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Using Enterprise Architecture for Modeling and visualizing the impact of change: a report from the trenches

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Abstract

Digital transformation has put Enterprise Architecture (EA) higher up on the agenda. The demands of digital transformation have intensified the need for organizations to have a common framework and vocabulary for understanding their structure and the interrelationship between key organizational components. This paper reports on the work developed by a multidisciplinary team from different European Higher Education Institutions (HEIs) to design a program that other HEIs can use to raise awareness of the importance of EA modeling in their organizations to display the impact of changes. The paper describes the program's goals, the underlying methodology applied, and the insights gathered from two workshops realized in 2022 at the Norwegian University of Science and Technology (NTNU), in Norway, to validate the program's methodology.

1 Introduction

Digital transformation has put Enterprise Architecture (EA) higher up on the agenda. The demands of digital transformation have intensified the need for organizations to have a common framework and vocabulary for understanding their structure and the interrelationship between key components of the organization whereby they can better understand the impact of changes and link their goals, objectives and strategies to their activities and functions to perform strategic analyses.

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There is no one universally accepted definition of EA. Janssen and Hjort-Madsen (2007) state that EA identifies the main components of the enterprise, its information systems, the ways in which these components work together to achieve defined objectives and the way in which the systems support business processes. Tamm et al. (2011) refer that EA offers a high-level overview of an enterprise's business and information technology (IT) systems and their interrelationships. For (Gong & Janssen, 2019), EA consists of enterprise models and standards that can be used to analyze the current landscape, model future states, and develop roadmaps to achieve the envisioned situation.

Given the complexity of the subject it is often difficult to discuss the importance of EA in an organization. Having a common understanding of concepts is pivotal to start a meaningful and fruitful discussion on what is the strategy of your organization and how it can be operationalized. EA is an instrument that enables fact-based decision-making grounded by the strategy. Describing what an organization does, and what it intends to do in the future are very complex tasks. EA modeling will not reduce the complexity of modeling an organization, but it will provide a tool to manage this complexity (Gong & Janssen, 2019).

This paper reports on the work developed by a multidisciplinary team from different European Higher Education Institutions (HEIs) to design a program that other HEIs can use to raise awareness of the importance of EA modeling in their organizations to display the impact of changes. It describes the program, the underlying methodology applied, and the insights gathered from two workshops realized in 2022 at the Norwegian University of Science and Technology (NTNU), in Norway, to validate the program's methodology.

2 Enterprise Metamodel

An Enterprise Metamodel is a conceptual model of the organization, describing the entities used in building an Architecture Description, their characteristics, and the key relationships between those entities (The Open Group Architecture Forum, 2022). A fundamental piece that kick started our work is the EA metamodel proposed by our colleagues at the Oslo Metropolitan University (OlsoMet), in Norway, reproduced in Figure 1. This model identifies 10 entities that can be used to build an Architecture Description of a HEI. In summary, **users** use **channels** to access the organization's **services**, and receive **value** as a result of the organizational **value streams** that are enabled by the organization's **capabilities**. The capabilities are realized by information, technology, process, and people.

The Enterprise Metamodel proposed by OsloMet includes a service-oriented approach. **Service** orientation in this context is a way of focusing on what the university delivers as seen from the perspective of its **users** or stakeholders (i.e., students, faculty, researchers, administrative, leadership, etc.), and use that perspective to create a better experience for the users. Some examples of a service could be a digital application portal, an academic advisory service for students and a service to handle research data for scientists.

Channels are the means through which organizations deliver services to its stakeholders or end users. In teaching and learning, a delivery channel can refer to how the learning is delivered to learners. Examples of delivery channels include instructor-led classrooms, e-learning, and videos. To be capable of delivering services and value to the users the organization needs to have the capabilities to do so.

The Higher Education Reference Model (HERM) maintained by the CAUDIT Enterprise Architecture Community, defines a Business **Capability** as *"a particular logical combination of People, Process, Information, and Technology necessary to deliver a discrete required outcome to achieve a specific business objective,"* (CAUDIT, 2022). The capabilities support the realization of an institution's strategy. A Business Capability Model (BCM) can be used as a tool to model and analyze

the organization in many ways. It identifies, categorizes, and decomposes the business capabilities required for the business to have the ability to deliver value to one or more stakeholders.

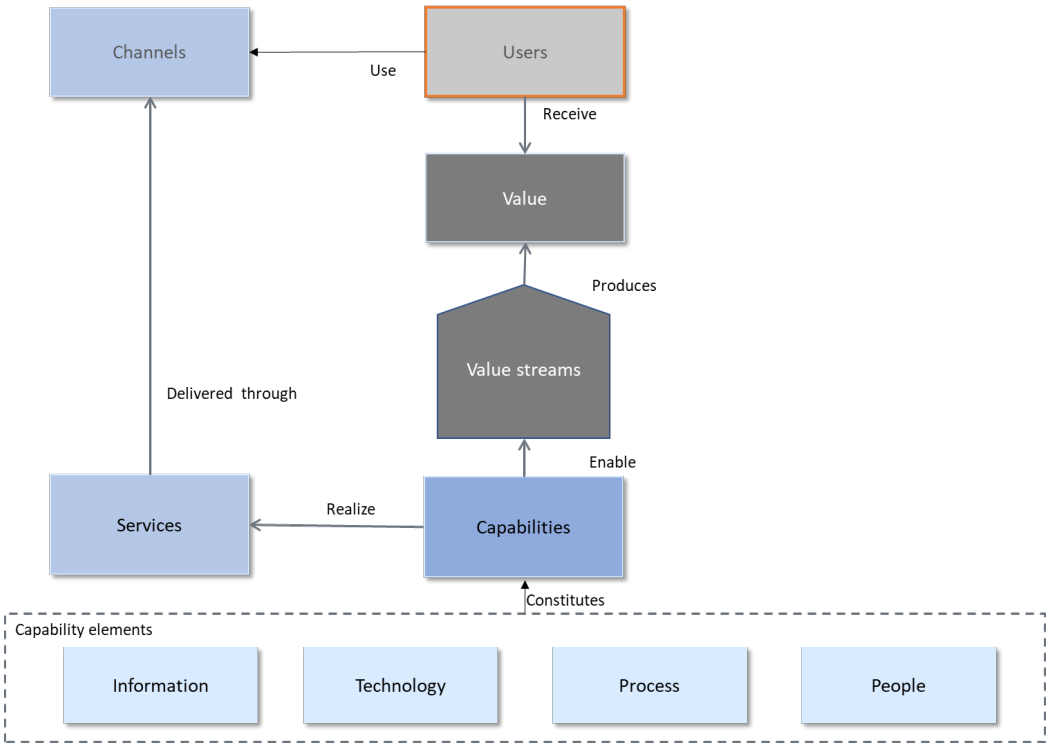

Figure 1: Enterprise Metamodel proposed by the Oslo Metropolitan University

Figure 2 displays the Norwegian translation of the HERM Business Capabilities Model (v2.6.1), performed by the team at NTNU. This is stable *("beta-version"*) translation that has been used by some universities in Norway. This model provides an abstraction of the organization's reality in a way that helps to simplify conversations between various stakeholders. As it will be shown later, this model was very useful in the workshops organized at NTNU.

Each capability, for instance the capability of Curriculum Design needs people with the right competence and experience to do the work, information as input to complete the curriculum design, processes describing how to do the work and technology to support it. The technology today will probably be a digital solution but could just as well be pen and paper.

The capability of delivering learning to students relies on (is composed of) people (teachers), technology (e.g., LMS), information (e.g., the curriculum design and the enrolment records), and processes for how learning should be delivered. With these elements modelled it starts to become much more transparent how the organization operates, it is no longer being hidden in the implementation details.

The reason why an organization exists is to provide **value** to one or more stakeholders. In this context, value is used in the most general sense of usefulness, advantage, benefit, or desirability, rather than the relatively narrow accounting or financial perspective that defines value as being the material or monetary worth of something.

The **value stream** concept is pivotal, albeit someway complex. The value stream is an end-to-end collection of value-adding activities the organization performs that end up creating an overall result for

a stakeholder or end-user. The complete set of value streams depicts the various ways in which an organization orchestrates its capabilities to create stakeholder value. An example of a value stream is the stages of activities that produce study programs and curricula that can be delivered to students to receive the value of learning and passing their exams.

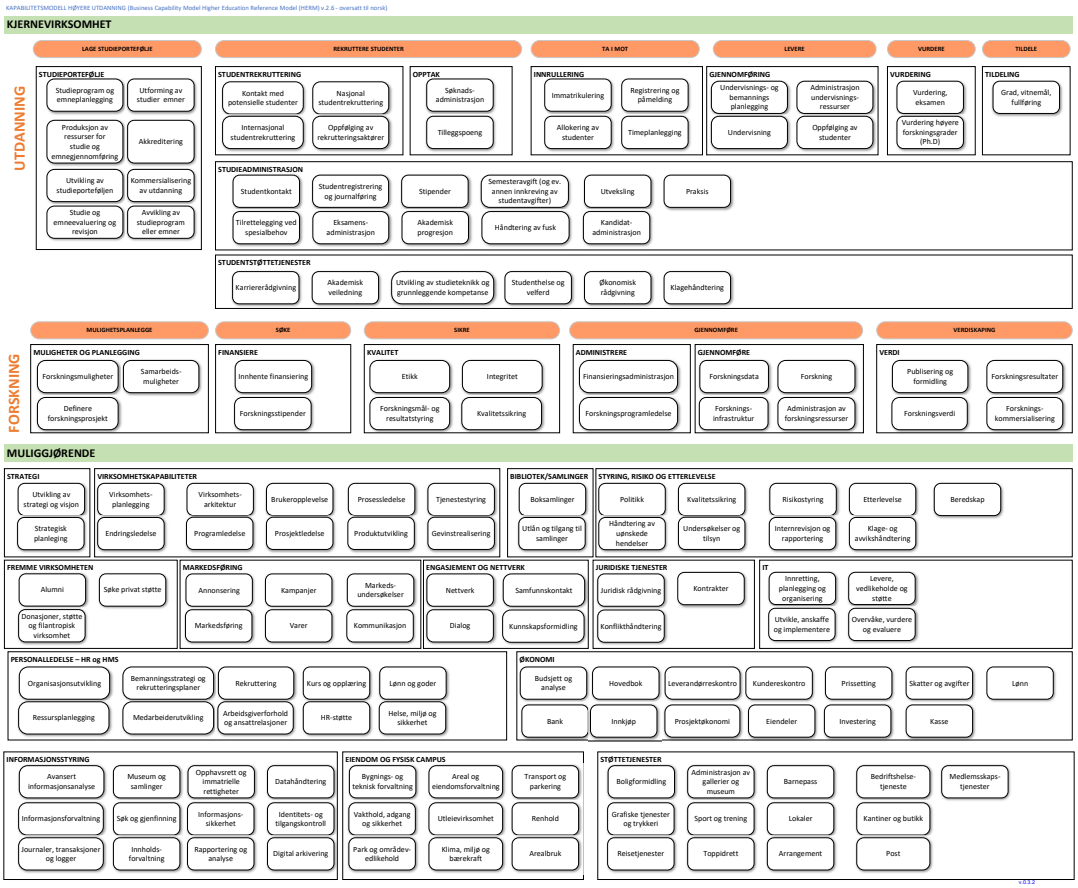

Figure 2: The Norwegian translation of the HERM Business Capabilities Model v2.6.1. Adapted from the original version (CAUDIT, 2022)

2.1 Enterprise Architects' use of metamodels

There are some generic enterprise metamodels that can be used as-is or tweaked to suit the needs of your organization. Enterprise Architects typically establish a metamodel of the organization using an appropriate tool, for instance a graph database. Once the model is populated with the organization's data then it is possible to create views and visualize different perspectives to see *how* and *where* changes will happen, as well as perform strategic analyses to identify where to better invest your efforts to reach your organization's goals.

A metamodel defines the language and rules used to create models, while a reference model provides a specific example of a model that can be used as a starting point.

3 The Program "Modelling the impact of change™"

3.1 Goals and motivation

Motivation to build the program:
Building a capability on organizational level to master the impact of change.

Primary outcome of the program:
Program that trains staff to become trainers in their own organizations.

Secondary Outcome of the program:
Design a workshop model that can be run autonomously by the internal staff of an HEI to kickstart the rising of the maturity of the organization to be able to model the impact of change.

3.2 Models and scope

The program focus is on modelling the impact of change. However, this requires a modular approach to tackle the necessary understanding of the impact (Module 1), then modelling or mapping the outcome (Module 2) in a way that it can be visualized and analyzed (Module 3). Figure 3 presents the overall structure of the program. Each module is described below in more detail.

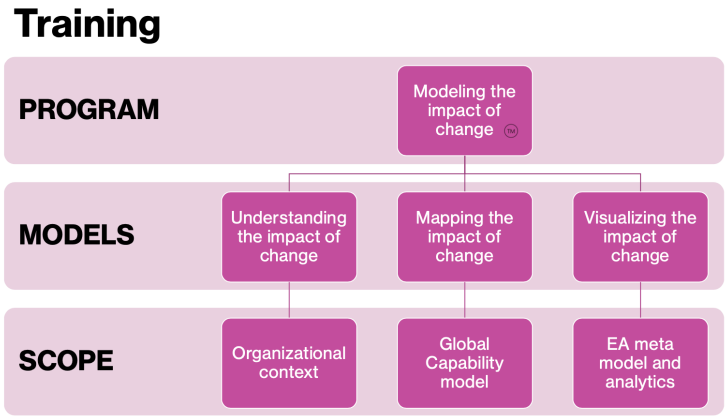

Figure 3: Overview of the "Modeling de Impact of Change™" program

Module 1: Understanding & context
The goal of this exercise is to build a common ground and understanding on the challenges the organization encounters to execute the strategy. Defining the challenge and driver is essential to start solving the actions that need to be taken across the organization. As the organization understands the challenge it will be able to map the capability (resources, tools, data, processes) that needs to be established or developed.

Module 2: Mapping & capability model
The goal of this exercise is to build a relationship between the challenges or identified development actions to a global sector specific capability model. Mapping the various actions to a common model (canvas) builds a visual representation of focus and gaps that will be an accepted truth shared by the organization regardless of the department or responsibility.

Module 3: Visualizing & metamodel + analyzing

The goal of this exercise is to build, based on the mapping, a comprehensive representation of the whole organization's activities starting from identified challenges but also existing activities. This will eventually result in a complex relationship "spaghetti" that can be analyzed, but also sliced into observable viewpoints. The outcome is complex but not complicated.

Selecting the approach to fit the maturity and challenge

The modules inside the training are partly interchangeable but depend on the selected context (step 2 in the path to collaborative actions), choosing the organizational Strategic focus requires the bridging of the impact to be explained after mapping the activities to the capability model. This is the basic path and recommended first time exercise for an organization (see Figure 4).

Choosing the selected context to be organizational, e.g., with a portfolio focus, requires the bridging of impact before the mapping of activities to the capability model. This is the advanced path (see Figure 5) with additional choice to either approach it through (a) an operational development viewpoint; or (b) value stream mapping. Both choices are recommended as the secondary exercise for an organization.

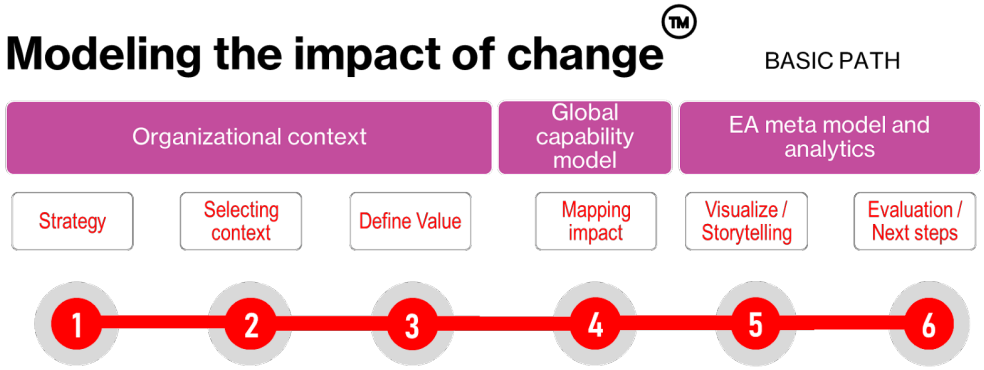

Figure 4: "Modeling de Impact of Change™" program: basic path

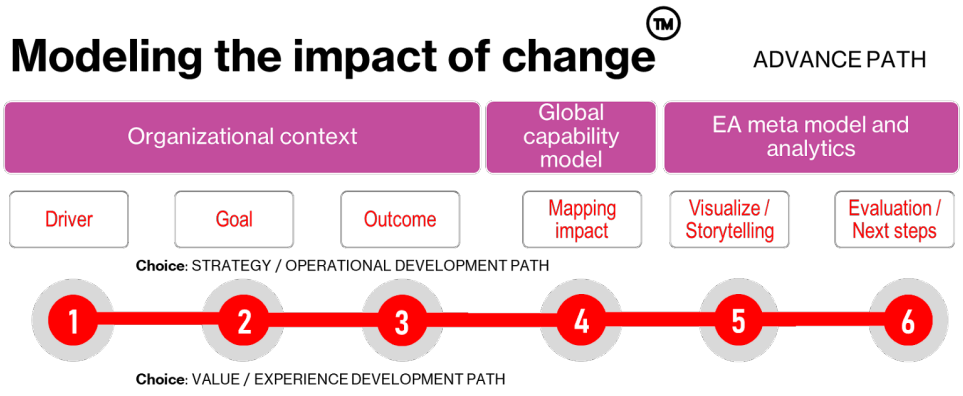

Figure 5: "Modeling de Impact of Change™" program: advanced path

4 Our approach

4.1 Background to building the program

The work to build the program included a lot of activities related to design thinking and innovation practices applied when trying to think out-of-the box. It also tapped into the existing work and experience the participants of the program members had. The program members include participants from three universities of three different countries: Finland, Portugal and Norway. A big success factor was based on including a unique combination of different skill sets and knowledge about methodology, metamodels and best practice. Just to mentions a few key skills behind this training set are people with expertise in: IT management, IT systems, digitalization, organizational planning, service design, enterprise architecture, Business Intelligence, visualization, program and project management, methodology, modelling, facilitation and understanding the HEI industry.

Applying this knowledge created some great outcomes such as:

- a metamodel for the training program
- a methodology applied to the learning
- a way to map organizational and staff activities to the HEI capability reference model (HERM Model)
- identification of visualization models that can directly be applied by the participants to build better understanding of their impact on operations.

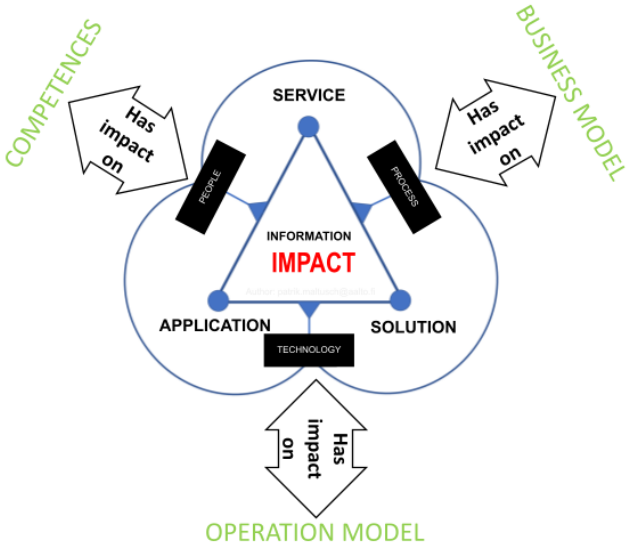

Figure 6: Breaking down the impact of change

Figure 6 reflects the program's team current understanding of the components that need to be considered when breaking down the **impact** of a change, and the respective effects on the organization's business model, operational model, and competences. This diagram is a conceptualization of the relation between **service**, **solution,** and **application**, and how a service relates to **capability** and **impacts** the organization.

4.2 Validation and insights learned

We also applied the training directly into practice with two separate user groups. In August 2022, we organized two workshops with the involvement of business and IT staff at NTNU, where we conducted a mapping exercise of business capabilities, with strategy and project portfolio. We had a total of 22 participants during the two workshops, which gave us the opportunity to test and verify the methodology we designed.

We learned that:

- The design of the applied methodology is working well when participant count does not exceed 12 and the session can be timed to last a maximum of three hours.
- The training has a specific flow that needs to be followed for participants to build the understanding and to be able to experience a possible "aha" moment.
- This program is common grounds for the methodology for strategic analytical practice.
- The methodology addresses the alignment of the following components of HEIs: strategic intentions and actions, business models, business capabilities, change management, implementation (with projects) using the existing data.
- This is a data-driven decision-making framework. Going from strategy to operational level.
- As an example: exploring how life-long learning as a business model could be supported is a question that could be answered with this methodology by identifying the gap between current and future requirements.
- Another activity is the study of data visualizations options for an effective, understandable communication of all the components.

4.3 Building understanding: the path of maturity and collaborative actions

Understanding is a path and builds on collaborative actions. The program takes the participants through this path by addressing the six identified stages, presented in Figure 7.

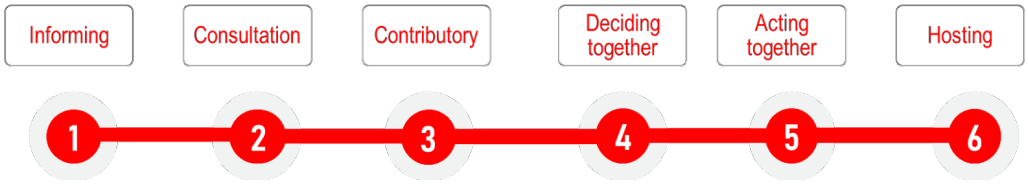

Figure 7: Path of understanding to collaborative actions

Informing
Explaining the scope and purpose of the workshop. Building the frame of reference that the participants will work on and collaborate. Expected or desired outcomes can be presented or listed.

Consultation
Involving the participants into a dialogue based on the frame of reference and context. Elaborate the existing understanding and facts provided through the discussion and applying it to the framework.

Contributory
Participants are contributing based on their role and experience to the context. Outputs are documented and made visible to the participants of the workshop. Initial mapping to the capability model will take place. Personal insight is shared.

Deciding together
Output is mapped and made visible to all participants. A dialogue on criticality, impact, actions, timeframe, focus, and scope is fostered in a way that it enables to make collaborative decisions.

Acting together
The participants as a group build the action plan or roadmap that will take them through the challenge and create actionable outcomes for the organization.

Hosting
The actions are owned, maintained and outcomes shared in a structured, collaborative, and positive way.

5 Conclusions

The major outcome of the program was the design of the framework "Modelling the impact of change™". This outcome was designed with the purpose to be a shareable and an extendable framework for the Higher Education Sector.
Some key features of the framework are:

- it has a learning methodology that builds on staging the engagement,
- it has a standardized capability model particular for Higher Education Institutions,
- it empowers people to visualize the impact of activities they work on,
- it builds a relational view that simplifies complexity by providing a structure,
- each module of the individual training set can be extended to be a stand-alone module,
- each individual training set can be adapted by selecting the prioritized context e.g., strategy, actions, services, portfolio or projects,
- it can be applied by any organization through a train-the-trainer workshop.

Reflecting on the direct outcomes and the impact the workshops had on the program team, we can report that these training sessions had a positive outcome on the professional development of the staff member participating and on the institutions' way of identifying the impact of change.
An expected outcome was also to increase the level of strategic and analytical literacy of the HEIs involved. Although the active participants to build this program were motivated by different outcomes, for NTNU and Aalto university, there was an expected impact on improvement of the business IT alignment of the institutions and for Iscte, the impact was on research activities, it matched perfectly with flexibility of the program framework.

5.1 Future impact and next steps

Work has started for spreading the training methodology within our own institutions and the larger European community we are collaborating in, such as EUNIS Special Interest Groups for Enterprise

Architecture and Business Intelligence. There are considerations to add a few selected partners for the creation of a joint project with the aim of building and running a training program for all European HEIs. There is also a plan to prepare an application for funding to enable the continuation and realization of this work. Work is progressing and next workshops have already been planned for a larger community in Spain in March and the EUNIS seminar 2023 will be hosting a training session in June as a pre-seminar activity organized by EUNIS own EA SIG.

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7 Author biographies

Patrik Maltusch is the head of EA architecture team at Aalto University. He is chairing the Finnish EA-IG, EUNIS EA-SIG and has been one of the lead educators coaching administration staff in the national Higher Education EA program. Early experience includes working as a customer service instructor and further fifteen years as network architect and business owner for infrastructure design in a global Telco company. Patrik is also a distinguished and accredited security professional, risk manager, system auditor and Education Enterprise Architect. For Patrik, interoperability is the key to master the ever-growing digitalization needs in a more complex and complicated ecosystem landscape.
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