Introduction to Resilient Enterprise Architecture

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Digitization is the use of digital technologies for creating innovative digital business models and transforming existing business models, processes and systems. Digitization creates profound changes in the economy and society. Information is often captured and processed without human intervention using digital means. Digitization impacts nearly all products and services as well as the customer and the value-creation perspective [1]. Digitized products and services are dynamic and can be functionally extended on the fly by using external services. Digital products are capable of reflecting on their own status and thus morph the selling of physical assets to services. Digitization changes the relationships with the customer significantly. Personal interaction is replaced by self-service and proactive action. Customers are interacting with the enterprise using a multitude of implicit touch points provided by the Internet of Things. Digitalization promotes value creation models based on a Service-Dominant Logic [2].

Digital transformation and digital disruption create many events that may impact enterprises and organizations. Resiliency [3] is the capability of enterprises to cope with fast and real-time changing events. Resiliency is an emergent capability because it is often achieved by combining a multitude of different perspectives on different abstraction levels such as organizational resiliency, information system resiliency, cyber resiliency, network and technology resiliency, as well as organizational resiliency.

Resiliency is the ability of an IT system to provide, maintain and improve a lot of services even when changes occur. These changes can be planned, i.e. include specific enhancements or improvements to functionality [4], or they can be unplanned. To increase resilience, redundant components and assemblies are inserted into physical IT systems. On the one hand, this increases the reliability of the system, but on the other hand, it reduces efficiency. Therefore, redundancy is a cost-intensive and inefficient procedure for increasing resilience.

In virtualized IT systems, resiliency can also be achieved through the ability to shift and reconfigure resources such as computing power, storage and network capacities [5]. If, for example, a disturbance becomes apparent due to a shortage of resources, this can be counteracted by adding resources. Even malfunctions that have occurred can be remedied by relocating resources. A blocked network connection [6] can easily be replaced by another. However, the prerequisite for this is to recognize problematic trends and disruptive events and to make quick decisions. In this way, planning for coping with disruptions and disasters can be carried out largely automatically.

The reliability and resilience [3] and [4] of e.g. cloud platforms are acquiring an increased relevance since society is relying more and more on complex software systems. Cloud computing is becoming as important as the other established utilities. The new type of software systems for cloud platforms is extremely complex. New approaches to resilience and reliability engineering are needed. The complexity and dynamicity of large-scale cloud platforms require automated solutions to reduce the risks of eventual failures and new intelligent components for an automated recovery.

Current software platforms [4] cannot be completely tested during their software development process. They need to be tested on the fly with realistic operations considering thousands of accessed servers and additional resources with often external services. Additionally, a data center's reliability needs to be constantly tested in near-real settings and during operations while hundreds or thousands of tenants are connected. New approaches are needed to diagnose failures in cloud platforms after injecting faults.

Resilient enterprise architecture management plays an important role in fostering strategies and capabilities for resiliency by providing methods and tools for designing enterprises architectures in a resilient way. It may address enterprises but also selected parts of enterprise architecture such as services and processes.

Resilient Services are services that provide additional meta-services in addition to their core functionality to handle disruptive events. E.g. airlines reschedule passengers of delayed flights. Resilient Processes provide event handlers to cope with external events and are thus capable to lead back the control flow on the desired track even in the case of adverse events. Their decision points use data from a multitude of internal and external sources allowing them to detect and react to changes in the environment.

A resilient and secure software development process [7] require a holistic approach for integrating nonfunctional requirements for resilient systems and services with a resiliency focused testing. First nonfunctional requirements (NFRs) need to be carefully analyzed for the context of resilient architectures and systems. After that we should detail specific security requirements for the development of application software and for the operating environment of resilient systems. Software design for resilient systems starts first with architecture design and includes secure and resilient software designs.

Information systems supporting digital products and services should respond to user input in a timely fashion and under all circumstances. But, because any computer system can fail we need to look at reliable systems which are distributed over multiple computers by following a set of precisely defined reactive design patterns [8]. The principle of a new resilient architecture style is to treat the physical distributed systems as an explicit concurrent system and to primarily consider the distributed nature of the application design.

Many traditional applications are provisioned with far more IT resources than needed. Additionally, most often the actual needs of the application are never measured and analyzed. In this case we have to think about misaligned operation and development architectures, processes, and concerns. Based on an introduction to resilient basic services of Microsoft Azure the developer's guide to the enterprise integration [9] defines a set of transient fault handling mechanisms for implementing resilient cloud services.

Based on the presented background of state of art concepts for resilient software and architectures we are introducing the papers of the REA workshop. The paper “Metamodel to Integrate Control Objectives into Viewpoints for EA” presents a metamodel-based approach and a reference implementation to integrate control objectives into EA viewpoints. Enterprise governance, risk, and compliance are important categories for managing risks from different perspectives of involved stakeholders. The main focus was put here to the effectiveness of controls for involved management bodies to support their risk adapted decisions. The mentioned metamodel links these controls with relevant EA concepts and associated decision techniques and results. An architecture cockpit was prototypically implemented and validated in practice to connect metamodel concepts with associated functionalities for supporting enterprise governance, risk, and compliance for a digital enterprise.

The paper on “EA Management in the German Public Sector” presents the specific background of usage of EA in the public sector mentioning also main differences between private and public companies. Derived from the organizational viewpoint a set of specific elements of reference architectures are analyzed to provide a starting set for specific EA models.

The contribution about “Visualizing Information for Enterprise Architecture Design Decisions using Elastic Stack" integrates specific perspectives of Enterprise Architecture with analytics of operational data in a datacenter and links these with instruments for visualization and decision support for adaptable system development processes. The core idea is to extract system runtime information from collected big data of observed real-time operation data streams. Elastic Stack is an open-source solution for visualizing and handling real-time Big Data scenarios.

The paper on “Product IT and Enterprise IT Integration in EAM” presents a methodological perspective of model integration. Product creation processes and service delivery are changing in times of digital transformation. The paper advocates an integration for product IT and enterprise IT. Core of this research is a case study. Main results of the paper are a set of high-lever requirements for EAM to enable an integration of product IT and enterprise IT.

The last but not least workshop paper is about “Envisioning Information Systems Support for Business Ecosystem Architecture Management in Public Sector”. Besides basic concepts of an ecosystem of sectoral public domains the paper presents an ontology-based shared EA repository. Additionally, the paper elaborates specific design principles and functional requirements for a system design and mentions some potential use cases. Finally, an EA concept for organizational design of a business ecosystem is proposed.

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