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# Improvements on capability modeling by implementing expert knowledge about organizational change

Georgios Koutsopoulos, Martin Henkel and Janis Stirna

Department of Computer and Systems Sciences, Stockholm University, Stockholm, Sweden  
{georgios,martinh,js}@dsv.su.se

**Abstract.** Modern digital organizations are constantly facing new opportunities and threats, originating from the highly dynamic environments they operate in. On account of this situation, they need to be in a state of constant change and evolution to achieve their goals or ensure survival, and this is achieved by adapting their capabilities. Enterprise Modeling and capability modeling have provided a plethora of approaches to facilitate the analysis and design of organizational capabilities. However, there is potential for improving management of capability change. This Design Science research aims to provide methodological and tool support for organizations that are undergoing changes. A previously introduced meta-model will serve as the basis for a method supporting capability change. The goal of this study is to explore expert knowledge about organizational change in order to evaluate the initial version of the meta-model and identify possible weaknesses. Ten semi-structured interviews have been conducted to explore the perspectives of experienced decision-makers on capability change. Three categories emerged from the analysis, reflecting on how capability change is observed, decided and delivered respectively. These have been used as input for revising the conceptual structure of the capability change meta-model.

**Keywords:** Capability, Enterprise Modeling, Change, Adaptation, Transformation

## 1 Introduction

The digital transformation occurring in modern societies has resulted in highly dynamic environments that entail a wide spectrum of changes, opportunities and threats for any organization [1]. These environments are conceived as internal or external interacting forces that motivate organizational changes constantly, whose aim is to improve efficiency in fulfilling business goals [2] and ensuring survival [3]. The environmental changes are not only faster than the organizational changes [4], but also hard to anticipate. As a result, the ability to trigger quick and appropriate organizational adaptations and transformations bears great importance. However, this situation poses significant challenges to organizations [3]. In this regard, organizations need a strategy guiding how to address these unpredictable changes in order to remain sustainable and competitive [5]. Strategy is deciding the organizational goals and coherent choices that concern resource allocation, involved activities and approaches for the realization of the goals

[6]. Usually, even though IT is becoming integrated with all aspects of business [7], organizations need to rely on human individuals for strategic decision-making activities, based on the assumption of human rationality [3]. Consequently, decision-makers are a significant part of any ongoing change in an organization.

The operationalization of strategy needs support and the concept of capability is gaining ground among decision-makers and scientists as a means to capture and analyze information relevant to organizations because of its practical relevance [5]. Change, strategy and capability are inextricably linked concepts [8]. Therefore, capability has become the core concept of approaches that aim to support organizations by motivating and providing input for the development of an Information System (IS). A plethora of capability modeling approaches exists, for example, [9, 10], however, there is room for improvement by providing a method specifically designed for depicting capability change focusing on all the change-related elements and the transition itself, which has been neglected to date.

This study is part of an ongoing Design Science Research (DSR) project that aims to provide methodological and tool support for the management of changing organizational capabilities. Having identified the opportunity to improve capability modeling, we explored the existing capability modeling approaches looking for concepts relevant to change [11]. Afterwards, the requirements for a modeling method focused on change were elicited [12], while, in parallel, the dimensions of changing capabilities were introduced in a typology [13]. Finally, a capability change meta-model was presented with purpose to serve as the basis for a modeling method [14].

The objective of this study *is to explore expert knowledge on the phenomenon of capability change*. Interviewing decision-making experts helps gain insight on how practitioners perceive capability change and provides an evaluation of the meta-model's conceptual associations established in the earlier steps of our research. Additionally, it facilitates the identification of potential omissions in the current structure of the meta-model. These findings can provide input for the meta-model's improvement.

The paper is structured as follows. Section 2 provides a brief presentation of the concepts relevant to this study and existing literature relevant to modeling of capability change. Section 3 describes the methods employed for data collection and analysis. Section 4 presents the derived results and section 5 summarizes how the results contribute towards the improvement of the meta-model and presents their conceptualization. Section 6 discusses the results and the conceptualization process. Finally, section 7 provides concluding remarks.

## 2 Background and Related Research

Organizations are conceived as social goal-directed systems that maintain boundaries reflecting their goals [3]. The phenomenon of changing organizations is important for business informatics focusing on the role of ISs in these changes [15]. It has been widely researched, utilizing several terms like change, transformation and adaptation, either interchangeably or reflecting differentiations in the scopes of change [16]. The same applies to the terms business, enterprise and organization, which are sometimes

used interchangeably or are being distinguished by defining an enterprise as a goal-sharing group of organizations, as in [15].

Organizational changes are driven by (i) rationally adapting to environmental conditions, (ii) planning and choosing strategically as a means to have the organization shaped by decision-makers, or (iii) a combination of these and organizational inertia. This results in three main perspectives in organizational change theories which are considered deterministic, voluntaristic and reconciling respectively [3]. What is often being neglected is the causality of change, an aspect that should be implemented in any method with the objective to capture the complexity of ongoing changes [3].

Enterprise Modeling (EM) approaches aim to capture this complexity. EM concerns the process of creating an enterprise model capturing the aspects of the organization which are relevant for a given modeling objective like concepts, goals, processes or business rules [17], and the integrated view of these aspects is of great importance. As a result, an enterprise model often is a set of sub-models each focusing on a specific aspect of the organization. Such as model facilitates people in an organization to develop a deeper understanding how their work gets integrated in a bigger picture and the role of the supporting information systems [18].

Since there is no consensus in the literature, combining two earlier definitions from [9, 19], the concept of capability is defined in this project as a set of resources and behaviors, with a configuration that bears the ability and capacity to produce value by fulfilling a specific goal in a specific context. The lifecycle of a capability [9] consists of its design phase, which concerns its development, and its run-time phase, which concerns the time when a the capability is operationally active. The concept is associated to several core business concepts like resource, goal, actor, process and context [5, 9]. Capability is often considered as the missing link in business/IT transformation because it (i) provides a common language to the business, (ii) enables accurate investment focus, (iii) serves as a baseline for strategic planning, change management and impact analysis, and (iv) leads directly to business specification and design [20].

Several modeling approaches have utilized the concept of capability including stand-alone approaches like Capability-Driven Development (CDD) [9] and Value Delivery Modeling language (VDML) [21], Enterprise Architecture frameworks, for example NATO Architecture Framework (NAF) [22], Department of Defense Architecture Framework (DoDAF) [23], Ministry of Defence Architecture Framework (MODAF) [24], and Archimate [25], extensions of existing modeling methods like i\* [26] and Capability Maps [27], or new notations, for example CODEK [10].

The aim of this paper is to explore how experienced managers perceive the concept of capability in relation to changes and adaptations in their organizations and convert the findings to requirements for updating our previously developed meta-model for capability change [14].

### 3 Methodology

This study follows the DSR paradigm, and in particular the guidelines of [28], according to which any DSR project consists of five iterative steps. These are (i) problem

The selected data collection method is asynchronous semi-structured interviews [30], which is an appropriate method, for in-depth understanding of complex phenomena. Purposive and convenience sampling [31] has been used for the selection of participants, which resulted in a group of 10 expert decision-makers. The purpose and convenience concern the inclusion of participants that are not only available but also possess the required knowledge and experience for the given topic. The set of questions consisted of (i) participant data, (ii) general questions on capability change, (iii) specific questions on the three change functions elicited in our earlier work, i.e. observation, decision and delivery of change [11], and (iv) questions related to identifying the need to change, because it was identified as a potential weakness of the meta-model [14]. The specific questions related to the change functions were about the responsibility, the actual process, factors and criteria affecting each function, and related challenges.

For example, the general questions on capability change included questions like “What does the concept of capability mean to you? Is it a term used in your organization?”, “Is capability change a common phenomenon in your organization/unit?”, “Based on your experience, what is the most common type of capability change?” and “Have you used any methods or tools to support capability changes? If yes, which ones?”

The function-specific set included questions like “Who is responsible for observing a capability's performance and identifying a need to change?” “How are the criteria determined for deciding on the best alternative for a capability change?” “What are the challenges when delivering a capability change?”

In parallel, the participants have been asked not only to evaluate the association of the existing meta-model concepts to capability change using a list of Likert – scale questions but also identify other possible concepts that they consider valuable for describing such phenomena. In addition, they have been asked questions related to the responsibility, communication and identification of need to change. Follow-up questions have been posed whenever clarifications were deemed necessary.

The collected data have been analyzed both quantitatively and qualitatively. A statistical quantitative analysis has been performed on the Likert-scale responses and the rest of the interview data have been analyzed by means of deductive thematic analysis [32], driven by the change functions. Initially, descriptive coding was applied on the raw data, which is considered an appropriate step for the initiation of thematic analysis [33]. The process requires familiarity with the dataset, systematic coding, generation of initial codes and identification of themes, which comprise the final report. The derived results have been mapped and systematically converted to input for the meta-model, using the UML notation standards [34] for consistency with the existing meta-model. Finally, the derived components have been integrated with the associated existing meta-model concepts.

## 4 Findings

This section reports the findings derived from the analysis of the collected data. The analysis produced a set of results, in the form of conceptual associations, related both with capability change in general, and the meta-model in particular.

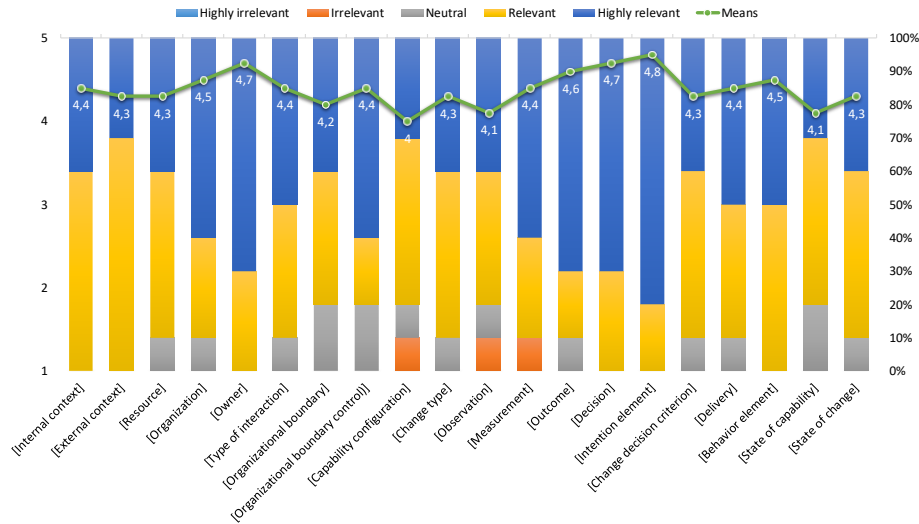
The participants are stated in three European countries, Sweden, Greece and the United Kingdom. Their work experience ranged from 14 to 42 years of experience with an average of 28,9 and median 29. Two participants were not familiar with the concept of capability and seven were not familiar with EM but the definitions were introduced to ensure a common understanding during the interviews. The participants' positions vary from owners and top managers to unit directors. They came into managerial positions having diverse educational backgrounds including studies in engineering, finance and management, humanities, IT and natural sciences. The organizations they have been working in are large (more than 250 employees) for seven participants and medium (51 – 250 employees) for the other three, without any participants from small organizations. They have been positioned as managers in various units, under roles like

managing director, product specialist, in units responsible for risk analysis, strategic product management, sales growth excellence, customer service etc. Two participants are working in public organizations and the rest are employed in private ones. For these reasons, there was a wide spectrum of responses associated with the concept of capability among the participants. This fact can be attributed to the wide range of backgrounds among the participating experts. The participants remain anonymous, hence, we will refer to them with the randomly assigned codenames P1-P10.

The interview questions were grouped in the categories mentioned in the Methodology section and the results are reported in the following sections.

#### 4.1 Evaluation of existing meta-model elements

Regarding the evaluation of the concepts existing meta-model elements, the participants responded to Likert-scale questions, labeling the concepts from “Highly irrelevant” to “Highly relevant” to capability change. The concepts of capability, change, context, state and change function have not been included. The former two have been excluded because the phenomenon of capability change is by definition highly relevant to capability and change and the latter three because they exist in the meta-model as super-classes and they overlap conceptually with their specializations which are included. “Highly irrelevant” has been assigned the value of 1 and “Highly relevant” the value of 5 for the analysis. Overall, the results indicate that all concepts are relevant or highly relevant to capability change, since the means for each concept range from 4.0 to 4.8. The results per concept along with the percentage distribution of responses that generated the values is depicted in Fig. 2.



**Fig. 2.** The result of the evaluation per meta-model concept, including distribution and average.

The concept that has been considered most relevant to capability change is the “Intention element” with a score 4.8/5 and the least relevant is “Capability configuration” which scored 4.0/5.

Before the discussion on the meta-model concepts’ associations, eight of the participants considered the meta-model’s concept set as adequate, with P6 mentioning “Risk culture (e.g. attitudes behind the behaviors), policies, strategies, competence, steering etc.” as possible candidates for inclusion and P3 felt that there were “a lot of” concepts missing even though none were provided by the participant.

## 4.2 Overall on Capability Change

The discussion around capabilities started from the participants’ understanding of the concept. Diverse perspectives were expressed from the participants. For example, P4, when asked if and how the concept is used in his work environment, responded: “Yes we use it widely in our organization. Capability is used in three aspects: 1. Human capabilities & Competence build up; 2. Processes and tools; 3. Ways of Working”. Other perspectives include “Knowledge to adapt and improve an organization to become efficient and competitive...” (P1), “Ability, organization & resources with the right competence” (P10), “Capacity, skills, expertise” (P7), “...capability means to manage every situation” (P3), “Qualification” (P9) and “...a list of things/abilities that an enterprise needs, does or can do to be successful.” (P8).

An interesting point raised during the interviews is whether a capability is considered a resource or not, and whether it consists of other resources or simply needs other resources allocated to it. The results are divided. Half of the interviewees consider a capability as a resource while the other half disagree. However, six out of ten believe that a capability consists of resources.

Capability change, in terms of *frequency*, is seen as a common phenomenon by eight of the participants with statements like “...it’s a continuous change” (P10) and “...things are moving too fast to stop.” (P2), while it is not common for P3 and P5. Concerning the types of capability change, eight participants consider the modification on an existing capability as the most common type and the other two consider introduction of a new capability as the most commonly encountered phenomenon. While discussing the positive and negative aspect of capabilities, six participants considered that capability can be both positive or negative, three others consider it an exclusively positive concept, while an interesting opinion was expressed by P2 stating that “A capability is a positive concept. A negative capability is just a weakness in observation.”, which emphasizes the importance of the observation function in capability change. Finally, the discussion shifted towards methods and tools used for capability management in their organizations with the participants providing various abstract responses like observation, training, support and explanations but also specifics like Driving Strategic Impact (DSI) from Columbia University, Jira, Confluence, Props-C, Aris and Six Sigma.



### 4.3 Observing Capability Change

The specific part of the interviews that was devoted to the observation of capability change resulted in several findings. Initially, among the participants, six out of ten did not consider that a capability is contextual, it only *depends on the context of the organization* that owns it. This fact supports our initial meta-model design. Regarding the *responsibility to observe a capability* to identify a need for change, the responses were similar, mentioning several high ranked managerial positions, for example, CEO, Head of Operations, business owner etc. An exception came from P2, who stated that the function is performed by “A specialized team that we call our “planning sector”. They are responsible for monitoring developments in the economic, legal, political, social, environmental and technological conditions. These people are not only experienced but also intelligent. They need to make informed assessment of a potential and report it to the top management.”.

Concerning the *identification of the need for change*, two points have been emphasized by the participants: (i) the factors that are being monitored and assessed as a means to identify a need for change are expressed as set of Key Performance Indicators (KPIs), however, (ii) the association between a capability and its relevant KPIs occurs only during the design phase of the capability lifecycle and not during run-time. Emergent evaluations occurring during run-time rely both on KPIs and “common sense and experience” (P1). They also agreed that the only way that the observations are communicated are within scheduled reports and meetings, a fact that indicates that a supporting IS could potentially facilitate these activities. P4 expressed his disappointment on the current practices stating: “How it usually is: Complex, detailed, technical presentations with in depth knowledge of the data and data-points, without any context and what the effect on the organization is. How it should be: Analysis on effect and impact that the observed data highlights and indicated. Always fact-based.”.

Regarding the *observed contextual factors* associated to a capability, all the participants agreed that “Each capability has its own factors but there may be some overlaps.” (P7). P8 was specific about these overlaps: “Yes! Changing technology or changing tools working with a certain capability (i.e. managing orders) may result in incompatibilities between IT systems, if different (i.e. in contract execution management, invoicing management, supply management and delivery management)... Internally based on bad performance experience, or bad fit with rest of business, or customer changing capabilities, or new trends and need of business transformation, or externally caused by Competition or PESTLE aspects (Political, Economic, Social, Technological, Legal, Environmental).”. P2 added “...the PESTLE factors, but we try to be open-minded.”. Asking how a factor is associated to a capability produced a variety of responses which can be summarized in “experience and common sense” (P1), collaborators, and PESTLE, as for example in P6’s statement: “Both external (crises, changes at macro or micro level, updated regulatory or legal requirements, market and competitive environment, politics) and internal (e.g. incidents, KPI/KRI levels, identified risks, new strategies, updated business or operation plans etc.) events trigger the changes.”. All the above were missing in the current version of the meta-model, thus, an abstract “Monitored Factor” concept is required, usually expressed as KPIs.

Finally, the *challenges related to observation* can be summarized as “To get the appropriate focus from other departments.” (P1) and the “Lack of specialized staff to make observations” (P7) because “...the intelligence, experience and common sense it takes to identify a potential. It is not something that can be easily taught.” (P2). Inter-organizational focus, attention and motivation, especially across organizational boundaries, has been neglected in the current version of the meta-model.

#### 4.4 Deciding Capability Change

Initially, the discussion about deciding a change concerned the *responsibility of the decision*. Similarly to the observation results, it concerns a variety of high ranked managerial positions, however, an interesting point was raised that indicated an omission in the meta-model. P1, 3, 4 and 9 agree that *change itself has ownership*, usually framed within a project that has an individual or unit that “drives the change” (P1) and is “profit and loss responsible” (P4). The owner also has the responsibility of communicating the change and motivating every involved party to actively participate in the planned activities.

Another important weak point of the meta-model was identified while discussing the *criteria for decision* on a capability alternative over another. Two codes that emerged several times in the data were “budget” and “cost” of the change initiative used as decision criteria. This means that a change requires resources for its realization. The current version of the meta-model has not taken into consideration this important aspect and only addresses the differences among different capability configurations and their allocated resources, therefore, it needs to be implemented. The finding can be interpreted as follows. Change requires one or more resources allocated to it in order to achieve realization.

Regarding the *definition of criteria* for a decision, the participants mentioned that the criteria are established and driven foremost by economic factors. It is noteworthy that even the two participants who are employed in public organizations funded by the government, mentioned “economy” (P5) and “cost reduction” (P2) as the primary decision criterion. Other factors for the establishment of criteria that were mentioned are “Logical assumptions and experience.” (P1) and “The many policies (internal and external e.g. regulatory) in different areas creates the framework for the changes.” (P6). They also agreed unanimously that measuring capability outcomes can result in the definition of decision criteria, as suggested in the current version of the meta-model.

The *initiation of a change initiative* usually starts with “Top down approach, top managers or CEO talks about the importance of a change, defines the driver, the goal and the budget.” (P1), also including “...a Change Request that is submitted...” (P4). These change requests are used for “informing” (P9), sometimes formally (P4) or in some cases informally (P2). This communication is often complemented by analyses using “Gap analysis and swot” (P10). These findings support the inclusion of ownership and the association between the concepts of resource and change in the meta-model.

As far as the *challenges of deciding* on a capability change are concerned, the participants emphasized even more the need “To get focus and attention from all involved parties that may be work-loaded with other priorities.” (P1), which emphasizes again

the need to implement inter-organizational motivation in the meta-model. Other challenges mentioned included “The transition from the old to new. The resistance to change, specifically if not entirely understood. Benefit is not obvious even if need to change is obvious.” (P8).

#### 4.5 Delivering Capability Change

As far as the delivery of capability change is concerned, several points have been emphasized during the discussion that are missing from the meta-model.

One such point is that the *speed of change*, which has been introduced in [13] as one of the dimensions of change and is included in the meta-model as the tempo attribute of the Change State class, is associated to the size of the organization, which is a missing concept. As P1 stated metaphorically “...constantly strive to improve but the company is a big elephant that moves slowly towards changes.” P8 also mentioned while discussing the realization of capability changes, “...this is the intention but it can take a couple of years.” These perspectives indicate an association between the size of the organization and the speed of change. This suggests removing the Tempo attribute and implementing it as a class in the meta-model.

Regarding the *responsibilities and communication of delivering capability change*, the responses were identical to the decision function, which means that there is no need for a repetition of the findings about change ownership and different types of informing. The only exception came from P2 who stated that there is no need to inform about delivering capability change because “If more than one unit is involved, they are also involved in the decision, so they are already aware of the deployed change.”

As far as the *actual delivery of the capability* is concerned, different perspectives were expressed, but the summary is that there is no predefined approach and it depends on the capability. For example, according to P4, “Two different approaches: 1. The agile approach with 3-week sprints to keep the focus on the change. 2. The change management approach with close connection to key stakeholders and impacted functions.”, while P2 stated: “Depends on the capability. It can be a single changed process which is deployed internally, to a major change that requires... even construction crews!”.

While discussing the delivery of an active change initiative, the opinions were divided about the *effect*. Half of the participants consider that a change always has an impact on the organization, for example by changing processes and services, but the other half is reluctant to accept this, mentioning factors that are actually blocking the effects of change, for example, “there is resistance to change the KPIs since people get their bonuses based on the KPIs.” (P8) and “...in my experience often the culture in an organization often beats the strategy and capability changes necessary.” (P4).

The *impact* of a delivered change was another discussed topic. Most of the participants responded in an abstract way, mentioning “monitoring” and “reporting” as the key activities, however, a few provided more elaborate answers, for example P4 “It should be analyzed with two type of data. The leading indicators that should reflect on the wanted position after the change. The lagging indicators that often are project based and strictly fact-based and data-driven.”, and P1 “Measuring the results using KPIs that

are monitored for a period of 3-4 years”, who added a temporal perspective. P2 also mentioned that evaluating the impact of delivered change requires “using experience and common sense”.

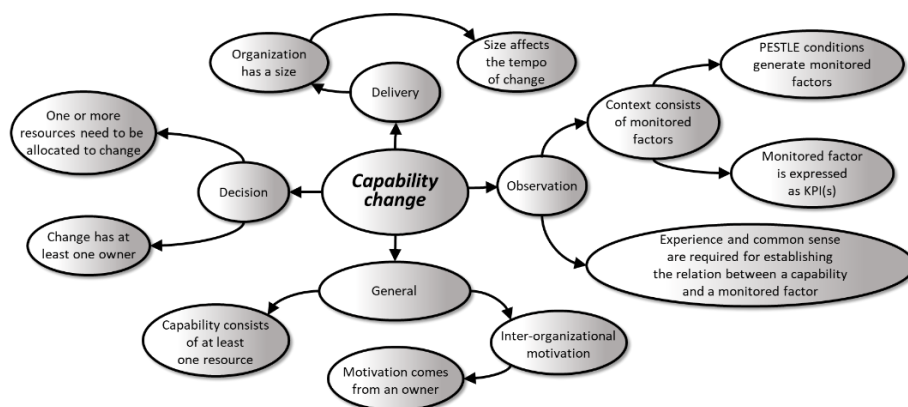
Finally, while discussing the *challenges of the delivery phase*, the inter-organizational motivation and commitment was mentioned again by several participants, the “Customers’ and employees’ reactions...” (P7) and P4 asked to consider the “Culture of the organization. Power base of the stakeholders. Identify the hidden stakeholders and address the value of the change to them if you want to have any chance for a change to succeed.”

## 5 Summary and Conceptualization of the Results

This section presents a summary of the analysis depicted as a map of the findings that are not overlapping with and can extend the existing meta-model structure and the conceptualization of the findings as a meta-model fragment.

A summary of the derived findings, which is also included in the map of Fig. 3:

- Capability consists of at least one resource.
- One or more resources need to be allocated to change.
- Change has at least one owner.
- Change requires at least one source of motivation.
- Motivation comes from an owner.
- Organization has a size.
- Size affects the tempo of change.
- Context consists of monitored factors.
- PESTLE conditions generate monitored factors.
- Monitored factor may be expressed as one or more KPIs.
- Experience and Common sense are required for establishing the relation between a capability and a monitored factor.



**Fig. 3.** The result of mapping the findings of the analysis.

The conversion of the majority of the findings and their implementation with existing meta-model concepts resulted in a UML meta-model fragment, as shown in Fig. 4. The light grey elements' origin is the initial meta-model and the teal elements are derived from the findings of this study.

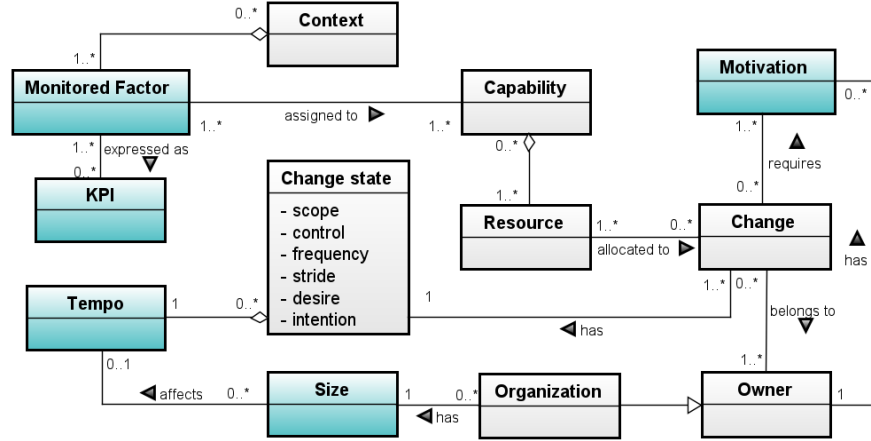


Fig. 4. A meta-model fragment derived from the findings of this study.

## 6 Discussion

The evaluation was realized as an empirical exploration of the experts' knowledge on capability change by interviewing experienced decision-makers. The results (i) confirmed the association between the concepts existing in the meta-model and the phenomenon of capability change, (ii) indicated several existing omissions and improvements, for example, the association between change and ownership, the inclusion of motivation and organization size as essential internal context factors, and (iii) provided insight regarding the processes followed while dealing with the identification of the need for change. The latter included an indication that a systematic approach that involves KPIs is only employed during the design face of capabilities but during run-time, the decision-making bodies rely on "experience and common sense". The two latter findings comprise additional requirements for the artifact.

The fact that the experts are considering the meta-model's concepts as relevant or highly relevant to capability change with no exception means that, from a modeling perspective, proper associations have been established in the initial design and no concepts needed to be removed or merged in the current conceptual structure. No significant positive or negative correlations between their capability perspective and their educational background, work experience or managerial responsibilities suggest that these factors are not relevant to how the capability change concept is shaped. As a result, these factors are not candidates for inclusion in the model.

The ownership of change discussed during the interviews and the resources required for performing the change emphasized on two important omitted associations in the

first version of the meta-model. These are the associations between change and ownership and change and resources. This has been implemented in the conceptualized results, so that the meta-model can enable the method under development to support change planning as well in accordance with the identified needs.

The change motivation aspect has been implemented in the meta-model as a requirement for the method to depict any actions performed during a change project to shift the attention of every involved party towards the given change. This concept, which has been implemented in the presented fragment, can also facilitate change planning, since it has been identified as relevant to all functions.

The identified correlation between the size of the organization and the change tempo suggested not only the inclusion of the organization's size in the meta-model, but also the conversion of the tempo attribute to a class. Following the UML standards [34], this is the only way to model this correlation without missing information valuable for the given modeling goal. This course of action led to the conversion of classes to the remaining attributes of the Change State class.

Finally, the inclusion of Monitored Factor class and the associated KPI improves the observation function's information structure, however, the abstract concepts of "common sense" and "experience" are a challenge to implement without resorting to ambiguous assumptions and possible logical fallacies, therefore their inclusion at this point has been eschewed, nevertheless it is a subject worth researching further.

The present study contributes to the field of capability modeling by advancing the conceptualization of capability change, having identified strengths and weaknesses of the existing meta-model and provided additional requirements for its expansion. This was achieved by analyzing the information provided by experienced decision-makers to gain a deeper understanding of the phenomenon of capability change. From a modeling perspective, the transition of capabilities, which had been neglected to date, can be modeled more precisely using the conceptual structure derived from the results of this study. As a result, the initially mentioned goal, which is a modeling method that addresses the negative, missing and inter-organizational aspect of capabilities is partially fulfilled since the main components' development for such a method is progressing.

## 7 Conclusions

This study, being an ex ante evaluation of a meta-model comprising main components of a capability change modeling method, was realized as an empirical exploration of expert knowledge on the phenomenon of capability change. The results confirmed the adequacy of the existing meta-model elements, indicated omissions and areas for improvement and provided valuable insight regarding the identification of the need for change in an organization.

The findings have been converted to a UML class diagram which is a fragment of a meta-model which is planned to be integrated with the initial meta-model as future steps in our research, a fact which will result in an improved version. This is a step towards the finalization of the method and the initiation of developing an IS aimed to support

digital organizations undergoing capability change phenomena. As DSR suggests, further evaluation is required, which is the next future step of this research project. In addition, the identified lack of a systematic approach of identifying factors relevant to capability change during run-time, suggests an additional possible gap that needs to be addressed within this project or any relevant research project.

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## References

1. van Gils, B., Proper, H.A.: Enterprise Modelling in the Age of Digital Transformation. In: Buchmann, R.A., Karagiannis, D., and Kirikova, M. (eds.) *The Practice of Enterprise Modeling*. pp. 257–273. Springer International Publishing, Cham (2018).
2. Burnes, B.: *Managing change*. Pearson, Harlow, England (2014).
3. Zimmermann, N.: *Dynamics of Drivers of Organizational Change*. Gabler, Wiesbaden (2011). <https://doi.org/10.1007/978-3-8349-6811-1>.
4. Burke, W.W.: *Organization change: theory and practice*. Sage Publications (2017).
5. Wißotzki, M.: Exploring the Nature of Capability Research. In: El-Sheikh, E., Zimmermann, A., and Jain, L.C. (eds.) *Emerging Trends in the Evolution of Service-Oriented and Enterprise Architectures*. pp. 179–200. Springer International Publishing, Cham (2016).
6. Petrevska Nechkoska, R.: *Tactical Management in Complexity: Managerial and Informational Aspects*. Springer International Publishing, Cham (2020).
7. Pearlson, K.E., Saunders, C.S., Galletta, D.F.: *Managing and using information systems: a strategic approach*. Wiley, Hoboken (2020).
8. Hoverstadt, P., Loh, L.: *Patterns of strategy*. Routledge, Taylor & Francis Group, London ; New York (2017).
9. Sandkuhl, K., Stirna, J. eds: *Capability Management in Digital Enterprises*. Springer, Cham (2018).
10. Loucopoulos, P., Kavakli, E.: Capability Oriented Enterprise Knowledge Modeling: The CODEK Approach. In: Karagiannis, D., Mayr, H.C., and Mylopoulos, J. (eds.) *Domain-Specific Conceptual Modeling*. pp. 197–215. Springer, Cham (2016).
11. Koutsopoulos, G., Henkel, M., Stirna, J.: Dynamic Adaptation of Capabilities: Exploring Meta-model Diversity. In: Reinhartz-Berger, I. et al. (eds.) *Enterprise, Business-Process and Information Systems Modeling*. pp. 181–195. Springer, Cham (2019).
12. Koutsopoulos, G., Henkel, M., Stirna, J.: Requirements for Observing, Deciding, and Delivering Capability Change. In: Gordijn, J., Guédria, W., and Proper, H.A. (eds.) *The Practice of Enterprise Modeling*. pp. 20–35. Springer International Publishing, Cham (2019).
13. Koutsopoulos, G., Henkel, M., Stirna, J.: Modeling the Dichotomies of Organizational Change: a State-based Capability Typology. In: Feltus, C., Johannesson, P., and Proper, H.A. (eds.) *Proceedings of the PoEM 2019 Forum*. pp. 26–39. CEUR-WS.org, Luxembourg (2020).

14. Koutsopoulos, G., Henkel, M., Stirna, J.: Conceptualizing Capability Change. In: Nurcan, S., Reinhartz-Berger, I., Soffer, P., and Zdravkovic, J. (eds.) *Enterprise, Business-Process and Information Systems Modeling*. pp. 269–283. Springer, Cham (2020).
15. Proper, H.A., Winter, R., Aier, S., de Kinderen, S. eds: *Architectural Coordination of Enterprise Transformation*. Springer International Publishing, Cham (2017).
16. Maes, G., Van Hootegeem, G.: Toward a Dynamic Description of the Attributes of Organizational Change. In: (Rami) Shani, A.B., Woodman, R.W., and Pasmore, W.A. (eds.) *Research in Organizational Change and Development*. pp. 191–231. Emerald Group Publishing Limited (2011). [https://doi.org/10.1108/S0897-3016\(2011\)0000019009](https://doi.org/10.1108/S0897-3016(2011)0000019009).
17. Sandkuhl, K., Stirna, J., Persson, A., Wißotzki, M.: *Enterprise Modeling: Tackling Business Challenges with the 4EM Method*. Springer, Berlin, Heidelberg (2014).
18. Frank, U.: Enterprise modelling: The next steps. *Enterprise Modelling and Information Systems Architectures (EMISAJ)*, 9, 22–37 (2014).
19. Koutsopoulos, G.: Modeling Organizational Potentials Using the Dynamic Nature of Capabilities. In: *Joint Proceedings of the BIR 2018 Short Papers, Workshops and Doctoral Consortium*. pp. 387–398. CEUR-WS.org, Stockholm, Sweden (2018).
20. Ulrich, W., Rosen, M.: The Business Capability Map: The "Rosetta stone" of Business/IT Alignment. *Cutter Consortium, Enterprise Architecture*, 14, (2011).
21. Object Management Group (OMG): Value Delivery Modeling Language, <https://www.omg.org/spec/VDML/1.0>, (2015).
22. NATO: NATO Architecture Framework v.4, [https://www.nato.int/nato\\_static\\_fl2014/assets/pdf/pdf\\_2018\\_08/20180801\\_180801-ac322-d\\_2018\\_0002\\_naf\\_final.pdf](https://www.nato.int/nato_static_fl2014/assets/pdf/pdf_2018_08/20180801_180801-ac322-d_2018_0002_naf_final.pdf), (2018).
23. USA Department of Defense: Department of Defense Architecture Framework 2.02, <https://dodcio.defense.gov/Library/DoD-Architecture-Framework/>, (2009).
24. UK Ministry of Defence: Ministry of Defence Architecture Framework V1.2.004, <https://www.gov.uk/guidance/mod-architecture-framework>, (2010).
25. The Open Group: Archimate 3.0.1. Specification, <https://publications.opengroup.org/i162>, (2017).
26. Danesh, M.H., Yu, E.: Modeling Enterprise Capabilities with i\*: Reasoning on Alternatives. In: Iliadis, L., Papazoglou, M., and Pohl, K. (eds.) *Advanced Information Systems Engineering Workshops*. pp. 112–123. Springer International Publishing, Cham (2014).
27. Beimborn, D., Martin, S.F., Homann, U.: Capability-oriented modeling of the firm. Presented at the IPSI Conference, Amalfi, Italy January (2005).
28. Johannesson, P., Perjons, E.: *An Introduction to Design Science*. Springer, Cham (2014).
29. Karagiannis, D., Bork, D., Utz, W.: Metamodels as a Conceptual Structure: Some Semantical and Syntactical Operations. In: Bergener, K., Räckers, M., and Stein, A. (eds.) *The Art of Structuring*. pp. 75–86. Springer International Publishing, Cham (2019).
30. Gubrium, J., Holstein, J., Marvasti, A., McKinney, K.: *The SAGE Handbook of Interview Research: The Complexity of the Craft*. SAGE Publications, Inc., 2455 Teller Road, Thousand Oaks California 91320 United States (2012). <https://doi.org/10.4135/9781452218403>.
31. Denscombe, M.: *The good research guide: for small-scale social research projects*. McGraw-Hill/Open University Press, Maidenhead, England (2011).
32. Braun, V., Clarke, V.: Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3, 77–101 (2006). <https://doi.org/10.1191/1478088706qp063oa>.
33. Saldaña, J.: *The coding manual for qualitative researchers*. Sage, Los Angeles, Calif (2009).
34. Object Management Group (OMG): OMG® Unified Modeling Language®, <https://www.omg.org/spec/UML/2.5.1/PDF>, (2017).