Towards a Reference Architecture for a Business Continuity

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Abstract: During turbulent times, enterprises need to find ways how to adapt, become resilient and strengthen abilities to cope with emerging threats. Business continuity management (BCM) is an enterprise strategic managerial capability. The recent global pandemic increased BCM maturity in many enterprises, still the importance of the capability is underestimated, and the enterprises are facing challenges to design and implement it across different enterprise architecture (EA) dimensions. In this paper, a business continuity (BC) framework for BCM capability development is proposed. The framework aims to provide guidance on design of BCM along different EA dimensions. It summarizes BC architecture principles and conceptualizes BC knowledge from related research as a reference architecture. The paper highlights challenges faced in BCM implementation, presents conceptual design of the BC Framework and its components. The application of the framework is demonstrated using an example from a target EA development project at a public sector institution.

1 INTRODUCTION

The world is facing several unexpected disruptive events, as global pandemic, supply chain issues, natural disasters, cybercrime, terrorist attacks and wars. These events cause variety of challenges for organizations. Being affected by Covid-19, the organizations had to substantially modify their operations to avoid supply chain breakdowns, to adapt services to customer demand and to mitigate work safety risks and their negative effects on the health of employees and society in general (Margherita & Heikkilä, 2021). Enterprises need to find ways how to adapt, become resilient and strengthen abilities to cope with emerging threats.

Business continuity (BC) "broadly refer to a company's socio-technical ability to withstand and restore from intra- and extra-organizational contingencies" (Niemimaa, 2015b). Business continuity management (BCM) is an enterprise strategic capability (Herbane et al., 2004; Niemimaa, 2015a; Niemimaa et al., 2019). The recent global pandemic "transformed the dynamics of workplace and workforce" (Agility Recovery, 2022). At the same time, it also led to a significant increase of BCM maturity across enterprises. However, the enterprises still face challenges to design and to implement the BCM capability, including (Hamid, 2018; Hussain et al., 2021; Obrenovic et al., 2020; Lingeswara & Tammineedi, 2012): missing capabilities, commitment and involvement issues, inadequate standardization, low preparation level for crisis and high costs. The enterprises need to carefully evaluate their business processes and economic factors to be better prepared for the crisis (Obrenovic et al., 2020).

Enterprise architecture (EA) is a widely used discipline for multi-dimensional enterprise design. It serves as a conceptual blueprint that guides enterprises in decision taking. It aims to connect and enhance the mutual alignment of business and IT (Gregor et al., 2007; Zhang et al., 2018). Reference architectures incorporate the best practices in a particular domain (Aulkemeier et al., 2016) providing valuable knowledge for design of an enterprise-specific architecture. EA is guided by architecture principles advising EA design toward defined goals and envisioned value (Haki & Legner, 2021).

The objective of this paper is to propose a BC Framework to direct enterprises in implementation of the BCM capability. The framework consists of three components: (1) BC architecture principles, that represent characteristics of a resilient enterprise; (2)

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Reference architecture for BC that suggests architecture components required in a resilient enterprise and (3) BC Maturity Model for BCM maturity evaluation. The framework aims to solve main BCM problems identified in scientific literature and industry survey.

The nested design science problem solving approach (Wieringa, 2009) is used, following four main phases: problem investigation, solution design, design validation and solution implementation. This paper presents the first two phases – the problem domain and an overview of the proposed BC Framework and its components.

The rest of the paper is organized as follows. Section 2 reviews related existing work that serves as a basis for the BC Framework design. The Section 3 presents research methodology. The problem domain description is provided in the Section 4. The proposed solution in a form of a BC Framework is presented in the Section 5. The framework application in target EA development for Latvian public sector institution is demonstrated in the Section 6. Section 7 concludes.

2 BACKGROUND

BCM has been evolving from 1970s as a technical and operational risk response to disruptions, incorporating disaster recovery planning and risk management (Corrales-Estrada et al., 2021a; Hamid, 2018). The International Standardization Organization defines BCM as "a holistic management process that identifies potential threats to an organization and the impacts to business operations that those threats if realized, might cause; and which provides a framework for building organizational resilience with the capability for an effective response that safeguards the interests of its key stakeholders, reputation, brand, and value-creating activities" (ISO, 2019). In recent years enterprises have acknowledged BCM importance, mainly after business interruptions caused by global pandemics and other disturbing events. However, still the importance of the capability is underestimated (Prataviera et al., 2022) and its maturity must be increased in enterprises across the world (Agility Recovery, 2022).

Characteristics of BC are investigated in several studies that analyze three interconnected concepts: organizational resilience, BC and sustainability. Relationships among those concepts are discussed in the (Corrales-Estrada et al., 2021), concluding that implementation of BCM practices promote organizational resilience and sustainability. The study summarizes organizational characteristics that impact BCM: adaptivity, flexibility, agility and others. Key factors affecting organizion's resilience and sustainability are also summarized in (Obrenovic et al., 2020). The authors claim that organizations with a distributed leadership, workforce and adaptive culture sustain business operations during distributive events. Similar resilient enterprise characteristics are also highlighted in other studies (Boin & van Eeten, 2013; Pal et al., 2014; Boin & McConnell, 2007). Identified characteristics can be translated to architecture principles.

Several studies investigate EA usage in BCM implementation (Anir et al., 2019; Gomes et al., 2017). The BCM integration in EA is assessed by Anir et al. (2019). The authors analyse integration of BCM aspects in EA and propose a metamodel and BC aspects implementation approach. The paper focuses on implementation of the BCM capability, although its scope is limited to the metamodel only. EA usage to assist BC planning is investigated in Gomes et al. (2017), however this paper also focuses on evaluation and implementation of BCM without suggestions for reference architecture.

Reference architectures are a widely used tool for knowledge reuse in a problem domain (Timm et al., 2017). They aim to describe the best practices in particular industries, such as banking (Farzi, 2022), telecommunications (Seraoui et al., 2020) or specific domains, as e-commerce (Aulkemeier et al., 2016), health information systems (Tummers et al., 2021). In the BCM domain, few reference architectures exist. A reference architecture for emergent behaviours control is proposed in Bemthuis et al. (2020). The model realizes main requirements of resilient enterprise: operational independence, managerial independence, distribution, evaluation development, heterogeneity, emergent behavior. It proposes architecture components required to support the execution and control of business logic for detecting and monitoring emergent behaviors. The model focuses on information system and technology architecture dimensions, while concepts of the business architecture are addressed partly.

While development of BCM related reference architectures is an open opportunity, several studies and industry frameworks propose BCM, resilience and sustainability measurement approaches. Maturity models are frequently used (Hernantes et al., 2019; Pinto et al., 2022; Virtual Corporation, 2003), as "maturity models offer organizations a simple but effective possibility to measure the quality of their processes" (Wendler, 2012).

To summarize, BCM is a widely investigated topic, what highlights its importance. The existing studies provide useful insights about processes, resources and behaviours promoting resilience, BC and sustainability. Still, they focus on a single dimension or domain and a multi-dimensional view structuring best practices is an open challenge what we aim to address with the proposed framework.

3 RESEARCH METHODOLOGY

The nested design science problem solving approach (Wieringa, 2009) is used for the research design (Figure 1).

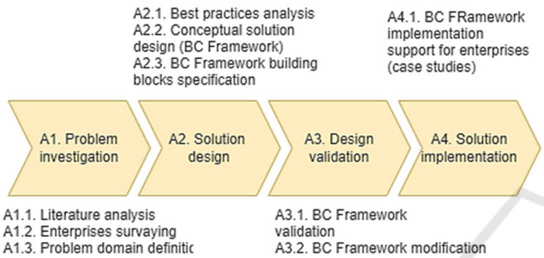

Figure 1: The research methodology.

The research starts with a problem investigation to validate hypothesis that enterprises face challenges in the implementation and provision of BC. The problem domain analysis is done in two steps, according to the Design Thinking methodology (Kelly & Gero, 2021). Firstly, divergent thinking is applied to widely explore the problem. Then convergent thinking is employed to define the point-of-view. The problem domain investigation is based on two main sources: professional and research papers and industry survey. The literature analysis is conducted to explore and integrate the existing knowledge base following an approach described in the (Webster & Watson (2002). It is assumed that BCM is a mature topic where the accumulated body of research exists that can be analyzed and synthesized for knowledge conceptualization. The industry survey supplements the findings from the literature.

Solution design is based on the best practices recommendations from two main sources: structured interviews with experienced industry experts and related research recommendations. A solution is prepared following a "top-down driven" architecture design approach (Nolan, 1997). Firstly, solution's conceptual architecture is prepared, and afterwards all of its components are specified.

The solution design is validated in two steps: expert assessment and solution implementation in the pilot cases as a part of applied research project jointly with an IT consulting company. The framework is refined according to the validation results.

Implementation of the solution is done by providing BCM implementation support services for enterprises. The case studies enable continuous improvement of the framework.

This paper represents the first research phases: (I) problem investigation (Section 4) and (II) solution design, presenting BC Framework (Section 5).

4 PROBLEM INVESTIGATION

The BC implementation and provision problems are collated from literature sources describing BCM key issues and industry survey (25 responses from mid-sizes enterprises from different industries). Results of the problem-driven investigation are summarized in the Table 1. The list includes problems that are

Table 1: The list of BC problems.

Commitment and involvement issues (Hamid, 2018; Hussain et al., 2021; Obrenovic et al., 2020; Lingeswara & Tammineedi, 2012; Bakar et al., 2015)
Time consuming BC implementation; Gap in attitude between experts and users; Lack of management involvement; Conflicting priorities; No responsibility and trust issues. Low senior management commitment; BCM implementation for the wrong reasons.
Inadequate standardization (ES, (Hamid, 2018; Hussain et al., 2021; Obrenovic et al., 2020; Lingeswara & Tammineedi, 2012))
Inconsistencies of the BCM adaptation; Different workplace recovery arrangements; Business impact analysis (BIA) sessions conducted in silos; Manual BCM processes. Business/IT Disconnect; Weakly defined BC roles and responsibilities; Several BCM standards and frameworks in use; Unoptimized resource utilization.
Ineffective strategies and an inappropriate approach (ES, (Hamid, 2018; Hussain et al., 2021; Lingeswara & Tammineedi, 2012))
Risks and uncertainties on actual recovery activities; Insufficient consideration of employee preferences; Limited data analysis, lack of data-driven decisions; Dependence on third parties ("Single-supplier" politics, locally partners only); Location-based risk assessments; Inappropriate BIA approach.
Low preparation level for a crisis ES, (Hussain et al., 2021; Bakar et al., 2015)
Insufficient business processes and economic actors evaluation.; Low system-level reliability. Low system flexibility.
Lack of resources (knowledge, financial, human) (ES, (Hamid, 2018; Hussain et al., 2021; Lingeswara & Tammineedi, 2012;, Bakar et al., 2015; Peterson, 2009))
Significant financial resources required; Lack of knowledge about enterprise; Low BC awareness. Limited technology awareness; Missing knowledge about "good practices"; Unavailability of human resources; Lack of thorough understanding of the data dynamics and dependencies; Incorrect and inappropriate assumptions.

mentioned in at least three sources (literature or industry survey, further referred as ES).

The main problem areas are related to the low standardization, insufficient resources (financial, knowledge, human), as well as cultural aspects (low commitment, conflicting priorities etc.). The selected problem areas for further investigation are: low standardization and lack of knowledge.

5 PROPOSED SOLUTION

This section presents BC Framework.

5.1 BC Framework Overview

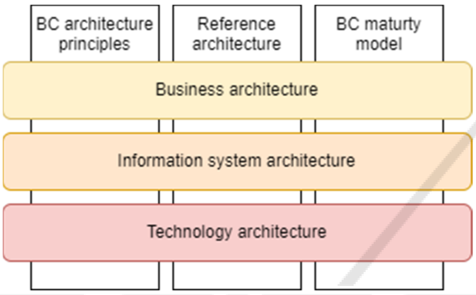

Figure 2: BC Framework overview.

A proposed BC Framework aims to support enterprises in implementation of the BCM. It can be used as an architecture assessment, planning and design tool. The model formalizes knowledge in three components (Figure 2): architecture principles, reference architecture and maturity model.

The BC architecture principles are used to guide resilient EA design. The reference architecture lists BC essential architecture components thus supporting modelling target EA. While the BC maturity model is used to evaluate enterprise's current BC maturity across the different EA dimensions.

5.2 Architecture Principles

An architecture principle (The Open Group, 2019) "represents a statement of intent defining a general property that applies to any system in a certain context in the architecture." The principles are abstract, high-level propositions, that aim to support enterprises to accomplish their goals (Stelzer, 2010).

Enterprises can use the principles on their BC implementation journey to build their operating model, information systems and other relevant concepts (Table 2). The following principles classification is used (Stelzer, 2010): EA principle (EAP), technology / infrastructure principle (TIP), software architecture principle (SAP), organization principle (OP) and business principle (BP).

Table 2: BC architecture principles.

Interoperability (Bemthuis et al., 2020; Nadhamuni et al., 2021; R. S. Gomes, 2016), *EAP*
Technical, syntactic, semantic, and organizational interoperability; Data and states exchange; Interaction following the business logic; Interact through cyber or physical channels; Standard interfaces and protocols.
Autonomy and decentralization (Duchek, 2020; Obrenovic et al., 2020; Weick, 1993; Bemthuis et al., 2020), *EAP*
Power based on expertise and shared responsibilities; Distributed leadership; More informed and decentralized decision-making; networked structure; respectful interaction.
Vertical or horizontal integration (Hussain et al., 2021; Bemthuis et al., 2020; R. S. Gomes, 2016; Birkel & Müller, 2021), *EAP*
Machines, internet, people, and value chain integration in real time scenarios; Communication and coordination to support inter-operations.
Transparency (Birkel & Müller, 2021), *EAP*
Data consistency and traceability across the supply chain; Vertical interconnection in real time.
Agility, adaptability and flexibility (Corrales-Estrada et al., 2021a; Agility Recovery, 2022; Hussain et al., 2021; Obrenovic et al., 2020; Weick, 1993; Ismail et al., 2011; R. S. Gomes, 2016), *BP & OP*
Flexible roles and responsibilities, Flexible and straightforward guidelines; Adaptive and flexible culture; Improvisation and bricolage; Shorter and more diversified supply chain; Multi-sourcing / alternative sourcing; Strategic agility.
Independence (Bemthuis et al., 2020), *BP & OP*
Operational independence; Managerial independence.
Robustness (Corrales-Estrada et al., 2021a; Ismail et al., 2011), *BP*
Robust business processes and capabilities.
Smart Services Orientation (Hussain et al., 2021; R. S. Gomes, 2016; Falazi et al., 2020), *SAP*
Service-oriented architecture and integration; Digitally integrated systems; Flexible systems that implement changing business processes quickly; Extensive use of reusable components.
Modularity (Hussain et al., 2021; Nadhamuni et al., 2021; Ezzahra et al., 2021), *SAP*
Application decomposition in integrated modules.; Modules serving specific business domain or services; Individual modules expanding or replacing due to changing business requirements.
Scalability (Ezzahra et al., 2021), TIP
Horizontal scaling; Vertical scaling.
Decentralized Controlling (Hussain et al., 2021), *TIP*
Separate components capable of making independent decisions in the direction of circumstances without local or individual control.

5.3 Reference Architecture

The reference architecture for BC is presented in the three dimensions: Business architecture; Information System architecture and Technology Architecture.

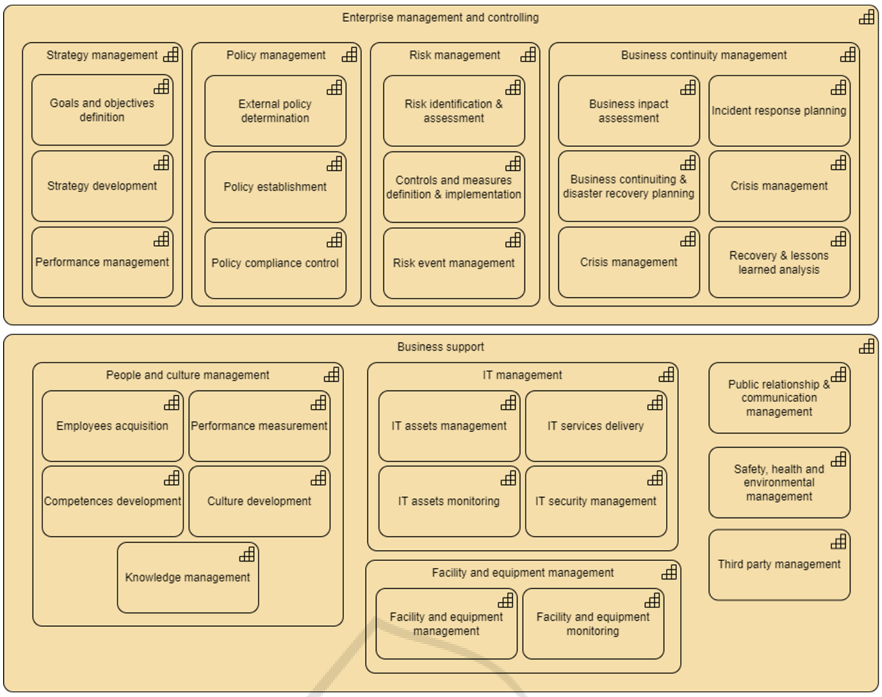

Figure 3: BC Business capabilities reference map.

5.3.1 Business Architecture

Proposed Business architecture aims to define Business Capabilities that enterprise must have to ensure BC. The Open Group define Business Capability as "particular ability that a business may possess or exchange to achieve a specific purpose" (The Open Group, 2005). This means, a Business Capability is an abstraction of a business function, which captures what an organization does, instead of trying to explain how, why or where it is done (The Open Group, 2016). Business Capabilities typically consists of 4-5 levels. Leveling is the process of decomposing each top-level Business capability into lower levels to communicate more detail – at a level appropriate to the audience or stakeholder group concerned (The Open Group, 2016). On this paper two Business capabilities levels are considered. Business architecture is represented in Business capability map viewpoint (Figure 3) what is well-known tool for addressing the challenge of business-IT alignment; it presents enterprise major Business capabilities enabling the organization's business model and reflects enterprise strategic direction (Bondel et al., 2018).

Resilience results from both operational and strategic capabilities (Ismail et al., 2011). BCM is the main capability, other strategic and operational capabilities supports or triggers BC (Table 3).

Table 3: BC Business capabilities list.

Strategy management
Strategy management defines BC related strategies, as business strategy, business recovery strategy, risk tolerance strategy (Gibb & Buchanan, 2006, Pinto et al., 2022). The strategic plans can rectify some of the existing society vulnerabilities, employing strategic planning, enterprises are more in control of their fate (Obrenovic et al., 2020). In terms of the BC, it is important to carefully plan supply chain strategies, including sourcing strategies (Agility Recovery, 2022).
Policy management
Policy management defines and describes organization BC related policies, based on defined strategies. Policies and actions, including prevention and incident response contributes in workforce protection (Obrenovic et al., 2020). Typical BC related policies are (Pinto et al., 2022, Gibb & Buchanan, 2006): BCM policy, training and induction policy, documentation and reporting policy. It is concluded that organizations with financial contingency plans and policies sustain their operation better in distributive events (Obrenovic et al., 2020).
BCM
BCM includes BC planning capabilities, as well as monitoring, crisis management, recovery and learning (Hamid, 2018, Pinto et al., 2022).The best practices and international standards (ISO, 2019) suggest enterprises to perform business impact analysis (BIA), identify critical processes, resources, possible disturbing events and define alternative processes and resources in BC plans. Disaster recovery (DR) plans are prepared accordingly. Besides BC and DR planning, it is essential also to test plans and train employees (Gibb & Buchanan, 2006). To detect disruptive events, monitoring must be applied. Crisis management deals with actual crisis situation in terms of communication and collaboration. While recovery activities returns business as usual. Lessons learned must be analyzed to ensure capability continuous improvement.

Table 3: BC Business capabilities list (cont.).

Risk and compliance management
Risk and compliance management identifies and oversees different kinds of organization risks, their levels, defines risk reaction strategies and treatments ; Pinto et al., 2022, Gibb & Buchanan, 2006). Typical risk categories are (Buhr, 2015; ; White et al., 2020): business risks, financial risks, operational risks, IT security risks, third party risks, geopolitical risks, climate risks. The pandemic has spotlighted dependencies on third parties and their resilience (Agility Recovery, 2022), so third-party risk category is essential. Risk and compliance management is directly interrelated with BCM, as risk assessment is key activity in BIA and based on it BC and DR are planned.
Facility management
Facility management deals with facilities related assets management, as buildings, physical workplaces etc. Typically, BC plans focuses on IT related assets, meantime facilities are critical assets that must be considered in BIA (Pitt & Goyal, 2004). Facility monitoring activities must be applied to detect distributions and damages. Facility management enables workplace transformation by implementing remote ang hybrid workplaces required in crisis situations (Tanpipat et al., 2021).
IT management
IT management ensures digital assets BC, as well as provide BC supporting Application and Technology components .
People and culture management
People and culture management ensures that right people with required competences are executing BCM roles (as operational and IT risk managers and others) (Agility Recovery, 2022). The capability enables enterprise sustainability (Yadav et al., 2019) and resilience (Lengnick-Hall et al., 2011) and is responsible about employees training and education to create resilient workforce (Duchek, 2020). Enterprise culture also take important role in BCM – culture must provide sense of openness, stability and safety (Agility Recovery, 2022). Culture must promote continuous learning.
Public relationship & communication management
Public relationship & communication management is essential capability if crisis situation occurs and external stakeholders are involved (for example, enterprise customers) (Agility Recovery, 2022). Besides external stakeholders, enterprises must ensure information flow between internal business units and employees (Obrenovic et al., 2020). Multichannel communication is advised to reach different stakeholders groups (Obrenovic et al., 2020).
Safety, health and environmental management
Safety, health and environmental management is responsible about workplace accidents reduce and work environment safety increase what aims to increase enterprise resilience and sustainability (Asah-Kissiedu et al., 2020; Asah-Kissiedu et al., 2021).
Third party management
Third party management oversees different kinds of third parties as due to partners ecosystems evolvement third parties play important role enterprises products and services delivery (Hamid, 2018).

Capability consists of four main components: roles, business processes, information and tools/applications (The Open Group, 2016). Each Level 1 business capability is described in a capability card (Table 4).

Table 4: Business capability card (example).

Capability:		Business continuity management (BCM)
Description:		Ability to ensure continuous operation in case of infection outbreak in organization
Components:	**Roles**	*Users:* Product owner, process owner *Stakeholders:* Enterprise management, SMEs, IT administrators, IT support specialists *Business units* (Hamid, 2018): Continuity Management Team, Coordinator Team, Crises Command Team, Business Recovery Team, IT Recovery Team, Administrative Support Team
	Sub-capabilities	BIA, BC planning, Incident response planning, Disaster recovery planning, Monitoring, Crisis management, Recovery & lessons learned analysis
	Data	Enterprise products, Enterprise processes, Enterprise assets, Risks, Controls
	Applications	HR application, ERP application, Incidents monitoring tool, Asset management system, Knowledge database, BCM tool

5.3.2 Information System Architecture

Information System reference architecture presents Application Components that can support Business Capabilities. An Application Component (The Open Group, 2019) "represents an encapsulation of application functionality aligned to implementation structure, which is modular and replaceable."

Information system reference architecture is represented in the Application Map viewpoint what is typically used to create an overview of the application landscape of an organization (Figure 4). BC can be supported by different kind of applications and technologies (Papadopoulos et al., 2020). Enterprises need to relay on Enterprise resource planning (ERP) systems, digital libraries, asset management and inventory management systems (Madhubhashini, 2019). An important role in the BCM plays the organization's knowledge base (Duchek, 2020). Geographical information systems and Geographical positioning systems bring value by helping to detect location of the affected areas (Vogt et al., 2011). Meanwhile, data analytics solutions support enterprises in data driven decisioning in BCM (Hussain et al., 2021; Sheng et al., 2021). Digital twins support disaster scenarios simulation (Hussain et al., 2021; Birkel & Müller, 2021). Intranet, social media, and online communication platforms are widely used for communication (Obrenovic et al., 2020).

BA interaction with IA is represented in the form of matrix (Table 5).

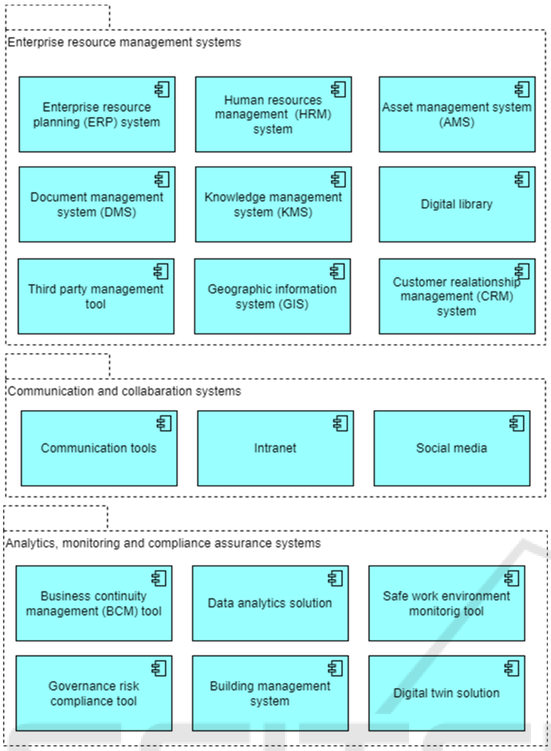

Figure 4: Application map.

Table 5: The Business Capabilities and Application Components matrix.

Business Capability	Application Component	Main use case
Strategy management	Intranet	Strategies communication
	DMS	Strategies coordination and communication
	Communication tools	Strategies communication
	Data analytics tools	Strategic decisions support
Policy management	Intranet	Strategies communication
	DMS	Strategies coordination and communication
	Communication tools	Strategies communication
BCM	ERP systems	Assets and resources identification
	AMS system	Assets and resources identification
	KMS	Lessons learned & knowledge capturing
	BCM tools	BIA; Alternative processes scenarios definition; BCM implementation plan preparation & tracking; BCM documentation preparation & storing
	Data analytics solutions	BC decisions support
	GIS and GPS	Disasters affected areas determination
	Digital twins	Disaster scenarios simulation

5.3.3 Technology Architecture

Technology reference architecture aims to define Nodes, Equipment and Facilities, that provide grounds for Application Components operation. Node "represents a computational or physical resource that hosts, manipulates, or interacts with other computational or physical resources", while Equipment "represents one or more physical machines, tools, or instruments that can create, use, store, move, or transform materials" and Facility is "physical structure or environment."(The Open Group, 2019). Physical elements are used to model cyber-physical ecosystem. Reference architecture is represented in the Technology viewpoint (Figure 5) what contains hardware and physical technology elements ensuring Application Components operation. Technology architecture is represented in an abstract level, as it varies based on Information system architecture realization and enterprise technological choices (vendors, sourcing policy, etc.).

Besides "traditional" Technology architecture components, as servers and devices, emerging technologies, as cyber-physical systems, the intelligent machines, autonomous robotics supports cooperation of enterprises key assets: machines, internet, people, and value chain in real time scenarios (Hussain et al., 2021; Bemthuis et al., 2020). The use of Internet of Things and physical sensors to monitor facilities and ensure safe workplace is a globally identified opportunity (Otoom et al., 2020,Petrovic & Kocić, 2020, Bashir et al., 2020). The cloud computing (Hussain et al., 2021; Sheng et al., 2021; R. S. Gomes, 2016) allows computing resources to be available when needed, offering agility and scalability.

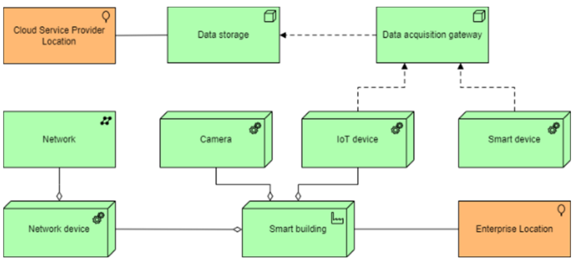

Figure 5: Technology architecture.

5.4 Maturity Model

The BC Maturity Model is an assessment tool, that supports enterprises in evaluation of their current BC maturity. It consists of a questionnaire and a maturity assessment model, that shows desirable EA characteristics for on each maturity level. The questionnaire is built following the defined BC principles and the reference architecture. It consists of a set of the statements about enterprise BC in different EA dimensions (Table 6). The Likert scale is used to provide the responses. The output of the questionnaire is a maturity radar.

Table 6: TCA Maturity Level Matrix (a fragment).

Area/ Level	Architecture Principles: Interoperability
Level 0	Manual data exchanges across business processes, applications and technology components.
Level 1	Semi-manual data exchange between applications. Siloed information exchange between business processes.
Level 2	Automated data exchange between applications.
Level 3	Automated data exchange between business processes, applications and technology components. Defined integration patterns.
Level 4	Automated data exchange between business processes, applications and technology components. Defined integration patterns. Standardized interfaces and protocols.
Level 5	Optimized flows between business processes, applications and technology components. Business logic-oriented interaction via cyber and physical channels. Defined integration patterns. Standardized interfaces and protocols. Common business glossary and data architecture in place.
Area/ Level	**Architecture Principles: Autonomy & decentralization**
Level 0	Hierarchical organization structure with centralized leadership and central decision taking bodies. Formal and asynchronous communication and interaction.
Level 1	Hierarchical organization structure with distributed leadership and central decision taking bodies. Formal and synchronous communication and interaction.
Level 2	Hierarchical organization structure with distributed leadership and central decision taking bodies. Shared responsibilities. Formal and synchronous communication and interaction.
Level 3	Networked structure with distributed leadership and central decision bodies. Shared responsibilities. Synchronous, open and respectful communication and interaction.
Level 4	Networked structure with distributed leadership and power based on expertise and shared responsibilities. Transparent, decentralized decision-making. Synchronous, open and respectful communication and interaction.
Level 5	Networked structure with distributed leadership and power based on expertise and shared responsibilities. Transparent and decentralized decision-making. Synchronous, open and respectful communication and interaction. Vertically and horizontally integrated autonomous, decentralized applications and technologies.

The model uses CMMI five levels of maturity and it considers such categories: (1) Principles - how well BC principles are implemented across EA dimensions; (2) Business Capabilities - if all capabilities are implemented and what are their quality and effectiveness; (3) Applications – which components are implemented and what are their integration level; (4) Technology – which components supports enterprise BC.

6 DEMONSTRATION

The framework application is demonstrated in a public sector institution target EA development project.

6.1 The Case Overview

The public sector institution operating in a tax and customs administration area (further referred as TCA) has a complex EA. The number of employees exceeds 4000, and they are located in subsidiaries across the country. IT function is centralized in headquarters, and it is responsible about institutional digitalization and provision of the stable IT environment. The TCA has about 70 information systems, including about 20 state information systems supporting delivery of critical government services. Most of the systems are deployed in a local data centre, located in the headquarters. Historically, there is large technology diversity. The institution is willing to define their target EA and engage external IT consultants to advise them. The project includes 3 phases: existing situation analysis; target EA definition; EA roadmap preparation. The project scope is limited to Information system and Technology architecture dimensions.

6.2 BC Maturity Assessment

Existing situation analysis includes different EA assessment factors, as compliance to business and technology requirements and the best practices, maintainability, cost effectiveness and others. TCA is providing essential public services thus BC is considered as a critical institution capability.

The average TC BC maturity level is 2, it is repeatable, but initiative (Figure 6). The lowest maturity dimensions are: (1) compliance to Architecture Principles caused by of historically evolved EA and centralized decisions making structure and (2) Technology Architecture, as mainly “traditional” components (servers, devices) are used.

The highest maturity level is in Business Capabilities dimension, as public sector institutions are regulated and risk averse. Still, also this dimension maturity level is low and must be increased.

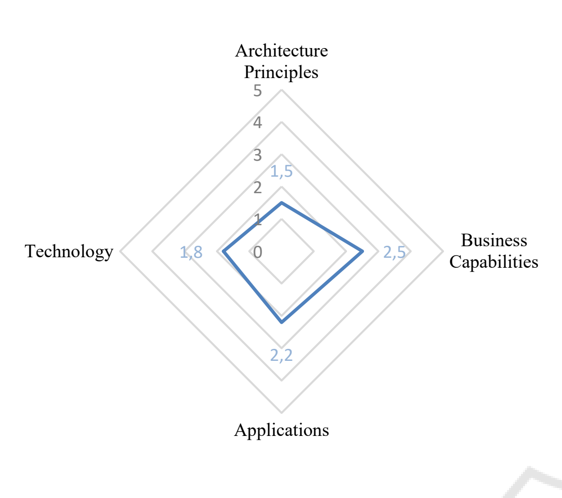

Figure 6: TCA BC maturity radar.

Besides the maturity levels and improvement path, results of the existing situation assessment highlight several BC related problems, such as: (1) business processes disruption due to unstable operation of the critical systems (downtown tends to exceed defined recovery time objective); (2) disaster recovery difficulties; (3) information unavailability due to low systems performance. The root causes of the problems were investigated and lack of standardization and limited knowledge were among them.

6.3 Target EA Design

The target EA is designed considering defined BC Architecture Principles and the Reference Architecture. The principles are detailed into the TCA architecture requirements (Table 7). An architecture requirement (The Open Group, 2005): "represents a statement of need defining a property that applies to a specific system as described by the architecture." The architecture requirements realize architecture principles. The principles are generalized to wider audience, while the requirements represent principles realization in particular organization EA design.

Table 7: BC architecture principles and requirements map (a fragment).

Principle - Interoperability		
Requirement	EA comp.	Required changes
Provide centralized integration point for standard interfaces	Integration platform	• Replace existing platform (extended platform services, new technology). • Standardize (rebuild) existing interfaces (priority – unsecure protocols). • Eliminate historical integration components.
Provide 360 customer view	Data analytics solution, Customer relationship management (CRM) system	• Implement new application services (CRM system). • Integrate new data sources in Data analytics solution (social media, others).
Provide business processes orchestration and common tasks management	Business process management (BPM) system	• Implement new application component (BPM system)
Ensure metadata management	Master data management (MDM) system	• Implement new component (MDM system)
Principle - Smart Services Orientation		
Requirement	EA comp.	Required changes
Provide self-service for public services users (citizens, enterprises) in digital channels	E-services portal, Mobile app	• Implement new application services (E-services portal). • Redesign E-services portal architecture. • Integrate CRM and wider data analytics. • Implement new application component (Mobile app).
Provide online information availability users (citizens, other public institutions)	Data analytics solution, Open data portal	• Implement new application services (data analytics solution). • Redesign open data transformation service.
Divide application in service-oriented, flexible microservices	Customs system	• Redesign system architecture
Reuse available state level services	Document storage service	• Integrate document storage service. • Migrate documents and eliminate existing data stores.
Reuse external standard services	E-services portal, Messaging service, Surveying service	• Redesign E-services portal architecture. • Integrate new external services (Messaging service, Surveying service).

The target EA components realize the requirements thus it is assumed that the TCA BC level will increase after target EA implementation. The fragment of the TCA target EA in the form of ArchiMate Requirement Realization Viewpoint is shown in the Figure 7.

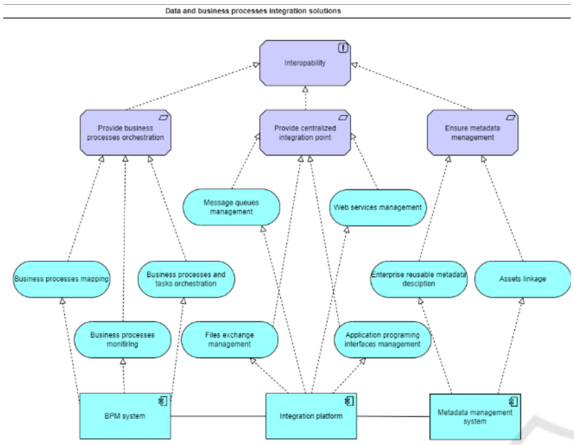

Figure 7: TCA target EA (fragment).

The reference architecture components are used to validate target EA components. The gaps between envisioned EA and reference model components are highlighted according to the TOGAF gap analysis technique recommendations (The Open Group, 2005).

6.4 Discussion

The example demonstrates application of a part of the BC Framework. The BC Maturity Model allows to identify BC maturity level and highlight development needs. The principles support design of the target EA, as well evaluate particular solution alternatives. The principles can be decomposed to organization specific architecture requirements to integrate BC best practices; proper requirement management is the central part of an EA design. BC Reference Architecture can be used to validate target EA components and guide their development.

Several limitations have been observed during the case to be addressed in the further research. To translate architecture principles in architecture requirements, expert involvement and deep domain knowledge is required. We claim that main BC component is Business Capabilities. While EAM covers several dimensions, including Business architecture, empirical observations in numerous EA design projects in the Baltics region shows that still EA typically is perceived as IT discipline. It rises challenges in Business architecture related principles and Business Capabilities realization as part of EAM initiatives.

Not all defined BC Architecture Principles and EA components are relevant in every industry andenterprise. For example, in the public sector institutions, the organization culture mainly is "traditional", involving centralized decision taking and relatively low agility and autonomy. The organization structure, roles, responsibilities are well defined, and everybody is expected to perform particular tasks.

Cultural aspects change is a long-term activity requiring the highest leadership commitment, what typically it is not part of EAM initiatives.

7 CONCLUSION

The paper proposes the BC Framework, that provide guidance of BCM capabilities implementation across different EA dimensions. The proposed framework aims to address enterprises issues related to the low standardization and missing knowledge. The architecture principles encapsulate related research results, thus providing knowledge base what can be used for EA design. The standardization is promoted by the reference architecture for BC. The reference architecture proposes BC related architecture components decomposition, thus promoting standardization. Standardization may trigger the costs decrease. It is assumed that the BC Framework would increase enterprise competences in BCM and enable better preparation for crisis, as the framework incorporates knowledge from the best practices.

In the design science research cycle, the current paper has focused on the investigation and solution design phases. The framework evaluation will be performed in the next research phase. Jointly with IT consulting company it is planned to apply framework for the company's clients. The first step will be enterprises current BC maturity evaluation, using BC Maturity Model. Afterwards the maturity increase plan will be prepared, based on the BC principles and reference architecture. The maturity will be re-measured after the plan implementation. Besides the framework practical application, the enterprises feedback will be collected and integrated in the framework next versions.

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