Skills for Sustainable Enterprise Architectures in a VUCA World

Eldar Sultanow[1], Ja-Nae Duane[2], and Alina Chircu[2]

[1] Capgemini Deutschland GmbH, Nuremberg, Germany; [2] Bentley University, Waltham, USA
eldar.sultanow@capgemini.com, {jduane, achircu}@bentley.edu

Abstract. Our understanding of enterprise architecture (EA) is evolving from EA as a way to align business and information technology to EA as enabler of organizational innovation and sustainability. This perspective fits the new realities of today's global business environment, which can be described through the acronym VUCA (Volatility, Uncertainty, Complexity, and Ambiguity). In a VUCA world, it is extremely important to create EAs that are sustainable, i.e. that can last a long time and evolve in response to internal and external changes. The new VUCA world and the need for sustainable yet agile EAs create new requirements for EA skills that will be valuable in the future. In this paper, we present an exploratory conceptual study of VUCA characteristics and skills in the context of sustainable EA. Our contributions are the new conceptualization of the skills and of the approaches that enterprise architects can use to develop these new skills.

Keywords: Ambiguity, Complexity, Enterprise Architecture (EA) Sustainability, Uncertainty, Volatility.

1 Introduction

An enterprise architecture (EA) includes the strategy plans, organizational charts, procedural instructions to business process models, application landscape and network plans as well as software structure and data models that help an organization maximize the efficiency and effectiveness of its information technology (IT) while minimizing the risk [1]. An EA attempts "to optimize across the enterprise the often fragmented legacy of processes (both manual and automated) into an integrated environment that is responsive to change and supportive of the delivery of the business strategy" [2]. A good EA can help companies create synergies from an integrated IT strategy, respond to changing business needs though innovation, and ultimately achieve competitive advantage [2]. This alignment of IT and business objectives has helped establish the importance of EA for both theory and practice. The understanding of the EA term is continuously evolving, and it now encompasses three schools of thought with different belief systems, definitions, assumptions and implications: enterprise IT architecting (which views EA as the glue between business and IT), enterprise integrating (which views EA as the link between strategy and

15th International Conference on Wirtschaftsinformatik,
March 08-11, 2020, Potsdam, Germany

https://doi.org/10.30844/wi_2020_x2-sultanow

execution), and enterprise ecological adaptation (which views EA as the means for innovation and sustainability) [3].

Enterprise architects are central members of an EA team and play a leading role in achieving the EA goals by ensuring the EA completeness (addressing the concerns of all stakeholders) and integrity (linking different perspectives, reconciling differences, and explaining tradeoffs) [2]. Enterprise architects need skills to gather and articulate a vision, coach and lead others, liaison between the business and technical groups, and operate with complex technology and industry concepts [2]. Since the EA development process can be very complex, and involve many actors (stakeholders, business executives and middle managers, project managers, designers, etc.), enterprise architects need to make sense of this complexity, identify critical details to concentrate on, adopt a practical view and develop fit-for-purpose (rather than theoretical) architectures. Thus, they need inductive rather than deductive skills as well [2].

The job of the enterprise architect is becoming increasingly difficult because the nature of today's business environment is more dynamic than ever before - defying confident diagnosis and full of traps to navigate [4, 5]. As the environment is no longer easy to understand and complex cooperation and interaction networks emerge, companies find it hard to plan their actions in line with pre-determined static objectives. A way to describe these turbulent environmental conditions and their oftentimes destabilizing effects for organizations is through the acronym VUCA (Volatility, Uncertainty, Complexity, and Ambiguity). VUCA was first coined by the U.S. military in the 1990's and is now used by business leaders throughout the world [4, 5, 6, 7]. Volatility refers to unstable situations and unpredictable change (in nature, speed, volume, magnitude, and dynamics) [4, 5]. Uncertainty refers to a lack of relevant information necessary to predict effects or actions - truths considered to be undeniable are no longer valid and executives can no longer base their decisions on past events. Complexity refers to situations that have many interconnected parts and massive amounts of information, creating a complex set of conditions in which cause-effect relationships and long-term effects become very complicated. Finally, ambiguity refers to situation where there is doubt about the nature of a relationship, particularly the cause-and-effect dynamic of that relationship. This ambiguity is sometimes caused by situational newness and the doubt that can occur when trying to make decisions within this new context [4, 5, 6, 7]. The main difference between complexity and ambiguity is that ambiguity most often involves change – so that the "rules of the game" become unknown. For example, moving into foreign markets is a complex situation that involves managing numerous, new and multipart rules and regulations. Moving from print to digital media, however, is an ambiguous situation, since the customers' behavior in the new technology environment is not fully known [5].

In a VUCA world, it is extremely important to create sustainable EAs – architectures that are long-living, but can be efficiently maintained and evolved [8, 9] and thus can endure and "tolerate changes resulting from shifts in requirements, environment, technologies, business strategies and goals" [10]. Sustainability of EAs can be viewed from five perspectives – economic (effects on value

https://doi.org/10.30844/wi_2020_x2-sultanow

creation/profitability), environmental (effects on natural ecosystems and resources), individual (effects on individual well-being), social (effects on equity, justice, etc.), and technical (longevity of the system) [10]. Sustainable EAs fit the enterprise ecological adaptation conceptualization of EA [3]. They can help increase corporate agility – the ability to adapt to the unexpected changes of the VUCA environment– by positively impacting a company's time to market, flexibility, innovation, quality and profitability [9].

Thus, the new VUCA world and the need for sustainable yet agile EAs create new requirements for EA skills that are future-proof. However, according to Bob Johansen, a distinguished fellow with the Institute for the Future in Silicon Valley, confusion about VUCA is paramount: "If you are not confused, you're not paying attention" [11]. Academics echo this opinion, finding that the VUCA definition is unclear, which in turn leads to a lack of information around the skills needed for a VUCA world [5].

To shed light on these issues, we present the results of a conceptual study – a "non-empirical study of ideas related to real objects" [12] intended to build an exploratory framework for VUCA characteristics and skills for sustainable EA. The methodology involves identifying the knowledge gap, adopting a conceptual exploratory method, identifying relevant books and peer-reviewed articles, extracting the key concepts and conducting snowball-type searches to find other concepts/ideas, analyzing and synthesizing the concepts, and proposing an exploratory framework [12]. The contributions of the paper are a) the first (to our knowledge) conceptualization for VUCA skills in general and EA skills in a VUCA world in particular and b) practical recommendations for methods, tools and frameworks for developing these new skills.

2 Theoretical Underpinnings: VUCA Characteristics and Required Skills

In a VUCA world, companies need to prepare for a plethora of scenarios - such as coping with insufficient insight, foresight, or situational awareness, technology disruptions, and business models that become obsolete very rapidly - but few possess the organizational capacity to do so [6]. The turbulent VUCA conditions require organizations to shift their decision making approach and break their usual reactive approach in order to prosper. As a result, companies need to build new dynamic capabilities instead of ordinary ones that can generally be used within strategic leadership [6]. These dynamic capabilities provide support to the firm through the monitoring of externalities, the governance of how skills could be reorganized, and the coherent collection of knowledge and skills needed for business development and market opportunities. They are difficult to develop, deploy, and imitate by competitors, and can thus become part of the unique organizational processes and culture that create path dependencies and enable successful response to future opportunities and threats. Schoemaker et al. [6] identify three clusters of dynamic capabilities: Sensing, Seizing, and Transforming. Sensing refers to change identification and testing before one's competitors do. Peripheral vision - applying a

https://doi.org/10.30844/wi_2020_x2-sultanow

wide lens to the external environment in order to detect easily missed warning signals - can allow for the detection of both threats and opportunities that are present in a VUCA world. Seizing refers to acting on the detected threats and opportunities in a timely way. Decision agility and the ability to support those decisions internally can allow an organization to flourish despite VUCA-type disruption to business as usual. Transforming refers to an evolution of the firm and its capabilities at the center of the firm's innovation prowess. The skills required for these dynamic capabilities are anticipating change and challenging current understanding (for sensing), interpreting information and making "good enough" decisions (for seizing), and aligning the views of multiple stakeholders and learning from both successes and failures (for transforming).

Bunker et al. [13] point to previous research suggesting that only a small number of organizations are equipped to navigate a VUCA world. This may be because of "unwitting collusion" where short-term performance is continuously rewarded, and taking another path is risky for decision-makers – and may even be reprimanded. The authors postulate that, in order to have VUCA-ready leaders, there needs to be an emphasis on educating employees how to maximize self-learning from one's own experiences in a short amount of time and at a low cost. This would increase the number of adaptive learners who would focus more on learning and less on performance results. This allows the leaders and their organizations to reinvent themselves and adapt to whatever the VUCA world brings their way. Bunker et al. [13] believe four capabilities drive VUCA readiness: vigilance (to extract as much context within a moment by focusing on subtle shifts), pattern recognition (to make sense of the extracted information by creating connections, recognizing the emerging patterns, and being ready with an on-target response to them), mental rehearsal (to practice a response to a VUCA event before it occurs), and response readiness (to provide advance preparation that can reduce reaction time and improve the quality of the response).

Horney et al. [4] indicate that organizational leaders are struggling with how to manage in a VUCA world where there are continuous shifts not only in people, but also in processes, structure, and the technology that supports them. Leaders not only have to prepare themselves for these shifts but their employees as well. To do so, leaders must develop leadership agility, or taking a fast, focused approach that emphasizes flexibility. Leadership agility supports anticipation of changes while infusing collaborative work processes with a balance of delegation and strategic direction. Thus, employees are incentivized and empowered to work on new products and processes, while co-creating with other key stakeholders (such as customers or suppliers).

Bolman and Deal [14] point out that making sense of the VUCA world requires mental models that are versatile and subtle, and create fluid expertise that encompasses situational awareness and allows for intuitive, quick and clear decision-making. To achieve this goal, the mental models or frames need to allow moving beyond one's own experiences and their dominant lenses in order to see a new set of future possibilities. This can be done by adopting four frames: structural, human resources, political, and symbolic. The structural frame emphasizes focus and long-

https://doi.org/10.30844/wi_2020_x2-sultanow

term goals. Through these goals, the leader can learn from the technology and the data provided to continue on its long-term course. In the human resources frame, the organization does not set the roles, like in the structural frame. Instead, employees self-select into projects and opportunities. This allows for accountability amongst team members and a commitment to deliver. In the political frame, leaders find themselves in the role of warrior relying on persistence and brute force in order to understand the competitive landscape and cultivate critical relationships in order to centralize power. In the symbolic frame, leaders focus on making sense of the VUCA ambiguity by becoming storytellers who relay the organization's values and vision to its employees and the world [14].

Murthy and Murthy [15] state that the VUCA environment "has caused dynamic instability, poor predictability, complex casual connections, and multiple plausible interpretations of events." This makes it vital for businesses to find a way to adapt while creating multiple-loop responses to the external and internal environment and the complex problems that emerge in both. Murthy and Murthy [15] explore neoclassical theories about leadership virtues, practices, and enactments that occur when learning to respond to a changing environment full of both challenges and opportunities. They propose the ensemble leadership repertoire (ELR) as a conceptual unification of leadership responses using integrates cognition, conscience and collective spirit. ELR is a hierarchical classification of three categories: enactments, practices, and virtues. Enactments are the preliminary conceptualization of actions, which lead people to manifest given ELR practices. They are substantive and are the lowest level of abstraction with ELR. Practices are theoretical codes that conceptualize connections between enactments and their underlining relationship to one another. Practices assist in the understanding of complex relationships, interconnections, and cause-effect variances between actions of leaders. Virtues encompass both the leadership practices and its enactments, and include being present, being good, being in touch, being creative, and being global. These virtues are considered dispositions that need to be in constant practice throughout a leaders' journey. The authors postulate that 90 enactments coalesce into 14 practices and are set into one of five virtues [15].

Bennett and Lemoine [5] identify globalization as a cause for VUCA and assert that it has created both opportunities and threats to firms and its leaders. The authors also claim that leaders consistently misinterpret externalities and their challenges. This leads to missed opportunities, a misallocation of approach resources, as well as a failure to address the root problem itself. These missteps in leadership are why a new approach to leadership in a VUCA climate is needed. The authors propose four skills to address VUCA problems: creating agility, gathering information, restructuring, and experimentation. Creating agility implies redirecting resources in order to build slack and future flexibility. Gathering information implies finding new data sources and looking at existing data from different perspectives. Restructuring implies matching external complexity by changing internal operations and processes. Experimentation implies testing strategies in order to assess their applicability in the face of change.

Based on the papers we reviewed for this study, the VUCA skills fall in three main categories: sensing skills, action skills, and transformation skills (See Table 1).

https://doi.org/10.30844/wi_2020_x2-sultanow

Table 1. VUCA skills summary

Skill category	*References*
Sensing skills	Sensing [6], situational awareness [14], vigilance and pattern recognition [13], gathering information and experimentation [5], leadership agility [4]
Action skills	Seizing [6], quick and clear decisions [14], pattern recongition and response readiness [13], leadership agility [4]
Transformation skills	Transforming [6], mental models/frames for new possibilities [14], work on new products and processes [4], restructuring [5]

3 Skills for Sustainable EAs in a VUCA World

An organization cannot meet the challenges of VUCA world with a traditional EA management approach. This is because in the VUCA world, long-term, risk-averse architectural planning will be inevitably torpedoed by short-term changes that cannot be predicted in advance. Recent conceptualizations of the EA field [3] highlight the role of sustainable EAs to enable strategic reorientation of the business and the identification of new opportunities– allowing a business to endure over time as internal and external changes occur. Enterprise architects need to understand not just technological sustainability of the architecture itself and the economic sustainability of the business opportunities it enables, but also EA's impact on the environment, individuals and society [10]. The United Nation's Sustainable Development Goals [16] provide a list of desirable design features for sustainability - such as resilience, inclusiveness, and protection of existing resources – which need to be incorporated into sustainable EAs. Thus, enterprise architects must develop VUCA-relevant skills that ensure sustainability. Based on our analysis of the relevant literature, we identify several important skills necessary in this new environment (see Table 2).

Table 2. Desirable skills for sustainable EAs in a VUCA world

VUCA skill category	*EA skills*
Sensing	Navigation, Data science
Action	Early adoption, Entrepreneurship, Data science
Transformation	Entrepreneurship, Value creation, Data science

3.1 Navigation Skills

In a VUCA world, enterprise architects have to focus more on setting the direction and providing recommendations and guidelines, rather than just following corporate decisions. These navigation, or direction-setting, skills are part of the sensing skills category. While knowing how to document the corporate vision, prepare technology impact assessments, or plan appropriate architectural transformations so that IT can support new business initiatives are important skills, they are not enough for VUCA. The enterprise architect should strive to understand the company, its industry and

https://doi.org/10.30844/wi_2020_x2-sultanow

business environment, and sustainability opportunities, so that he can identify trends and make recommendations. Thus, the enterprise architect can become a trusted advisor to the company's senior executives, influencing the development of the business and being its "navigator" in the VUCA world (i.e. keeping the course, detecting shifts, and taking immediate action whenever necessary). The enterprise architect should not merely perform corrective actions, but also preventive or even proactive measures by actively avoiding problems in existing business models and generating new models or disruptive innovations that also fulfill multiple sustainability criteria.

3.2 Early Adopter Skills

Acting in a VUCA world requires quick and clear decisions. To achieve this, enterprise architects need early adopter skills for both technology and sustainability concepts. An early adopter knows the latest trends before others implement them. The new enterprise architect is expected not only to know the new concepts, but also to have applied them, or at least to have experienced them in practice. Ideally, he has many characteristics of a hands-on architect. With this experience and expertise about new technologies and sustainability practices acquired at an early stage, the enterprise architect enables the company to gain and sustain its competitive advantage - ideally as a first mover or fast follower. For example, nowadays it is very difficult to imagine developing an EA without artificial intelligence (AI) or cloud components. And as other technologies are introduced in the future, the enterprise architect will have to incorporate them quickly in future EA designs or transformations as well.

3.3 Entrepreneurship Skills

Acting against VUCA challenges and transforming the enterprise in response to them also requires leadership agility. One way to achieve this is by adopting an entrepreneurial mindset. The entrepreneur is a person "who is willing to bear high responsibility and high risk", characterized by "a certain attitude towards life and the ability to constantly come up with new innovations" [17]. This ability to continuously innovate is extremely important for the sustainability of the EA solutions from an ecological adaptation perspective [3]. One's entrepreneurial mindset is an extension of their entrepreneurial personality and is unique to the individual [18]. However, studies show that successful entrepreneurs engage in networking activities in order to obtain the resources they need (such as information, capital, skills or labor) [19] – suggesting that these resource-seeking activities are important for achieving an entrepreneurial mindset. The entrepreneurial mindset as a VUCA skill is the ability to have a singular, unshakable vision while navigating the factors of VUCA through communication, networking and agile decision-making. For an entrepreneur, the focus is less on the scope or depth of the industry knowledge required for entrepreneurial decision-making, but rather on the inner attitude to make decisions and take responsibility. As an entrepreneur, the enterprise architect has to communicate and interact well with others and convince them to leave their comfort

https://doi.org/10.30844/wi_2020_x2-sultanow

zone and to try new things. This role requires powers of persuasion and charisma to instill a sense of confidence – all built on past practical experience and ability to implement. With this ability to think like an entrepreneur, the enterprise architect can anchor strategically in the tactical/operative level and turn isolated objectives into common objectives.

3.4 Value Creation Skills

The view that enterprise architecture management automatically adds value to a company by reducing long-term risks or increasing synergies between applications is no longer valid in a VUCA world – where competitor moves and environmental conditions shifts can quickly negate these benefits. This also applies to larger architectural transformation projects that companies have to carry out in order to replace unsupported, outdated technologies or to satisfy new regulatory requirements – including those related to sustainable development regulations. Thus, cost-intensive EA initiatives need to create and demonstrate value – for the enterprise and its stakeholders – that is sustainable over time. It is therefore essential that enterprise architects put value creation – an essential skill for transformation - at the forefront of their activities. In A VUCA world, the enterprise architect not only carries out the required architectural transformation according to stated rules and requirements, but also identifies potential value-adding impacts of the target architecture, and designs it to capture this value. For example, in the pharmaceutical industry, developing a track-and-trace EA in order to meet regulatory mandates generates detailed data about product movements that could be later used for market analyses and identifying successful vs. underperforming sales territories.

3.5 Data Science Skills

“Data is the oil of the 21st century” is a statement many practitioners and academics agree with [20, 21]. Every company has access to sources of this oil (i.e. data) and must be able to extract and exploit it in order to enable sensing, action, and transformation. First, as described above, companies are subject to influences that are difficult to anticipate in a VUCA business environment. Indicators for such influences can be found in the data. The distillation of influence indicators from the data is synonymous with the early perception described above via so-called “receptors.” Second, once analyzed, this data can help companies respond quickly and carry out changes of direction based on the data signals. Third, data can be distilled into higher-level business intelligence and wisdom insights, which can be used to draw conclusions about process innovations and associated cost savings, market developments, or even disruptions and new business areas. Data science skills enable the detection of subtle shifts in technical, economic, or environmental metrics that can threaten sustainability – and prompt immediate action. These valuable insights are not limited to business/functional areas, but can also be derived for technical areas, for example to optimize the architecture through consolidation or elimination of rarely or never used interfaces. The enterprise architect has to standardize the data, data flows

https://doi.org/10.30844/wi_2020_x2-sultanow

and interfaces as much as possible in order to enable the quick deployment of machine learning models (without the need for intermediate steps to transform and harmonize the data). To support this, the enterprise architect has to build a reference architecture that defines and describes the data science and AI tools and frameworks (such as TensorFlow, Scikit-Learn, DeepLearning4J, etc.) used. The enterprise architect has to map the current and future (strategic) organizational capabilities onto this reference architecture using the tools and frameworks that contribute to the fulfillment of each capability. The architect should identify potential business AI use cases by working with business users and deriving which capabilities (such as speech recognition, document analysis, video/image recognition, etc.) are particularly important for the company. The enterprise architect should also use of these capabilities and the resulting analyses to identify new business models or needed changes in direction due to VUCA turbulence.

4 Methods, Tools and Frameworks for Developing VUCA-ready Sustainable EA Skills

In this section, we propose several methods, tools and frameworks that help enterprise architects build the VUCA and sustainability-ready skills described in section 3. Table 3 presents an initial summary of the available approaches for skill building, which we will continue to update. It is important to note that these approaches do not always come with step-by-step instructions on how to apply them. Instead, they require a completely new attitude toward EA, the type of tasks to be solved and the manner in which they are solved. Thus, the enterprise architect has to develop a new mindset for VUCA.

Table 3. Methods and tools for sustainable EA in a VUCA world

EA skills	*Methods, tools and frameworks*
Value creation	Discovery mindset
	Design thinking
Entrepreneurship	Cynefin framework
	Shift of paradigms
	Sociocracy & Holacracy
Early adoption	Lean Statup
	Difussion of Innovations
Navigation	Cynefin framework
	Scaled Agile Framework (SAFe)
	Business Motivation Model (BMM)
Data science	Internet of Things (IoT)
	Data mining
	Machine learning

https://doi.org/10.30844/wi_2020_x2-sultanow

Discovery Mindset. A discovery mindset refers to the way of thinking necessary to establish a culture of innovation and to free oneself from various fears – such as fear of failure, fear of making mistakes, or fear of looking "stupid" [22, 23]. Instead, individuals with a discovery mindset should focus on commitment, authenticity and forward-looking action. The traditional, prescriptive, action-oriented view of decision making is subject to several traps – including failing to reconcile claims, ignoring barriers to action, providing direction that is too ambiguous, limiting search, conducting the wrong kinds of evaluation, overlooking ethical questions, and failing to learn [24]. In contrast, a discovery mindset changes the decision maker's frame of reference and mental model of the process, and allows them to focus on generation of varied ideas and exploration of multiple perspectives as well as on collaboration with and engagement of all stakeholders (who can help the innovation process) [24]. Accessing knowledge others have through a discovery mindset is an essential entrepreneurship skill as well [19]. To achieve a discovery mindset, decision makers have to develop self-awareness, a development orientation (by learning and reflecting), an emotional orientation (by considering the needs and interests of multiple stakeholders and the ethical implications of the decision), a systems perspective (by assessing the problem and the environment where it is occurring from a holistic perspective), and a complexity dynamics perspective (by accepting that the decision making process is subject to instability and change, and adapting as needed) [24]. Finally, engaging in generative, or transformative, conversations is also required to create a synergistic interaction of the previously-mentioned mindset components for discovery and collaboration [24].

Cynefin Decision-Making Framework. The Cynefin Framework [7, 25] is a sense-making tool that helps decision-makers classify the facts, problems or events according to the stability and perceptibility of cause-effect relationships. The framework provides decision-makers with awareness as to whether such a relationship can be determined in advance or only a posteriori. This enables organization sot make adequate decisions regarding when and where preventive or postventive measures are to be undertaken.

Design Thinking. Design Thinking (DT) involves the use of design practice (i.e. design practical skills and competence) "beyond the design context […] for and with people without a scholarly background in design, particularly in management" [26]. Theoretical conceptualizations of DT define it as the creation of artefacts, as a reflexive practice, as a problem-solving activity, as a way of reasoning/making sense of things, or as meaning creation [26]. In the management field, DT is viewed as a way of working with design and innovation (using the methodology promoted by the Silicon Valley company IDEO), as a necessary managerial skills for approaching indeterminate problems, or as part of management theory ("managing as designing") [26]. Thus, DT is an important tool that supports both entrepreneurship and value creation.

https://doi.org/10.30844/wi_2020_x2-sultanow

Business Motivation Model (BMM). The Business Motivation Model is a tool developed by the Object Management Group (OMG) for developing, communicating, and managing business plans [27]. BMM makes stakeholders, both internal and external, transparent to a company's business. With BMM, the enterprise architect not only develops a uniform understanding of terms for the upper management level, but also ensures the transparency of strategy and the influences to which it is subject to. The enterprise architect can use this transparency as the basis for an early sensory perception of the influences affecting the business environment.

VOPA+. The German agile management model VOPA+ stands for networking, openness, agility, participation, and trust [28]. It posits that managers must connect with information and knowledge experts via social networks. Thanks to their openness, the network members exchange necessary information and knowledge. Managers adapt to the VUCA changes by following agile principles, such as promoting self-organization and allowing mistakes. Managers trust the ability of employees to solve the problems autonomously. Thus, empowered employees are fully involved from the beginning – including in early decision-making processes. According to this model, the enterprise architect has to develop the competence of ambidexterity to adapt to change depending on the situation and to lead with both "classical" and agile approach by switching between hierarchical, rigid decision-making and flexible action in networks of self-organized actors [28]. Thus, the VOPA+ model supports the entrepreneurship skillset.

Scaled Agile Framework (SAFe). The Scaled Agile Framework bridges the gap between "classic" and "agile" practices by making agility scalable to large firms. According to is creators, SAFe is now adopted by over 70% of Fortune 100 companies [29]. SAFe changes the role of the enterprise architect in a large company from merely mapping the past and making the IT landscape more readable to interacting with management in its own language, communicating relevant topics in an understandable manner, and successfully linking different stakeholder levels and perspectives [29].

Shift of Paradigms. Large companies fall behind in competition or even collapse because their initial "secret" of success becomes ineffective over a period of time [30, 31]. Gharajedaghi [30] identifies five forces that undermine the competitive advantage:

1. Imitation: Successful innovators lose their unique selling proposition because imitators catch up with this lead over a period of time.
2. Lethargy: The more successful a company is, the more resistant (an hostile) it is to change.
3. Sub-optimization: When a success formula becomes more and more popular and the heroes who have formed it become authority, a monolithic culture is formed that recognizes narrow paths and few alternatives for a solution.

https://doi.org/10.30844/wi_2020_x2-sultanow

4. Changing the rules of the game: Winning a game constantly changes the game itself. The winner does not understand this and sticks to the old rules.
5. Paradigm shift: Contradictions and dilemmas, for which existing models no longer provide an explanation, suggest that the prevailing paradigm is no longer valid. As "acceptable ideas are competent no more and competent ideas are not yet acceptable," organizations rise and fall subject to powerful threats and opportunities [30, 32].

The shift of paradigm happens in two complementary directions. The first direction concerns the understanding of the nature of the organization away from a thoughtless "mechanical" to a mutual "biological" and finally to a multilaterally minded "socio-cultural" system [30, 31] with "one or more common objectives and collectively acceptable ways of pursuing them" [30] The second direction concerns the method of gaining knowledge about the organization – not just as independent components but as a complex web of interactions. This helps explain organizational behavior that has a complex network of mutually influencing variables, self-organization, and socio-cultural decision-making behavior [30, 31]. In a VUCA world, the enterprise architect can exploit these paradigm shifts to achieve transformation and agility [31] in the new "elastic" and flexible organization using a systems thinking perspective [30].

Reflexive Management. In the management literature, reflexive management is defined as the ability to review one's actions (what, how) as well as their causes (why) and effects (with what consequences), and imagine alternative courses of action "to mentally test alternatives and navigate towards an imagined future" [33]. Reflexive management is an answer to VUCA's "wicked problems," the models needed to solve them, and the challenges that are interwoven into these problems and their potential solutions. Reflexive management embodies an agency of contingency to allow for actors to focus on viewing VUCA problems as if everything is possible. This approach is paramount when the firm struggles to concentrate on appropriate approaches in this VUCA environment versus "business as usual" strategies that have worked previously [33]. In the cybernetics field, reflexive management describes, through mathematical models, how people conceptualize perceptions of self and of other actors they interact with and how they can predict these actors' reactions [31, 34, 35]. Reflexive management has been used to analyze how to avoid conflict with other actors who have different ethical systems or to direct other actors (for example, organizational members, external influencers or competitors) to make decisions that are beneficial for the initiator [31, 34]. In the same vein, reflexive games – which are part of game theory – can be used to study decision making by actors with different awareness levels pursuing individual goals in a social network [35]. Reflexive management can be applied not just to "win the game" but also to create favorable conditions and develop new opportunities for the future [31]. Thus, reflexive management can help the enterprise architect recognize and control internal or external influences on the organization.

https://doi.org/10.30844/wi_2020_x2-sultanow

Sociocracy & Holacracy. Adaptability to rapidly changing requirements involves not only redefining the role of an enterprise architect, but also the general roles in the organization. Organizational models such as classical sociocracy, holocracy and sociocracy 3.0. can help with this. In a sociocracy, or dynamic governance model, the organization is structured in double-linked management circles [23] (if two circles are connected, then one person represents the other in each of the two circles), decision are taken according to the consensus principle and the roles and the choice of their members are determined in an open, consensus-oriented discourse. A holacracy, or decentralized governance model based on sociocracy, separates the individual and the role in the same way, is also characterized by the circle organization [23] with double linkage, and makes decisions by consensus. However, the holacracy is much more formalized and defines the so-called Holacracy Constitution as a corporate constitution [7] - a set of rules that are intended to empower all members while setting clear limits. These rules determine, among other things, who is responsible for what, how the meetings are held, and when an objection is justified (applying the consensus principle). Sociocracy 3.0 (S3) expands the classic sociocracy into an open pattern construction kit for individual implementation of self-organization [36]. The new enterprise architect should be aware of these models and as a coach, enable the company to adopt them as appropriate.

Lean Startup. The Lean Startup is "a scientific approach to creating and managing startups and get a desired product to customers' hands faster" [37]. First publicized in a 2011 book by entrepreneur Eric Ries, this method is now adopted by many startups around the world. The core of the method is to create order in innovation activities from the inherent uncertainty surrounding these activities by continuously testing their vision through a build-measure-learn feedback loop. The process involves determining a problem to be solved, building a minimum viable product to test, and learning how to evolve it as quickly as possible. This continuous innovation ensures that adjustments can be done swiftly as more information about the customers or the competitive environment is obtained and that the final product meets the real customer needs.

Diffusion of Innovations. Rogers's diffusion of innovation theory [38] describes how innovation – an idea, practice or object - is communicated through various channels and spreads among the members of a social system over time. Innovations are adopted based on their perceived relative advantage over other options, compatibility with adopter's values, experiences or needs, complexity (difficulty to understand and use), trialability (the extent to which adopters can try out the innovation beforehand), and observability (the extent to which the results of the innovation are visible). The theory posits that early adoption – by opinion leaders – requires the provision of practical information about implementing and using the innovation.

https://doi.org/10.30844/wi_2020_x2-sultanow

5 Discussion and Conclusions

In this paper, we identify the required skills as well as corresponding methods, tools and frameworks for creating sustainable EAs in a VUCA world. We posit that architects who possess these skills and use the associated methods, tools and frameworks can better incorporate sustainability in EAs not just from a technical/EA longevity and maintenance perspective, but also from an innovation perspective that considers the EAs impact on the environment, the society, and the individuals, as well as from an economic/business profitability perspective that considers the long-term success of the company [10]. In addition, the skills, tools, methods and frameworks enable innovation in a broad sense – including the use of sustainable development goals [16] in process and products improvements due to VUCA turbulence. We do not believe enterprise architects can access generic recipes (i.e. "decompose all applications into microservices") for dealing with VUCA challenges. Instead, the enterprise architect needs to adopt a much wider view and recognize the kinds of paradigm shifts the organization really needs to make and the kinds of methods and tools it needs to apply in order to succeed in the VUCA world. The enterprise architect has to employ the optimal mix of methods, tools and technologies and recognize how to leverage them accordingly. The right mixture and dosage is an art, not a science – and it requires a lot of experience, openness to change and perseverance in order to be successful.

The analysis we present in this paper is conceptual and exploratory – and is derived both from an analysis of the literature and practical EA experience in a variety of organizations. One limitation of this approach is that there is no empirical evidence to substantiate our claims. We believe this is an acceptable tradeoff given that the concepts we discuss in this paper – VUCA and sustainable EA – are still in their infancy. One of the authors is currently analyzing the practical applications of these concepts in different industries, such as insurance and aviation, and disseminating the ideas in practitioner publications [39-41] in order to elicit feedback for further refinements. Future research can investigate adoption drivers and barriers for the proposed methods, tools and frameworks, contingency factors affecting their usefulness, and ways to develop and test measurement instruments for the necessary skills.

References

1. Niemann, K.D.: From Enterprise Architecture to IT Governance: Elements of Effective IT Management. Springer, Wiesbaden (2006)
2. OpenGroup: Architecture Skills Framework. TOGAF, https://pubs.opengroup.org/architecture/togaf9-doc/arch/chap46.html (Accessed: 11.10.2019)
3. Lapalme, J.: Three Schools of Thought on Enterprise Architecture. IT Professional 14. 37-43 (2012)
4. Horney, N., Pasmore, B., O'Shea, T.: Leadership agility: A business imperative for a VUCA World. People & Strategy 33(4), 32-38 (2010)

https://doi.org/10.30844/wi_2020_x2-sultanow

5. Bennett, N., Lemoine, G.J.: What a Difference a Word Makes: Understanding Threats to Performance in a VUCA World. Business Horizons 57(3), 311-317 (2014)
6. Schoemaker, P.J.H., Heaton, S., Teece, D.: Innovation, Dynamic Capabilities, and Leadership. California Management Review 61(1), 15–42 (2018)
7. Hesselberg, J.: Unlocking Agility: An Insider's Guide to Agile Enterprise Transformation, Addison-Wesley, Boston (2019)
8. Koziolek, H.: Sustainability Evaluation of Software Architectures: a Systematic Review. In: Joint ACM SIGSOFT Conference -- QoSA and ACM SIGSOFT symposium -- ISARCS on Quality of Software Architectures -- QoSA and Architecting Critical Systems -- ISARCS, pp. 3-12. ACM, New York (2011)
9. Schelp, J., Aier, S.: SOA and EA - Sustainable Contributions for Increasing Corporate Agility. In: 42nd Hawaii International Conference on System Sciences, pp. 1-8. IEEE (2009)
10. Venters, C.C., Capilla, R., Betz, S., Penzenstadler, B., Crick, T., Crouch, S., Nakagawa, E.Y., Becker, C., Carrillo, C.: Software Sustainability: Research and Practice from a Software Architecture Viewpoint. Journal of Systems and Software 138, 174-188 (2018)
11. Johansen, B., Euchner, J.: Navigating the VUCA World, Research-Technology Management 56(1), 10-15 (2013)
12. Mora, M., Gelman, O., Paradice, D., Cervantes, F.: The Case for Conceptual Research in Information Systems. In: CONF-IRM Proceedings, 52 (2008)
13. Bunker, K., Gechman, A., Rush, J.: Learning to Lead In a Volatile and Uncertain World: Making Experience Really Matter. Business Strategy Series 13(6), 288-294 (2012)
14. Bolman, L. G. and Deal, T. E.: THINK—OR SINK. Leader to Leader 76, 35-40 (2015)
15. Murthy, V., Murthy, A.: Adaptive leadership responses: Introduction to an emerging classification of zeitgeist enactments, practices and virtues for a VUCA world. World Journal of Entrepreneurship, Management and Sustainable Development 10(3), 162-176 (2014)
16. United Nations, Sustainable Development Goals, https://sustainabledevelopment.un.org/?menu=1300 (Accessed 26.12.2019)
17. GS Lexicon, https://www.gruenderszene.de/lexikon/begriffe/entrepreneur, (Accessed: 24.04.2019)
18. Fisher, S., Duane, J.: The Startup Equation : A Visual Guidebook to Building, Launching and Scaling Your Startup. McGraw-Hill Education, New York (2016)
19. Greve, A., Salaff, J.W.: Social Networks and Entrepreneurship. Entrepreneurship Theory and Practice, 28(1), 1-22 (2003)
20. Toonders, J.: Data Is The New Oil Of The Digital Economy. Wired (2014), https://www.wired.com/insights/2014/07/data-new-oil-digital-economy/ (Accessed 14.10.2019)
21. "Data is the oil of the 21st century" - Volker Lüdemann, Head of the Lower Saxony Data Protection Center (NDZ) on Smart Systems (2017), https://www.bennigsen-stiftung.de/content/daten-sind-das-ol-des-21-jahrhunderts (Accessed: 24.04.2019)
22. Sweeney, J.: 4 Ways to Embrace a Mindset of Discovery. The Business Journals, https://www.bizjournals.com/bizjournals/how-to/growth-strategies/2016/01/4-ways-to-embrace-a-mindset-of-discovery.html (Accessed: 25.04.2019)
23. Moreira, M.E.: The Agile Enterprise - Building and Running Agile Organizations, Apress, New York (2017)
24. Benson, J., Dresdow, S.: Discovery Mindset: A Decision-making Model for Discovery and Collaboration. Management Decision 41(10), 997-1005 (2003)

https://doi.org/10.30844/wi_2020_x2-sultanow

25. Snowden, D., Boone, M.: A Leader's Framework for Decision Making. Harvard Business Review 85, 68-76 (2007)
26. Johansson-Sköldberg, U., Woodilla, J., Çetinkaya, M.: Design Thinking: Past, Present and Possible Futures. Creativity and Innovation Management 22(2), 121-146 (2013)
27. OMG: About the Business Motivation Model Specification Version 1.3, https://www.omg.org/spec/BMM/About-BMM/ (Accessed 11.10.2019)
28. Scheer, H.-D. When the Manager Pushes on the Controller: VOPA+. Project Magazine (2017)
29. Scaled Agile: Scaled Agile Framework – SAFe for Lean Enterprises, https://www.scaledagileframework.com/ (Accessed 11.10.2019)
30. Gharajedaghi, J.: Systems Thinking: Managing Chaos and Complexity. Elsevier, Burlington (2011)
31. Zykov, S. V., Gromoff, A., Kazantsev, N. S.: Software Engineering for Enterprise System Agility: Emerging Research and Opportunities, IGI Global, Hershey (2018)
32. Beer, S.: Platform for Change, John Wiley & Sons, New York (1975)
33. Rennison, B.W. Reflexive Management: System-theoretical Reflection on Reflection. Journal of Leadership and Management 1(3), 27-36 (2015)
34. Lefebvre, V.A.: Elements of Logic in Reflective Games. Problems of Engineering Psychology 4, 273–299 (1966)
35. Novikov, D.A.: Cybernetics – From Past to Future. Springer, Basel (2016).
36. Rüther, C.: Sociocracy, S3, Holacracy, Laloux" Reinventing Organizations "and New-Work, BoD: Norderstedt (2018)
37. TheLeanStartup, http://theleanstartup.com/ (Accessed 12.10.2019)
38. Rogers, E. M. Diffusion of Innovations, 5th Edition. Free Press, New York (2003)
39. Sultanow, E.: VUCA and the New Role of the Architect: Why and How We Redefine This Role in the Insurance Industry. In: Specialist Conference on Specialist Architecture in Insurance (2019)
40. Sultanow, E., Breithaupt, C.: VUCA and the New Role of the Architect at Lufthansa. In: OOP (forthcoming 2020)
41. Heimann, T., Sultanow, E.: 5 Things the Corporate Architect Must Continue in the Future. SQ-Magazin, http://www.sq-magazin.de/de/magazin/sq-magazin-53.html (Accessed 26.12.2019)

https://doi.org/10.30844/wi_2020_x2-sultanow