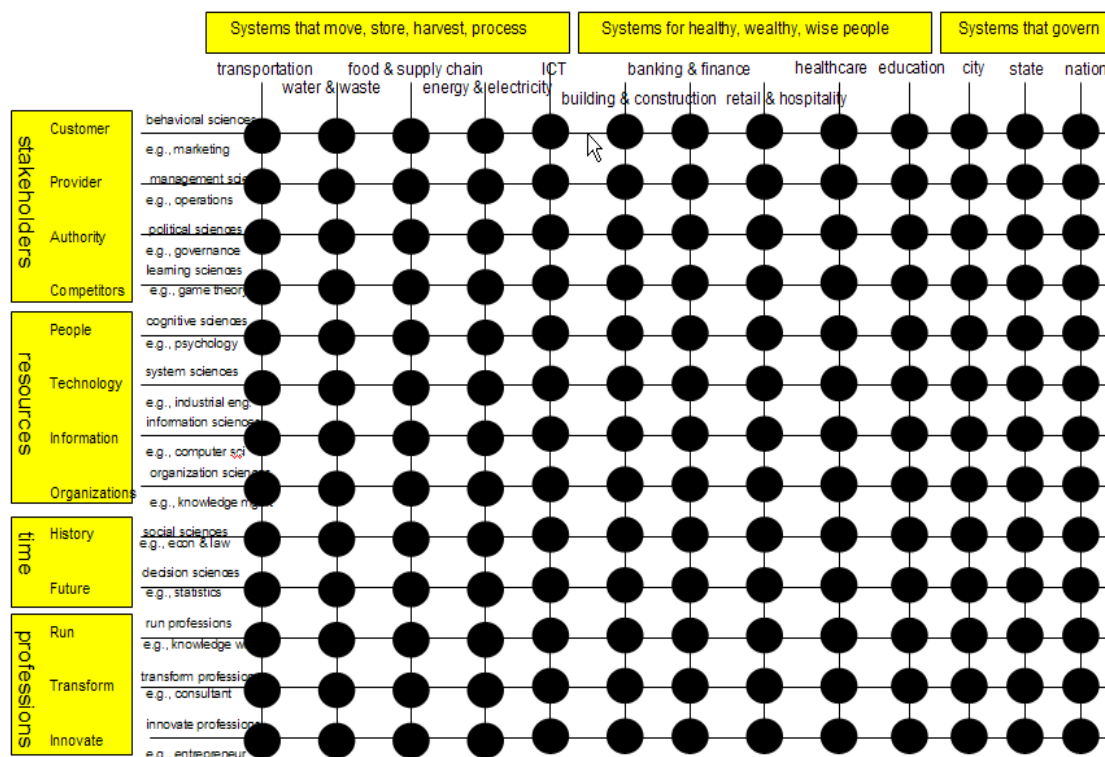
Entrepreneurial innovation is probably the greatest creator of new entities and job roles (Baumol, Litan, and Schramm, 2007). Technological innovation is probably the greatest transformer of entities and job roles (Levy and Murnane, 2004). Spohrer and Maglio (2008) provide a Z-theory of work evolution that describes the role of technology in first enhancing human performance (tool or augmentation), then enabling transfer (off-shoring or outsourcing), and then enabling technological substitution (off-peopling or automation).

Two of many possible incentives for job role change are to move up (greater pay or control) or move toward (greater satisfaction or freedom). If people, with effort and time, could record and replace themselves with technological and organizational assistance, while retaining rights to a certain portion of the value they or their replacement technologies cocreate with others, then an even greater incentive for job role change would exist. Ultimately, every individual person would be a serial entrepreneur, creating more and more technological substitutions for themselves in value cocreation roles.

However, currently, with rare exceptions, employees cannot substitute technology replacements for themselves and retain rights to a portion of the value created. Nevertheless, during the age of apprenticeship, this was realized to some degree by masters training their own replacements, or providing a service to nearby villages that wished to have their own capability. This situation is akin to a sole proprietorship, or a lone entrepreneur, using technology to become more efficient (improve productivity) or effective (improve quality).

Today, the two dominant perspectives on changing job roles is that of the individual seeking to move up or move towards, or governing authority of a service system seeking to cut costs (grow margins) or grow capacity (grow opportunities for next change). The average person born in the later years of the US baby boom held 10.8 jobs from age 18 to age 42 (BLS 2008). Thus, the average person stayed in a job role about two years. The viability of organizations might be threatened if their employees changed jobs roles every week or every month. During the early boom days of call centers in India and a few other times in history, job role changes have approached the level of monthly turnover of a substantial fraction of all employees.

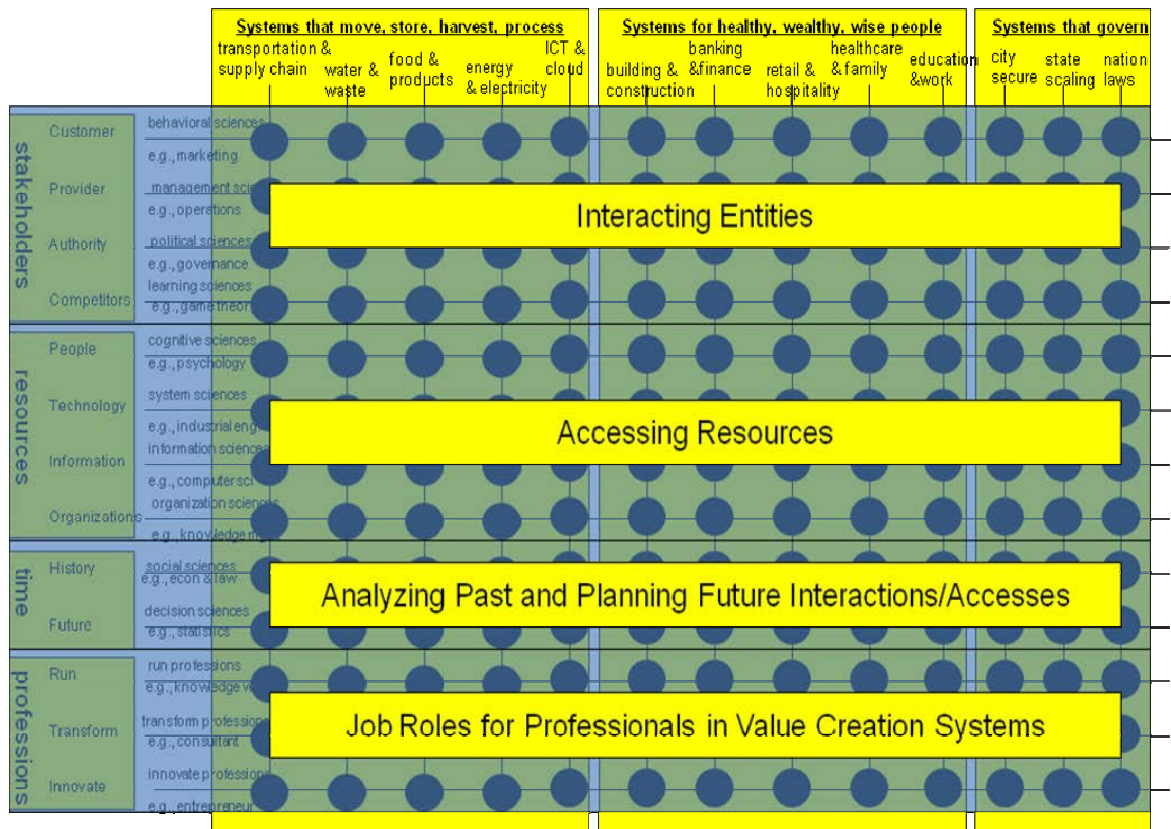
Figure 2 Service Science: Primary Types of Systems (13) and Disciplines (10)/Professions (3)



Source: Our elaboration from Spohrer and Maglio 2009.

From a Service Science perspective (Spohrer and Maglio, 2009), there are thirteen types of systems (economic segments) based on the nature of the service provided (transportation and supply chain, water and waste, food and manufacturing, energy and electricity, information and communication technology infrastructure, building and construction, retail and hospitality/media and entertainment, financial and banking, healthcare and family, education and professions, city government and security, region/state government and development, national government and laws/policies). These thirteen types of systems are not exhaustive, but they are the major providers of jobs in society. There are also three primary types of jobs roles in those systems, RUN-TRANSFORM/COPY-INNOVATE. RUN is increasingly the work of specialist or knowledge-workers. TRANSFORM/COPY is increasingly the work of consultants, managers, and engineers who know about existing best practices for processes. INNOVATE is increasingly the work of scientists, designers, and entrepreneurs who must invent the new. Again, a real job may combine one or more aspects of RUN-TRANSFORM/COPY-INNOVATE, but many job roles are primarily one of these. Ten primary discipline clusters provide additional professional preparation for graduates entering the work force. Figure 2 summarizes these types of systems, types of professions, and types of disciplines. People from all ten discipline clusters can find jobs in any one of the systems. That is because the disciplines deal with stakeholders (customer, provider, authority, competitors), resources (people, technology, information, organizations), and time (history, future). The three primary types of professions are, of course, found in all types of systems as well. When people change jobs, they may move from one type of system to another, or stay in the same system category. When people change jobs, they may move from one type of profession to another, or stay in the same profession category. The number of possible job role transitions is nearly 2000 possibilities; assuming an individual begins in one of the discipline clusters, this creates nearly 20,000 possible start background-jobs to first job role change transitions. Unfortunately, except for statistics on reemployment after job loss, very little statistical data exist for national populations across a complete life span.

Figure 3 Service Science: a Deeper Focus on Types of Systems (13) and Disciplines (10)/Professions (3)



Source: Our elaboration from Spohrer and Maglio 2009.

For individuals in modern society relatively frequent (a year or two) job role changes seems to be the norm. Preparing students for this type of challenging job change environment is not easy. For example, Smerdon (1996) suggests that the days in which an engineer could find a stable career in one manufacturing business are gone. Today, life long learning is needed to prepare engineers for a series of customer engagements or service projects, either as part of a consulting firm or as specialist for hire. In fact, in this increasingly complex and dynamic world, one of the great problems is: “*there is too much for students to know, and too little time to teach it*” (Donofrio, Spohrer, Zadeh, 2010).

The questions are: How can we solve this dilemma? What practical advice can SS-VSA researchers provide? What could be the benefits of students better prepared for many job roles during their working life span? Before answering these questions, it will be useful to overlay on Figure 2, some additional information to create Figure 3.

Figure 3 shows that entities changing job roles they offer is primarily constrained to the thirteen columns that correspond to the thirteen types of service systems that exist today. Figure 3 also shows, the last horizontal overlay, that the job roles primarily fall into three categories, run-transform-innovate, based on the primary activity of the individual filling the job role. However, what Figure 3 also shows, the first three horizontal overlays is that the discipline preparation of most graduates that enter the workforce is initially related to understanding stakeholders (interacting entities), understanding resources (accessing resources), or understanding how entities change over time (analyzing past and planning future interactions/accesses).

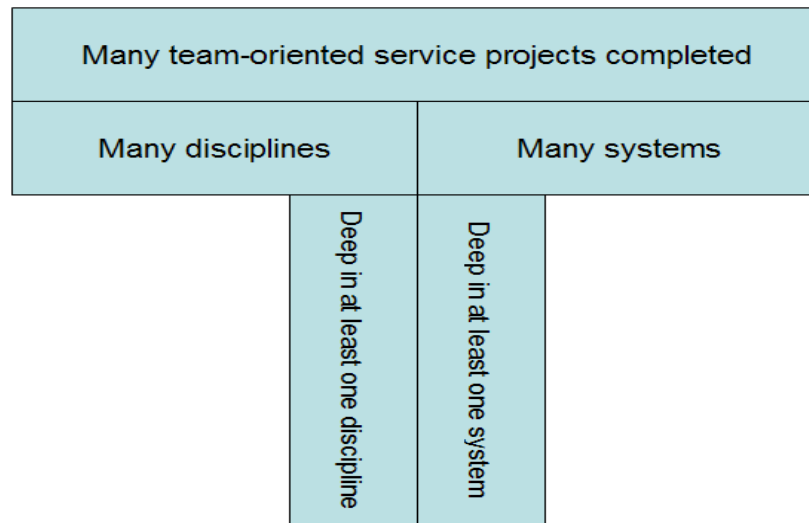
Because of the integrated SS-VSA analysis of (1) types of systems, (2) types of disciplines (as they relate to understanding the dynamics of service systems and viable systems), and (3) types of job roles, we are now in a position to make a recommendation that may improve the potential for value-cocreation (consonance) in the service system ecology and in the context. During the transition of individual workers from farms (agriculture and family) to factories (product manufacturing and professions) it became important that individuals gained additional reading, writing, and arithmetic skills. Now, during the global transition from farms and factories to a greater diversity of types of service systems, and greater frequency of changing job roles, it is becoming increasingly important for individual workers to know more about the types of systems, types of disciplines, and types of job roles. However, how can this be accomplished?

4. Recommendation: The Shape of Professionals to Come

The “shape of a professional” is a way of talking about the capabilities that professionals can apply when they are solving problems and when they are communicating with other professionals as part of a project team. The shape is determined by depth and breadth of knowledge in different areas of study (Donofrio, Sanchez, Spohrer, 2009). For example, from an industry perspective, universities today are very good at graduating I-Shaped Professionals (I-SP). I-SP have deep knowledge of one discipline area. Graduates with two degrees, who are deep in two disciplinary areas, are referred to as H-Shaped Professionals (H-SP). A single H-SP with the appropriately matched disciplinary background would be able to solve problems that would require the collaboration of two I-SP. Of course, the H-SP might not have the productivity of the two I-SP, but nevertheless would be successful on the same range of problem-solving tasks.

T-Shaped Professionals (T-SP) have breadth as well as depth. Breadth implies communication ability across a range of disciplinary areas. A person with breadth is able to understand the vocabulary of a discipline, and use it to understand and describe problems, that they may not be able to solve, but they can reason about which discipline experts might be able to solve the problems. In practice, from an industry perspective, after hiring an I-SP, once that person has worked for several years on real-world project teams, then they become a T-SP. The T-SP have better communication, teaming, and project experience than an I-SP, and hence are more highly valued in industry. The type of T-SP that SSMED as an emerging discipline seeks to graduate is summarized in Figure 4 below (see also Spohrer, Anderson, Pass, Ager, and Gruhl, 2007; Spohrer and Kwan, 2009; Spohrer and Maglio 2010).

Figure 4 A T-Shaped Professional in Service Science



Source: Our adaptation from (Spohrer *et al.*, 2007; Spohrer and Maglio, 2010).

The evidence that supports the need for more T-SP at the national level is beginning to appear. Using thirty years of economic trends related to job descriptions, MIT and Harvard economists Levy and Murnane examine how computers create and enhance some jobs, while they eliminate and redistribute other jobs (Levy and Murnane, 2004). The result is a clear trend in U.S. occupational structure with most job growth in higher-end, high-skilled occupations, and most job elimination in the lower-end low-skilled occupations. Their recommendation is to recognize this division and to prepare the population for the high-wage and high-skilled jobs that are rapidly growing in number-jobs that use computers and require extensive problem solving (depth) and interpersonal communication (breadth). Perhaps more important than the specific findings of this economic trend analysis study is the development of a method that could lead to a more precise definition of T-shaped skills needed by professionals to improve the performance of nations as a function of increasing computer capabilities (Collins and Kusch, 1998).

Determining “the right” ratio of T-SP to I-SP in a service system entity depends on a number of factors. The cost of graduating a T-SP is greater than that of an I-SP, since a T-SP knows more and has more team-oriented project experiences. Nevertheless, if universities graduated only T-SP, then a business might want only T-SP. However universities, do not currently graduate T-SP, they graduate predominantly I-SP and occasional H-SP. So given the limited availability of T-SP and the greater cost a business would incur to transform I-SP into T-SP at an accelerated rate, the question of “the right” ratio of T-SP to I-SP to improve business performance is an interesting one.

While not a complete answer to the above question, the area has received some study (Cataldo, Carley, and Argote, 2001). The overall results of the computational organization theory simulations were perhaps not too surprising, but using a simple model of demand and altering the ratio of simulated generalists and specialists in an organization, the research effort suggested that: (1) in the case of constant demand, organizational performance can be optimized using all specialists, but (2) in the case of variable demand, organizational performance can be enhanced by increasing the ratio of generalists that increase knowledge flows across the organization. Up to a point, the more demand varies, the more generalist are able to create performance benefits over alternative populations of strictly specialist employees. Perhaps more important than the specific findings of these computational organization theory experiments is the development of a method for lending more precision to the definition of people with different “shaped skills” and measures of performance benefits when demand and skills vary.

The results of the simulation study above are reminiscent of another resource allocation decision that organizations must make, namely exploitation or exploration (March, 1991). As March suggested, if an environment is changing rapidly, an entity that only exploits existing knowledge, risks being less able to compete against entities that explore and find new higher value knowledge apply. In an environment with little change a knowledge exploitation strategy and I-SP can perform adequately. However, in an environment with rapid change a knowledge exploration strategy

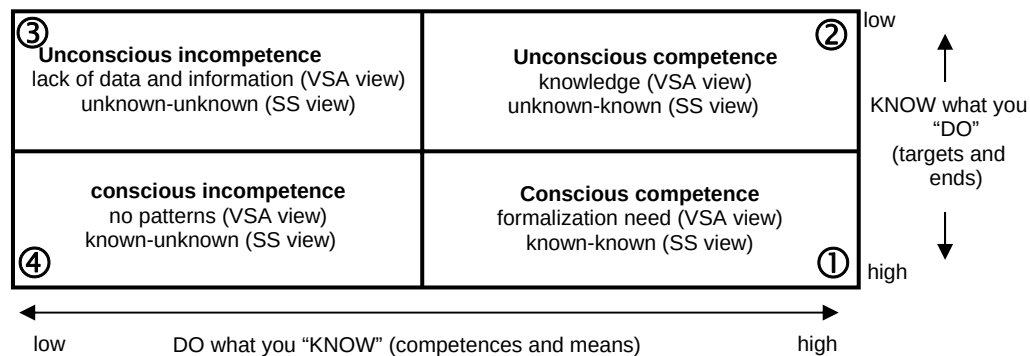
and T-SP have the potential to outperform exploitation and I-SP. Of course, there are no guarantees because exploration and T-SP are costly and have risks. Moreover, experience suggests that exploration and T-SP often pay large dividends when successful.

In this context, we can now attempt a first and quite tentative integrated SS-VSA analysis:

- 1a) I-SP are problem-solvers specialists because they are able to manage complexity in their particular job but they are less able to live with change (elasticity plus efficiency).
RUN is least costly and least risky if the environment is not changing much.
- 1b) T-SP are better decision-makers because they are able to manage complexity in breadth and deep sense and so they are able to live with change (elasticity and flexibility plus efficiency). TRANSFORM/COPY-INNOVATE may be costly and risky, but also may create the greatest value. If the new best practice is true INNOVATE, then it may be further monetized, as when other entities pay to adopt the innovation (e.g., patents).
The other entities are performing a TRANSFORM/COPY change.
- 2a) When the scenario is quite stable, I-SP are needed to guarantee RUN will work.
- 2b) When the scenario is dynamic and unstable, T-SP are needed to TRANSFORM/COPY what others have done to INNOVATE given the change. Of course, INNOVATE may also require an additional capability of CREATIVITY.

In complex environment, the search of viability on job implies the capability of human resources to make decision on the basis of decision-making (D-M) and problem-solving (P-S) processes. D-M process assures a virtuous circle of syntropy (Picicocchi *et al.*, 2009) able to manage the decisional uncertainty (complexity vs complication); P-S process guarantees performance in a stable scenario.

Table 2 Decision Making and Problem Solving in SS-VSA view



Source: our elaboration

Square 1: conscious competence

In this square the Decision-Making (D-M) and Problem-Solving (P-S) processes are carried out with formalized processes to achieve known ends with known means.

In SS-VSA view, this scenario is most predictable:

- ☑ Decision-Making process is adequate and useful to TRANSFORM/COPY-INNOVATE.
- ☑ Problem-Solving process is adequate and useful to RUN.

Square 2: unconscious competence

In this square the D-M and P-S processes are carried out to achieve known ends with unknown means.

In SS-VSA view, this scenario is less predictable:

- ☑ Decision-Making process is inadequate and useless for TRANSFORM/COPY-INNOVATE.
- ☑ Problem-Solving process is adequate and useful to RUN.

Square 3: unconscious incompetence

In this square the D-M and P-S processes aren't possible

In SS-VSA view, this scenario is unpredictable:

- ☑ Decision-Making process is inadequate and useless for TRANSFORM/COPY-INNOVATE.
- ☑ Problem-Solving process is inadequate and useless to RUN.

Square 4: *conscious incompetence*

In this square the D-M and P-S processes are carried out to achieve unknown ends with known means.

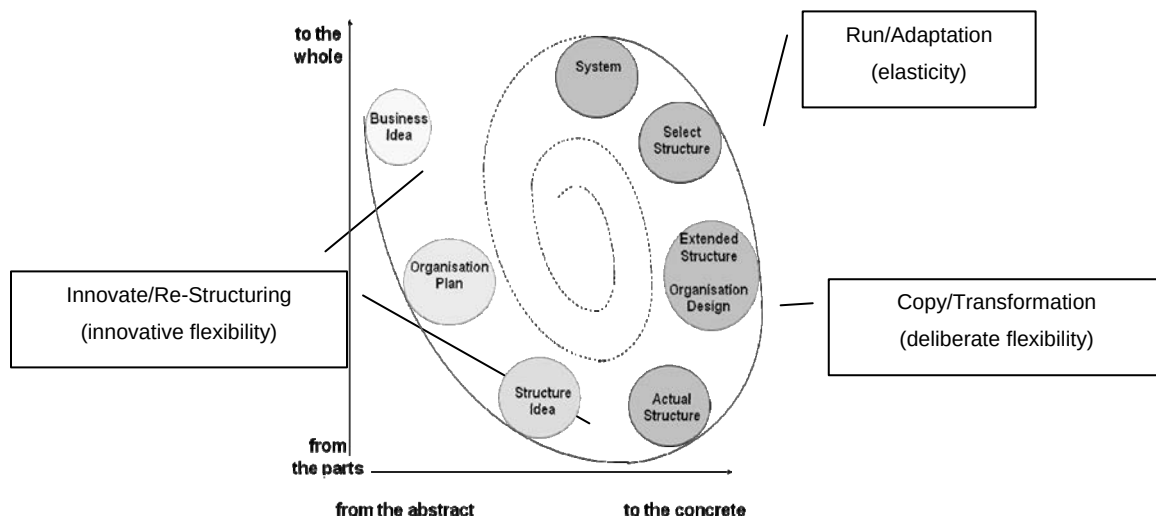
In SS-VSA view, this scenario is less predictable:

- ☑ Decision-Making process is inadequate and useless to TRANSFORM/COPY-INNOVATE.
- ☑ Problem-Solving process is adequate and useful to RUN.

5. Practical Implications

In Service Science, RUN-TRANSFORM/COPY-INNOVATE is a choice that is concerned with the most fundamental resource allocation decision-making task that every service system entity faces continuously. In Viable Systems Approach, ADAPTATION-TRASFORMATION-RESTRUCTURING is a recursive model used to describe the changes that a viable systems entity goes through during the course of its life span.

Figure 5 The Conceptual Framework of the Viable Systems Approach (VSA), i.e. the Basic Plan for Business Start up and Development in a System's Perspective



Source: our adaptation from (Golinelli G.M. *Viable Systems Approach (VSA). Governing Business Dynamics*, Kluwer, CEDAM, 2010).

Figure 5 shows the basic plan which make up the conceptual framework of VSA. These are the foundations of the system; a system which is judged by its dynamics and the development of interaction processes between components, varying in time and space.

It is necessary at this point to consider these concepts within the field of service systems. To give shape, consistency and development perspectives to any organization as a system, the presence of significant and continuous planning activity is necessary. This activity must be conducted and implemented by the company's government.

Figure 5 analyses the progression from a business idea, through a process that allows the structural elements to be established gradually, through to the definition of the select structure. The system emerges from the activation of relationships between the components and between the components and the context (Golinelli, 2010).

The Service Science RUN-TRANSFORM/COPY-INNOVATE is a linear model and a repeated decision that entities must make (explicitly or tacitly) time and time again.

The Viable Systems Approach ADAPTATION-TRANSFORMATION-RESTRUCTURING is a recursive model or a circular model that highlights a process of becoming where decision making is changing over time as well. In particular, recursion means that every process activated by a system is incorporated into a wider process, originating in turn from the interaction of other systems.

From a SS perspective, the resources that an entity allocates at each time step to RUN-TRANSFORM/COPY-INNOVATE can be viewed as follows:

- **RUN** means small adaptation of behavior through practice effects but stable structure or variety;
- **TRANSFORM/COPY** means copying the structure and actions of another entity. Transform is costly and risky, but may have benefits once the change is complete (adopting a new best practice). Transform has to be considered as “the boundary” between adaptation and creativity;
- **INNOVATE** means creative change of structure and actions, and may be riskier and more costly.

From a VSA perspective, the process of becoming where decision making is changing over time to ADAPTATION-TRANSFORMATION-RESTRUCTURING, can be viewed as follows:

- **ADAPTATION** means an alteration to the relationships and peripheral components (intensity and use) of the selected structure/extended structure;
- **TRANSFORMATION** means a modification to the organization design, (a change in the extended structure);
- **RESTRUCTURING** means an alteration of the organization plan.

Table 3 shows the resource allocation decision-making in complex scenario according to SS and VSA. As you can see from the table, the substantial change of identity of a service system requires an additional capability of CREATIVITY in SS view or a process of RETHINKING which means an alteration of the business idea in VSA view.

Table 3 Resource Allocation Decision Making in Complex Scenario: an Assessment According to SS and VSA

Analysis and Feedback	Viable Systems Approach (VSA)	Service Science (SS)	Resource Allocation Decision
Select Structure	<i>Adaptation</i>	<i>Run</i>	<i>Exploitation</i>
Organisation Design	<i>Transformation</i>	<i>Transform/Copy</i>	<i>Exploration</i>
Organisation Plan	<i>Re-structuring</i>	<i>Innovate</i>	<i>Exploration</i>
Business Idea	<i>Re-thinking</i>	<i>Creativity</i>	<i>Exploration</i>

Source: our elaboration

6. Conclusion

An integrated SS-VSA analysis suggests that the phenomenon of people changing job roles is only likely to accelerate as change processes become more efficient. Students can prepare for this accelerated change by becoming more T-shaped. T-Shaped Professionals (T-SP) combine breadth and depth, which goes beyond the traditional I-Shaped Professional (I-SP) known only for depth.

From a Service Science perspective, breadth is complex communication skills (across many disciplines and systems with many team-oriented project experiences) and expert thinking (in at least one specialized discipline and one specialized system). As the life-cycle of entities becomes ever more a series of service projects that co-create value between providers and customers, T-Shaped Professionals will become more and more in demand for their ability to excel at collaborative innovation and adaptive innovation (Donofrio, Sanchez and Spohrer, 2009).

From a Viable Systems perspective, breadth is Decision-Making and depth is Problem-Solving. To create the right conditions for consonance and resonance in job markets (synergic job network), it is necessary to produce and share common:

- a) Information Units = Data
- b) Interpretation Schemes = Schema
- c) Categorical Values = Identity (Depth Structure)

VSA	Synergic Job Network
Information Units	Data
Interpretation Schemes	Schema
Categorical Values	Identity

The creation of synergic job networks will depend on improving value cocreation networks that can better manage ambiguity and complexity of scenario interpretation, decision-making, and problem-solving processes (Barile, 2009; Picicocchi, Saviano, Bassano, 2009).

In sum, this paper has presented a first integrated Service Science and Viable Systems Approach analysis of a real-world phenomenon. This first attempt has made some progress and exposed some intriguing possible connections. Nevertheless, much more remains to be done. We hope this effort will encourage others to make even more progress, and study other real-world phenomenon associated with the viability of service systems entities.

7. Appendix

To continue the integration of Service Science (SS) and Viable Systems Approach (VSA) is important to have a shared view on the key concepts of both analytic frameworks. In the following tables, we present Service Science and Viable Systems Approach glossaries to create a first pass conceptual connection for an integrated (SS-VSA) analysis framework for systems. We hope these glossaries will serve as a jumping off point for members of both communities to further develop and improve.

SERVICE SCIENCE (SS) GLOSSARY

Adaptive Innovators	People who are entrepreneurial and capable of systems thinking in the many project roles they may fill during their professional life
Ecology	Is the population of all types of service system entities that interact over time to create outcomes. Types of service system entities include individuals (people) and collectives (organizations). History is the trace of all entities that interact
Evolutionary perspective	It is the service science perspective that structure (resource and service entities) and action-patterns (interactions, both value-co-creation and governance) constrain each other in a coevolving way
Entities/Service Systems or <i>Globally integrated formal service system entities of today</i>	Dynamic configurations of resources (people, technology, organizations and shared information) that can create and deliver service while balancing risk-taking and value-co-creation. They are complex adaptive systems. They are also a type of 'system of systems', containing internal smaller service systems as well as being contained in a larger service system (see Stakeholder)
Informal service system entities	Local clan, hundreds to thousands of people
Formal service system entities	Written national laws, thousands to millions of people
Interaction	Interactions between service system entities are what lead to outcomes
Interaction takes place	Patterns of interaction give rise to service system network. The interactions occur between and among a set of service system entities over time. The simplest service system network is a customer and a provider connected by a single value proposition
I-Shaped Professionals	Specialized problem solvers of the 20th century with deep knowledge in one discipline
T-Shaped Professionals	Decision makers of the 21st century that are still grounded in their home disciplines but have strong communication skills across areas of business, technology and social sciences
Potential for value co-creation	Potential resources – those have not yet been created – also provide opportunities
Value co-creation	Is the normative, or desired outcome and of course is win-win or mutual benefit
Stakeholders (Customer, provider, Authority, Competitor)	Include participants in service systems and others who are indirectly affected. Stakeholders who are 'named participants' are also known as role holders, who can be people or other service systems that fill named roles in service systems
Structure	Resources and service system entities

Action Patterns	Interactions, both value co-creation and governance, that form networks
Resources	Every named thing can be a resource. There are four types of resources: physical-with-rights (people), physical-with-no-right (technology, environment), non-physical-with-no-rights (info)
Life Cycle	All resources have a lifecycle: a beginning, middle, and end. All non physical resources exists as localized or distributed patterns in the physical states of physical resources, and are subject to coding errors (imperfect patterns or interpretation)
Run	Is least costly and least risky if the environment is not changing much (change is gaining experience – practice effects and learning curves, anomaly detections)
Transform	Is costly and risky, but may have benefits once the change is complete (adopting a new best practice by copying another)
Innovate	May be costly and risky, but also may create the greatest value, if the practices can be monetized if others adopt them (e.g., patents, consulting practices, etc.)
Creativity	A capability of entities to create new knowledge and embody it in resources, entities, or interaction mechanisms
Interactional Expertise	Also known as complex communications skills, the ability to communicate across knowledge domains or disciplinary boundaries, without necessarily possessing deep contributory expertise. Contributory expertise allows experts or specialists to extend the knowledge in a discipline
Measures Ranking (quality, productivity, compliance, sustainable innovation)	Service system entities often have associated KPIs that must be improved to create value. So value co-creation can occur when the KPIs of two or more service system entities become linking in ways that improve the KPIs together. Estimating the quantitative or qualitative value of KPIs and communicating these measures to others are fundamental competences of service system entities
Offerings – value proposition	A specific package of benefits and solutions that a service system intends to offer and deliver to others. Division of labour is at the root of many value propositions. By traditional economic and marketing definitions, value propositions may be confined to either products (things) or services (activities). However, the modern meaning of service is value co-creation that involves both products and services as part of offerings.

VIABLE SYSTEMS APPROACH (VSA) GLOSSARY

Viable Systems Approach	The VSA is an approach which, being within a continuum with reductionism and holism at its extremes, is able to reconcile the two. The focus shifts from the parts to the whole, implying a perception of reality as an integrated and interacting unicum
Accomplished Systems	A viable system with all the VSA features at their highest fulfillment degree, entirely respecting the VSA postulates. We tends to call these "entities" simply "viable systems"
Embryonal systems	A viable system at its lowest fulfillment degree. For example free markets, where it is not possible to find government among firms and investor
Evolving systems	A viable system provided with a quite remarkable fulfillment degree. For example, company networks with a relatively unstable government "guiding" the network
Context	The representation of reality, created by the government of a firm, which interprets the environment in which it operates as a virtual place populated by suprasystems (systems entities) which are decisive in reaching its objectives as holders of critical resources and able to exert influence on the firm
Consonance	This refers to the degree of integration among structures, i.e., their potential structural compatibility for exchange It is the ability to relate to the outside world in order to bring about the exchange of resources
Resonance	It is a form of systems interaction able to generate harmony among parts, bringing about a higher level of synthesis than that manifested by individual systems identities. It is the development/improvement of the potential compatibility between parts (consonance) through operative collaboration in order to reach a common goal It is a syntony and coinciding of aims; the ability of the system to create synergy with other systems, maintaining a shared goal
Suprasystems (L+1 level) (Infinite)	A system which projects its own expectations on another system which thus becomes a subsystem
Viability	The concept of viability should be understood in terms of autonomous existence, the fruit of strategic decisions, the system in its own context Viability is intimately connected to the concept of survival, but must not be identified with it
Adaptation	Alterations to the relationships and peripheral components (intensity and use) of the select structure/extended structure
Transformation	Modifications to the organization design, (a change in the extended structure)
Restructuring	Alteration of the organization plan
Rethinking	Alteration of the business idea (substantial change of identity)

Interaction	Refers to structural relations activated at system level insofar as they emerge when the components, forging structural relationships, actually exchange resources and share knowledge in order to reach their common goal
Elasticity	A system's ability to limit possible negative shifts in the expected results due to context dynamics concerning both output placement and the input supply
Deliberate flexibility	Systems ability inherent in the possibility to change the select structure without varying the extended structure
Innovative Flexibility	A systems capability deriving from government's capability to change the variety of the extended structure's components and relationships, and then create a new select structure
Value creation	The process of satisfying supra and subsystems while governing the system's exposure to risk in the long run

As we asserted before there is a need for a change of theoretical and operational perspective, based on a common lens deriving from SS-VSA. Perhaps not surprisingly, the vocabulary used by the two approaches is different, but the core recommendation is nevertheless fundamentally the same.

At this point we here introduce connection between both glossaries to make more comprehensible the vocabulary and core concepts of this and some of the other papers collected in this Special Issue.

CONNECTION BETWEEN SERVICE SCIENCE (SS) AND VIABLE SYSTEMS APPROACH (VSA)

SERVICE SCIENCE (SS)	VIABLE SYSTEMS APPROACH (VSA)
Ecology	Context
Entities/Service Systems or Globally integrated formal service system entities of today	Accomplished systems
Formal service system entities	Evolving systems
Informal service system entities	Embryonal systems
Evolutionary perspective	Viable Systems Approach
Interaction takes place	Context
Potential for value cocreation	Consonance
Value cocreation outcomes	Resonance
Stakeholders	Suprasystem
Life Cycle	Viability
Run	Adaptation
Transform	Transformation
Innovate	Restructuring
Creativity	Rethinking
Interaction	Interaction
Measures, Ranking	Elasticity, Deliberate flexibility, Innovative flexibility, value category
Outcome	Value creation

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