Towards a new logic of value co-creation in the digital age: Doing more and agreeing less

< The Human Side of Service Engineering/The Viable Systems Approach/Artificial intelligence and the human machine service interaction >

Barile Sergio
Department of Management, Sapienza, University of Rome, Rome, Italy

Paolo Piciocchi
Department of Political Sciences and Communication, University of Salerno, Salerno, Italy

Marialuisa Saviano
Department of Pharmacy and Pharmanomics Interdepartmental Center, University of Salerno, Salerno, Italy

Clara Bassano*
Department of Management and Quantitative Methods, University of Naples "Pathenope", Naples, Italy

Maria Cristina Pietronudo
Department of Management and Quantitative Methods, University of Naples "Pathenope", Naples, Italy

James C. Spohrer
IBM Research-Almaden, San Jose', US

(*) Corresponding Author
Sergio Barile
Department of Management
Sapienza University of Rome, Via Del Castro Laurenzano, 9, Rome (RM), 00161, Italy
email: sergio.barile@uniroma1.it
Paolo Piciocchi
Department of Political Sciences and Communication
University of Salerno, Via Giovanni Paolo II, 132, 84084, Fisciano (SA), Italy
email: p.piciocchi@unisa.it
Marialuisa Saviano
Department of Pharmacy and Pharmanomics Interdepartmental Center
University of Salerno, Via Giovanni Paolo II, 132, 84084, Fisciano (SA), Italy
email: msaviano@unisa.it
Clara Bassano **(*)**
Department of Management and Quantitative Methods (DISAQ)
"Parthenope" University of Naples , Via Generale Parisi, 13 (Palazzo Pakanowski), 80132, Naples, Italy
email: clara.bassano@uniparthenope.it

Maria Cristina Pietronudo
Department of Management and Quantitative Methods (DISAQ)
"Parthenope" University of Naples, Via Generale Parisi, 13, 80132, Naples, Italy
email: mariacristina.pietronudo@uniparthenope.it
Dr. James ("Jim") C. Spohrer
Director, IBM University Programs (IBM UP) and Cognitive Systems Institute
IBM Research - Almaden, 650 Harry Road, San Jose, CA 95120 USA
email: spohrer@us.ibm.com

Towards a new logic of value co-creation in the digital age: Doing more and agreeing less

Abstract

Purpose - Technology has greatly accelerated socio-economic processes (Arthur 2011, 2017; Harari 2014). As a result of Artificial Intelligence (AI) advances, we are witnessing a change in perspective in value co-creation logics. Technologies are more appropriate for some tasks, and perhaps less for tasks that require aligning people and organizations to co-create value. For the first type of task (performance) the question is can businesses provide customers "performance, scalability, and availability" (Thompson 2019). For the second type of task (consensus), the question is what can businesses provide customers (or governments provide citizens, or family leaders provide their families)? Regarding reaching agreement on the value to be co-created – consensus on desired changes in the world – how can groups of people at multiple scales get better faster?

Methodology – According to an integrated framework based on Viable Systems Approach (VSA) & Service Science (SS) new rules should be discovered that improve service systems architectures and allow local optimizations to lead to global optimizations more often (Spohrer et al, 2012). However, additional study and an integrative methodology is required to better comprehend how and why technological growth justifies the social shift from value collinearity to value co-creation processes (Barile, 2009; Barile et al, 2018; Golinelli 2010; Spohrer and Maglio, 2008; Spohrer et al., 2017).

Findings – Increasing technological capabilities may be making reaching consensus more and more difficult, even while it is becoming technologically easier and easier to realize any one of many different outcomes. This is a paradox of increasing levels of technology-mediated value co-creation in business and society – we can do more, but agree less on what needs to be done.

Practical implications – In the digital age, the search for a new logic of value co-creation means transforming the traditional concepts of resources/workers to include both biological and digital forms. This implies focusing on not just smarter service systems, but wiser service systems (increase worker quality-of-life over multiple generations of workers). Wiser service systems will depend on AI applied for IA (Intelligence Augmentation) to reach both smarter and wiser consensus on value co-creation goals. Therefore, it is relevant that a human component (problem solver and/or decision maker) should be able to ensure sustainable decisions for a common welfare (Nonaka, 2011).

Originality – The paper highlights the awareness in the service science, viable systems, and service-dominant logic communities to focus on understanding and extending value co-creation logics from a systems perspective, integrating resources/workers across human cultures, academic disciplines, and industrial systems.

Key words: Value Co-creation, Wise System, Artificial Intelligence, Artificial Augmentation, Digital Thinkers.

Paper type – Conceptual paper

Introduction

Technology has greatly accelerated socio-economic processes (Arthur 2011, 2017; Harari, 2014). In the last decade certain technologies – digital and information technology – have changed the economy, sometimes making processes easier, while at other times causing a pervasive impact on businesses and jobs making some processes more difficult (Qu, Simes and O'Mahony, 2017). Artificial Intelligence (AI), considered by some authors a general-purpose technology (Brynjolfsson and McAfee, 2017; Barile et al., 2019), is causing further skill-biased technical changes and change in perspective in the value co-creation logics (Piciocchi et al., 2017). More precisely, AI is modifying how people create value together (Maglio et al., 2009). Created value is often the result of a human-machine interaction, rather than human-human interaction. The range of tasks that technology can perform well are continuously increasing; technology is no longer simply a tool, but is rapidly becoming an excellent learner. Sometimes technology can learn to do complex tasks, not just simple repetitive tasks. AI systems diagnose cancer, recognize emotions, recognize images and speech, as well as generating art, news stories, and even books. However, now and in the near future, AI seems unlikely to perform the type of tasks that require aligning objectives of people and organizations, being not able to guarantee the co-finalization of the value proposition (Barile et al., 2019).

AI systems are being built for tasks and processes where more data can lead to performance improvements. JPMorgan Chase introduced a supervised learning system for reviewing commercial loan contracts; the system spends a few seconds to complete a task, while before officers employed 360000 hours (Brynjolfsson and McAfee, 2017). Both academics and practitioners agree for these types of tasks and processes businesses can provide customers "performance, scalability, and availability" with intelligent technologies (Thompson 2019). The second type of tasks requires a deep comprehension of intents, a stable communication and a consensus among parties. The question is what can businesses provide customers (or governments provide citizens, or leaders of households provide their families) when assisted by AI systems? If knowledge dynamics has an exponential trend, then what can businesses provide regarding agreement on the value to be co-created – consensus on desired changes in the world? In short, the growth of technological performance on the first type of tasks appears to be growing at a much faster rate than for the second type of tasks that require creating consensus on shared goals.

Our paper focuses on these last aspects related to consensus in value co-creations as augmented entities have greater and greater capabilities for achieving tasks on their own. It highlights the growing awareness in the communities that study service science (Spohrer and Banavar, 2015), viable systems, and service-dominant logic communities (Vargo and Lush, 2006) that certain aspects of value co-creation are paradoxically becoming more difficult as AI capabilities increase. These three communities seek to understand and extend value co-creation logics from a systems perspective, integrating resources/workers across human cultures, academic disciplines, and industrial/technical systems.

From our perspective, introducing new logics of value co-creation can be interpreted as the potential to realize a different types of project in terms of consensus capacities and not merely task competences. We argue for a new value co-creation logic that moves beyond the notion co-created value connected strictly to competencies and so to the role of Artificial Intelligence (AI) in systems. Our paper is a first attempt to interpret value as meta-value, by enhancing existing/old/previous notions of value in the sense that we create new value useful for the old value. This observation in part justifies the need to shift from the concept of AI to the innovative concept of Intelligence Augmentation (IA) across multiple scales of entities from families to businesses to nations, wherever consensus on goals is required between empowered individuals to make progress (Barile et al. 2018; Barile et al. 2019).

Moreover, this new logic of value co-creation requires the analysis of the phenomenon of value co-creation in the digital age as strictly connected to the phenomenon of learning from a viable systems

perspective that essentially consists in the variation of an *informative variety* with respect to an initial *configuration* perceived by an observer (Barile, Di Nauta, Iandolo, 2016). In the next section, we illustrate the Literature Background to support the evolution of the concept of Artificial Intelligence (AI) shifting to the concept of Intelligence Augmentation (IA). The rise of socio-technical systems, in which the role of technology is more influential, requires a multidisciplinary approach to analyze complex systems viability. Consequently, in the section 3 we illustrate an integrated perspective based on two frameworks: the Viable Systems Approach (VSA) and the Service Science Management Engineering Design, Arts and Public Policy (SSME+DAPP – SS for short). Both frameworks are useful to study complex human systems and, in particular, how to discover new rules for improving service systems value co-creation processes. Section 4 highlights Findings. In Section 5 implications will be described. Finally, conclusions and future research directions are discussed.

Literature background

From Artificial Intelligence (AI) to Intelligence Augmentation (IA)

The AI and IA dilemma/binomial has found great ferment in scientific studies. On the one hand, AI supporters believe that the future will be dominated by rather autonomous computing systems capable of imitating and/or replacing human cognitive functions; on the other hand, researchers on IA hold up, instead, the centrality of human resources and the related cognitive processes, while recognizing the role of great support and integration of information technologies.

It is undeniable that AI will clearly play an important role in both social and productive dynamics. AI-based solutions work in structured environments where all relevant information can be considered and where the system's objectives are clearly defined, such as ordering a lunch, organizing a meeting, playing chess. In these cases, the result can be predicted with a high degree of security and be optimized based on the user's response to improve results in the future (i.e. IBM's Deep Blue computer, beats chess grandmaster Gary Kasparov in 1997). This is the perspective in which AI has an advantage over the human mind. On the other hand, IA is suitable for situations in which objectives and inputs are not well defined; in these cases, the IA will continue to play an important role.

So we can say that AI-based systems can help here as well. They can give sense to the enormous Data-Tower of Babel by creating contexts out of information emanating from different systems. AI can contribute with fundamental progression impulses, but what comes next requires human intervention: from this perspective IA will have an essential role in the tecnology applications. This means, AI and IA both have an important role to play in our future.

The concept of *intelligence* has been discussed by several authors in different fields from the psychology (Guilford, 1967; Piajet, 2005) to the philosophy (Skagestad, 1993) to the computer science (Turing, 1950). Recent authors have re-thinked the real significance of the term "Intelligence" to argue their discussion on the risks and limitations of machine intelligence in comparison to those human and for better understanding the impact of the first one on social and economic issues (jobs, economic growth). Malone (2018) has defined intelligence as the ability to achieves a goal: individuals are considered to be intelligent on the basis of their capacity to reach attributed goals. However, they (individuals), differently from the machine - holders of an artificial and specific intelligent - have a general intelligence that enables them to do a wider range of tasks useful to operate in different environments and for different goals. Arthur (2017) writes about intelligence defining it as a combination of "conscious thought" or deductive reasoning incorporated in individuals, considering, by contrast, the machine intelligence as an associative intelligence. Indeed, an AI works for associations, recognizing and sensing situations before acting appropriately (Arthur, 2017): to detect credit-card frauds a machine collects an huge amount of data on historical credit- card transactions and proceed for association to classify new transaction as "fraud" or "not fraud" (Jordan and Mitchell, 2015). This intelligence is not appropriate for another

kind of tasks as reasoning or solve a new problem (Rouse and Spohrer, 2017). The human intelligence is much wider, it goes beyond an association, it covers a huge range of issue and involves much of tacit knowledge (Brynjolfsson and Mcafee, 2017). These definitions open a positive scenario for the future. Some authors discuss distinctive elements of human intelligence, by implying the importance of human machine collaboration and make unreasonable the hypothesis of human obsolescence. Machines need humans and humans needs machines. Rao and Verweij (2017) identify 4 categories of Intelligence, but it emerges that each one needs of human interaction:

- an *assisted intelligence* helps people to perform tasks;
- an *automated intelligence* facilitates and relieves people tasks' replacing them in some activities;
- an *augmented intelligence* supports people in making a decision;
- an *autonomous intelligence* acts without human intervention but a person or an organization will be responsible for the actions of the AI develops (Pakkala and Spohrer, 2018).

The result of human and machine interaction seems in some instances to improve and augment human intelligence rather than replace it (Rouse and Spohrer, 2018). Moreover, also the automation of some tasks needs human help, to ensure that the machine works well.
So, the concept of *Intelligence Augmentation* that we will introduce in the next section is not synonymous with the concept of *augmented intelligence* introduced by Huang and Rust (2018): as we will explain it is an extension and it is the broadest concept (Barile et al., 2019).

In fact, some authors have reflected on the interaction and collaboration between human and machine highlighting certain changes in the structure of human thought. Barile et al., 2019 explain the cognitive transformation is involving people interacts with machines. AI inevitably change the way people will develop their rational and emotive intelligence to integrate input derived by artificial intelligent in their problem-solving process (Carter and Nielsen, 2017). Whilst new abilities should be developed to interface with the machine language and interpret their output (vertical and technical abilities), at the same time new soft skills needed both for converse with machines, both for manage all those relationships with others human actors (empathy, listening, cooperation) that characterize and guarantee the viability of an entities in its environment (Barile et al., 2018; Barile et al., 2019). Therefore, a virtuous and circular interaction between humans and machines is needed to guarantee a synergic collaboration and the sustainability of a system (Barile et al., 2018; Barile et al., 2019).

Malone (2018) describes the cyber-human system in which humans and machines work together as in a team:

People can supply the general intelligence and other skills that machines don't have. The machines can supply the knowledge and other capabilities that people don't have. And, together, these systems can act more intelligently than any person, group, or computer has done before (Malone, 2018, p. 37).

The Intelligence Augmentation

Researchers are therefore recently discussing how to integrate human intelligence and that of machines introducing the concept of Intelligence Augmentation (IA), (Barile et al., 2018; Barile et al., 2019), an intelligence given by the integration and interaction between smart people and artificial entities.

Their assumptions start from a new definition of intelligence, as "the ability to approach a solution by changing our *endowment of knowledge* (Informative Variety)," that can be described as follows: (Barile et al., 2018).

$$V_{inf}(k) = (U_{inf}(k), S_{int}(k), C_{val}(k))$$

where:

$V_{inf}(k)$ = *Informative variety of viable system k*
$U_{inf}(k)$ = *Informative units of Informative variety of viable system k*
$S_{int}(k)$ = *Interpretative schemes of Informative variety of viable system k*
$C_{val}(k)$ = *Categorical values of Informative variety of viable system k*

Consequently, the question is:
By modifying our *endowment of knowledge* does a modification of intelligence result?
In our perspective, given that the *endowment of knowledge* consists of (Barile, 2009):

- *value categories*: strong beliefs that affect interpretative schemes;
- *interpretative schemes*: all external component that transforms the general knowledge in specific knowledge;
- *informative units*: all perceived elements that contribute to generating knowledge;

it follows that

if you can have different schemes then you can have Intelligence Augmentation (IA)

In short, being intelligent means acting not just on the basis of data and objective information but also on the basis of schemes and values that make the knowledge an intelligence able to take the best decision in specific circumstances. An AI does not have own values or own interpretative schemes: the human contribution makes the AI output suitable for a particular situation. Consequently, it is necessary to re-define the role of artificial intelligence where configurations of people, organization and technologies work together for a mutual benefit (Maglio et al., 2015). In these human-centered systems (like families, companies, cities, nations) it is fundamental to be worried about the integration of machines with the social environment in which they operate. Rather than to be worried about how smart an organization is and how is it endowed by super-intelligent machines, leaders should guarantee the systems is wise and supported by an intelligence augmentation. However, the dynamics of these kinds of systems are not easy to explain and predict (Beer, 1972).

New abstractions and new criteria for a smarter and wiser system should be introduced to manage the use of advanced technologies for the benefit of the future and current generation (Demirkan et al., 2015). To date, system entities are not able to manage this process of change, new levels of complexity require new pattern or schema (Barile, 2009; Barile and Saviano, 2018) to formulate and re-design the service system ecology, identifying an appropriate solution for businesses, or government enterprises and for the whole system. (Piciocchi et al., 2018; Barile et al., 2012).

Therefore, the issues raised to open up new discussions about how to integrate human and machine intelligence to achieve improvement in term of efficiency and growth but also effectiveness and development of new value.

An integrated methodology

According to an integrated framework based on Viable Systems Approach (VSA) & Service Science Management Engineering Design, Arts and Public Policy (SSME+DAPP - for short SS) new rules should be discovered that improve service systems architectures and allow local optimizations to lead to global optimizations more often (Spohrer et al, 2012). However, additional study is required to better comprehend how and why technological growth justifies the social shift from value collinearity to value co-creation processes (Barile, 2009; Barile et al, 2018; Golinelli, 2010; Spohrer and Maglio, 2008; Spohrer et al., 2014). This means the search for a general law is an on-going process as the boundaries of human capabilities change along with the diverse individual needs, wants, and aspirations of people. This requires an integrative methodology that combines multiple analysis frameworks for analyzing and planning interventions along the dimensions of technology change, policy change, skills change, and cultural change (Piciocchi et al., 2018). Two frameworks are considered and togheter are caraterized by a muldiscipliary approach: VSA and SS.

The VSA - which is an interdisciplinary systems theory that includes elements derived from resource-based theory, biology, sociology, and mechanics - might provide valuable insights into the re-design and management co-creation processes (Barile and Polese, 2010). It starts from the study of entities (individuals, organizations, other systemic configurations), analyzing then how they interact with and the nature of the outcome produced. However, it proposes a way to configure as smart the service systems, designed to be sustainable and to satisfy all the participants' needs. It means setting a system in relation to their social context and environment (Spohrer et al., 2017; Piciocchi et al., 2011).

SS is an interdisciplinary approach that studies capabilities, constraints, rights, and responsibilities, as well as their value co-creation and capability co-elevation mechanisms of service system entities (Spohrer and Kwan, 2009; Spohrer et al., 2017). Particularly, it provides tools to re-interpret the technological world and how to integrate different types of service system entities at multiple scales in the overall ecology (Spohrer et al., 2010; IfM and IBM, 2008.

Findings

Technological advances are driving a shift in the value co-creation logics for individuals and businesses how (realization of an output) to what (the generation of the idea that underlies it) (Barile et al., 2019). Nevertheless, increasing technological capabilities may be making reaching consensus more and more difficult, even while it is becoming technologically easier and easier to realize any one of many different outcomes. This is a paradox of increasing levels of technology – mediated value co-creation in business and society – we can each individually do more, but agree less on what needs to be done collectively.

Empirically, the analysis of economic growth and productivity in the past typically distinguishes between two main effects of ICT. First, investment in ICT contributes to capital deepening and therefore helps raise labour productivity. Second, greater use of ICT throughout the economy may help increase overall efficiency, through lowering transaction costs, encouraging rapid innovation and fostering more robust competition.

According to our integrated framework, our findings show that the new logics of value co-creation in the digital age is strictly connected to the concept of Intelligence Augmentation as the *potential to realize projects in terms of capacities and skills* and not in terms of competencies.

Using a metaphor, we can explain the need of shifting from the concept of AI to that one of IA as following:

1) The AI is watching better what we already watch.

2) The IA is watching things that before we couldn't watch.

In other words:

- AI allows doing better what you can already do

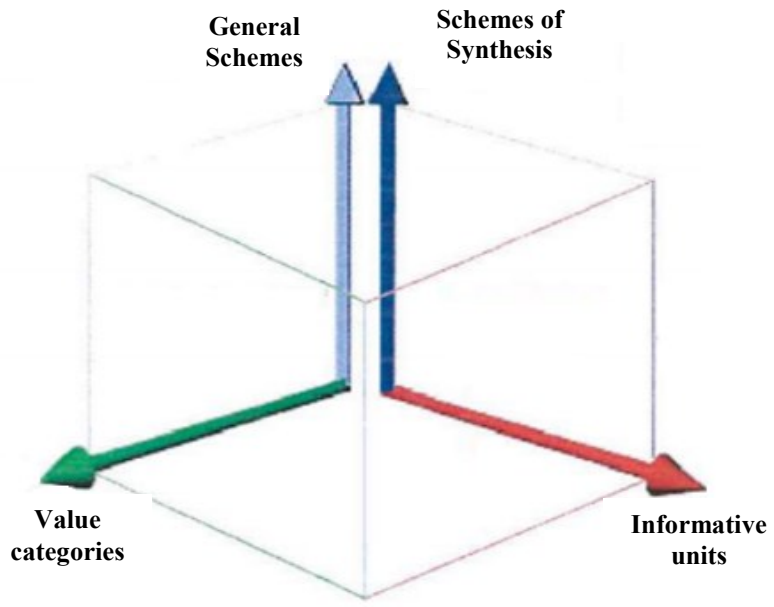
- IA allows doing things that you do not know how to do.

From our perspective, this new logics of value co-creation requires the analysis the phenomenon of learning from a viable systems perspective that essentially consists in the variation of an *informative variety* with respect to an initial *configuration* perceived by an observer (Barile, Di Nauta, Iandolo, 2016).

Previously it was specified that an informative variety can be traced back to three components:

- *Value categories;*
- *Interpretative schemes (general and of synthesis);*
- *Informative units.*

Figure 1. Components of an informative variety



Source: our adaptation from Barile, Di Nauta and Iandolo 2016.

Value categories, which appear to be strongly based on specific value aspects to specific communities and assumed as a shared tendency by the individual,

Interpretative schemes must be distinguished into **general schemes** and **schemes of synthesis. General schemes** which are substantially inspired by general truths (laws) felt as true by the subject and, in general, by the community to which they belong, compose the dimension of the deepest interpretative sensitivity of any phenomenal. The **schemes of synthesis**, of direct derivation of the general schemes, could be defined as the contextualized transposition of the former, pertain to a rational dimension, because they are linked to the motivations of the actor, based on his own knowledge, and referable to the specific systemic context.

Informative units, finally - even if ennobled with respect to the concept of "given" by belonging to a specific systemic context - correspond in any case to a qualitative and quantitative level, and therefore referable to logics of representation typical of the theory of communication.

The intelligent activity is understood in terms of active force capable of giving order to the whirlwind of information that crowds a mind committed to a choice, to the conditioning determined by the action carried out by the general schemes factor. The choice of this rather than that possible solution, or rather the approach to a resolutive hypothesis rather than another, significantly dependent on the role played by the general schemes.

At this point, a first conclusion can be made: intelligence, considered as an active force which is capable of rationally ordering a large amount of information stuffed-up in someone's mind during the moment of making a decision, and capable of making a new idea acceptable, is to be considered highly influenced by the effects of certain *value categories*.

The choice which is taken amongst various possible solutions, depends on the level of acquaintance and personal accustoming to a given resolutive theory. We must bare in mind that in VSA terms, the level of *acquaintance/approach* is represented by the *level of consonance* (harmony), and therefore, it is possible to assert that each variation of informative variety must necessarily refer to the levels of variation of Consonance due to the general Schemes keeping in mind the influence value categories.

In short, Consonance, understood as a variation of the informative variety due to the information received i, is strongly conditioned by the general Schemes. The General Schemes intervene to direct towards the adoption of a specific interpretative Scheme, influencing the hypothesis selection process. It can therefore be argued that the action carried out by the general schemes is such as to influence the dynamics of consonance with respect to incoming information.

Therefore, there is an action, a force, which intervenes in the moment of perception of information and which conditions learning.

Baring in mind that Consonance can be expressed as $C_{ons} = \frac{\partial V_{inf}}{\partial i}$,

It can be concluded that, consistently with the new logics introduced, the new value co-created is nothing other than the variation of Consonance that is determined.

$$\Delta C \geq \text{Value Creation}$$

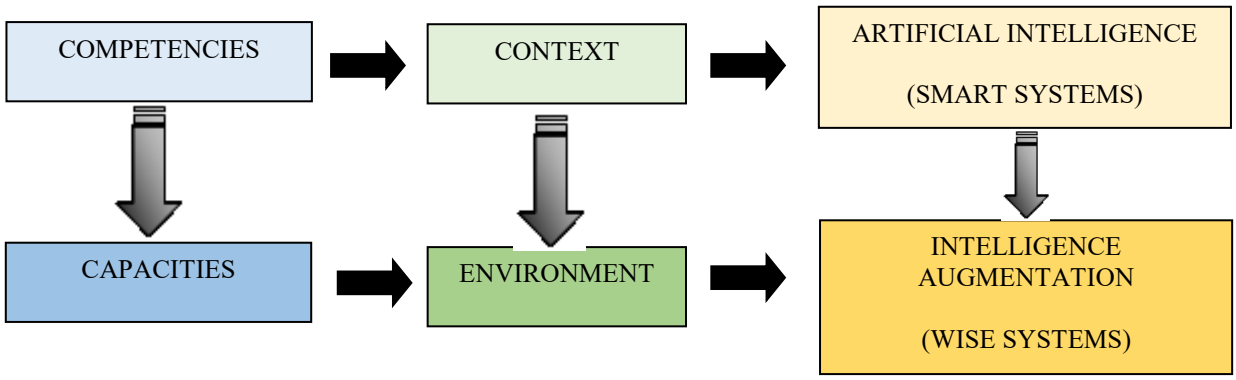
Practical implications

Until now, the value was strictly connected to competencies and so to the concept of Artificial Intelligence (AI). Our paper is the first attempt to interpret the value as meta-value as we enhance the existed/old/previous value in the sense that we create new value useful for the old value.

This justify the need to shift from the concept of AI connected to the context and the competence to do better what you can do to the innovative concept of IA (Intelligence

Augmentation) (Barile et al. 2018; Barile et al. 2019) closely related to the concept of environment as the capability to adequate in doing things that you can't do.

Figure 2. Competencies vs Capacities: the innovative concept of IA



Source: our elaboration

In the digital age, the search for a new logics of value co-creation means transforming the traditional concepts of resources/workers to include both biological and digital forms.

This implies focusing on not just smarter service systems (reduce resource waste) but wiser service systems (increase worker quality-of-life over multiple generations of workers). Wiser service systems will depend on AI applied for IA to reach both smarter and wiser consensus on value co-creation goals. Therefore, it is relevant that a human component (problem solver and/or decision maker – the worker) should be able to ensure sustainable decisions for a common welfare (Nonaka, 2011).

Those who can appreciate the relativism of values, can understand the priorities of the individuals acting in the system, and are better able to balance collective context's expectations (Carr, 2011).

Conclusion

Artificial Intelligence rarely replaces an entire job, process or business model. More often, AI automates a task and therefore can be viewed as a complement to human activities. The most effective rule is give certain types of tasks to machines, and people remain in charge, while becoming more effective and efficient. Designing and implementing new combinations of technologies, human skills, and capital assets to meet customer's need requires large scale creativity and planning (Brynjolfsson and McAfee, 2017).

By this means, the paper highlights the need to shift towards a new idea of value understood as the potential to carry out projects in terms of capacities and skills related to consensus and reaching agreements between augmented entities.

The foregoing certainly does not claim to express conclusive conceptualizations with respect to the possibility of developing a new logics of value co-creation in the digital era capable of explaining decision-making dynamics and managerial choices. It is believed, however, that the signs of consistency found are not negligible, and therefore sufficient to be able to favor the possibility of a further commitment, by a community of scholars necessarily endowed with interdisciplinary skills and competences, to explore the frontiers of relative knowledge to the dynamics of organizations (Barile et al., 2016).

A related future research direction for academics, practitioners and policy makers is to explore how best to combine people and machine capabilities and competences in service systems to create superminds (Malone, 2018) that can lead to a smarter and wiser planet.

However, few studies have examined new co-creative processes and the role and the responsibility played by AI.

Certainly, with the introduction of the Intelligence Augmentation perspective, new intelligent systems can be studied as entities in reticular systems that improve co-created value. Cognition-as-a-service will impact all occupations including both occupations that aim to increase efficiency and those whose goals are consensus in and between service systems (Spohrer and Banavar, 2015).

References

Arthur, W.B. (2011), *The Nature of Technology: What It Is and How It Evolves*, Free Press.

Arthur, W.B. (2017), Where is technology taking the economy? *McKinsey Quarterly.* October 2017. Retrived from: https://www.mckinsey.com/business-functions/mckinsey-analytics/our-insights/where-is-technology-taking-the-economy.

Barile, S. (2009), *Management sistemico vitale*, Giappichelli, Torino.

Barile, S., Ferretti, M., Bassano, C., Piciocchi, P., Spohrer, J. and Pietronudo, M.C. (2018), "From Smart to Wise Systems: shifting from Artificial Intelligence (AI) to Intelligence Augmentation (IA)", *Poster in International Workshop on Opentech AI in Helsinki*, March 13-14.

Barile, S., Di Nauta, P., and Iandolo, F. (2016), "La decostruzione della complessità", *Collana Studi di Management e Organizzazione Aziendale*.

Barile S., Piciocchi P., Bassano C., Spohrer J.C. and Pietronudo M.C. (2019), "Re-defining the role of artificial intelligence in wiser service systems", in Janusz Kacprzyk (Eds) *Advances in Intelligent Systems and Computing* (AISC), Vol. 787, Springer International Publishing AG, part of Springer Nature pp. 159-170. ISSN 2194-5357 - ISBN 978-3-319-94229-2 - eBook, (2019).

Barile S., Bassano C., Spohrer J.C., Piciocchi P., Pietronudo M.C. and Saviano M. (2019), AI & Value Co-creation: An Integrated VSA and SS Perspective, in Proceedings of the AIRSI2019 Conference, Zaragoza, July 6-8 forthcoming.

Barile, S., Polese, F., Saviano, M., Carrubbo, L. and Clarizia, F. (2012), "Service research contribution to healthcare networks' understanding", *Innovative service perspectives*, 71.

Barile, S. and Polese, F. (2010), "Smart service systems and viable service systems: Applying systems theory to service science", *Service Science*, *2*(1-2), 21-40.

Barile, S. and Saviano, M. (2018), "Complexity and sustainability in management: insights from a systems perspective", in *Social dynamics in a systems perspective* (pp. 39-63). Springer, Cham.

Beer, S. (1972), *Brain of the firm: the managerial cybernetics of organization*, London: Allen Lane the Penguin Press.

Brynjolfsson, E. and Mcafee, A. (2017), "The business of artificial intelligence", *Harvard Business Review*.

Carr, A. (2013). *Positive psychology: The science of happiness and human strengths*. Routledge.

Carter, S. and Nielsen, M. (2017), "Using artificial intelligence to augment human intelligence", *Distill*, *2*(12), e9.

Demirkan, H., Bess, C., Spohrer, J., Rayes, A., Allen, D. and Moghaddam, Y. (2015), "Innovations with Smart Service Systems: Analytics, Big Data, Cognitive Assistance, and the Internet of Everything", *CAIS*, *37*, 35.

Golinelli, G.M. (2010), *The Viable Systems Approach*, Cedam, Kluwer, Torino.

Guilford, J. P. (1967). *The nature of human intelligence*.

Harari, Y.N. (2014), *Sapiens: A brief history of humankind*, Random House.

IfM and IBM (2008), "Succeeding Through Service Innovation: A Service Perspective for Education. Research, Business, and Government", University of Cambridge Institute for Manufacturing, Cambridge.

Jordan, M. I. and Mitchell, T. M. (2015), "Machine learning: Trends, perspectives, and prospects", *Science*, 349(6245), 255-260.

Maglio, P. P., Vargo, S. L., Caswell, N. and Spohrer, J. (2009), "The service system is the basic abstraction of service science", *Information Systems and e-business Management*, *7*(4), 395-406.

Malone, T. W. (2018), "How Human-Computer 'Superminds' Are Redefining the Future of Work", *MIT Sloan Management Review*, *59*(4), 34-41.

Nonaka, I. and Takeuchi, H. (2011), "The wise leader", *Harvard Bussiness Review*, 89, 58–67.

Pakkala, D. and Spohrer, J. (2019). "Digital Service: Technological Agency in Service Systems", in *Proceedings of the 52nd Hawaii International Conference on System Sciences*.

Piaget, J. (2005), *The psychology of intelligence*. Routledge.

Piciocchi, P., Bassano, C., Pietronudo, M. C. and Spohrer, J. C. (2019), "Digital Workers in Service Systems: Challenges and Opportunities", in *Handbook of Service Science, Volume II* (pp. 409-432), Springer, Cham.

Piciocchi, P., Spohrer, J. C., Martuscelli, L., Pietronudo, M. C., Scocozza, M. and Bassano, C. (2017), "T-Shape professionals co-working in smart contexts: VEGA (ST)–venice gateway for science and technology", in *International Conference on Applied Human Factors and Ergonomics* (pp. 178-190), Springer, Cham.

Qu, J., Simes, R. and O'Mahony, J. (2017), "How Do Digital Technologies Drive Economic Growth?", *Economic Record*, *93*, 57-69.

Rao, D. A. S. and Verweij, G. (2017), "Sizing the prize: What's the real value of AI for your business and how can you capitalise?", *PwC Publication, PwC*.

Rouse, W. B. and Spohrer, J. C. (2018), "Automating versus augmenting intelligence", *Journal of Enterprise Transformation*, 1-21.

Skagestad, P. (1993), "Thinking with machines: Intelligence augmentation, evolutionary epistemology, and semiotic", *Journal of Social and Evolutionary Systems*, *16*(2), 157-180.

Spohrer, J. and Banavar, G. (2015), "Cognition as a service: an industry perspective", *AI Magazine*, *36*(4), 71-86.

Spohrer, J., Bassano, C., Piciocchi, P. and Siddike, M. A. K. (2017), "What Makes a System Smart? Wise?", in *Advances in The Human Side of Service Engineering* (pp. 23-34), Springer, Cham.

Spohrer, J., Golinelli, G. M., Piciocchi, P. and Bassano, C. (2010), "An integrated SS-VSA analysis of changing job roles", *Service Science*, *2*(1-2), 1-20.

Spohrer, J. and Kwan, S. K. (2009), "Service science, management, engineering, and design (SSMED): An emerging discipline-outline & references", *International Journal of Information Systems in the Service Sector (IJISSS)*, *1*(3), 1-31.

Spohrer, J., Kwan, S. K., Fisk, R. P., Rust, R. T. and Huang, M. H. (2014), "Marketing: a service science and arts perspective", *Handbook of service marketing research*, 489-526.

Spohrer, J. and Maglio, P. P. (2008), "The emergence of service science: Toward systematic service innovations to accelerate co-creation of value", *Production and Operations Management*, 17(3), 1-9.

Spohrer, J., Piciocchi, P. and Bassano, C. (2012), "Three frameworks for service research: exploring multilevel governance in nested, networked systems", *Service Science*, 4(2), 147-160.

Thompson, B. (2019), AWS, MongoDB, and the Economic Realities of Open Source, available at: https://stratechery.com/2019/aws-mongodb-and-the-economic-realities-of-open-source/.

Turing, A. M. (1950). "Can a machine think", *Mind*, *59*(236), 433-460.

Vargo, S. and Lush, R. (2006), "Development of new dominating logic of marketing", *Russian journal of management*, *2*(4), 73-106.