Validation of Capability Modeling Concepts: A Dialogical Approach

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Abstract. Involvement of potential users in early stages of elaboration of development methods is needed for successful method adoption in practice. This paper reports on activities of introduction and assessment of the Capability Driven Development (CDD) methodology with a group of industry representatives. This was performed in an interactive workshop and the main evaluation objectives were to assess the relevance of the CDD concepts and their recognizability as well as to identify potential use cases for CDD application. A dialogical approach was used to convey the CDD methodology to the participants and to entice discussions. The main findings are that the participants easily recognized the modeling constructs for capability design. They found that adjustments are particularly useful for the purpose of identification capability steering actions. The use cases described by the participants were later formalized as capability models.

Keywords: Enterprise modeling · Capability modeling · Capability design

1 Introduction

Capabilities are used in strategic management to define core competencies possessed by enterprises [1]. Several enterprise architecture and management frameworks identify capabilities as a starting point of defining enterprise services, processes and supporting technologies, c.f., for instance [2, 3]. Despite the importance of this concept, there is a disagreement on its meaning. Zdravkovic et al. [4] identify that frameworks that use the concept of capability and require capability modeling often lack methodological guidance for capability elicitation and development. Furthermore, only a few of them integrate capability with information systems (IS) solutions. Thus, the capability concept seems to be better elaborated at the strategic level while there is limited understanding of how to go about the actual implementation of capabilities once they have been identified on the strategic level.

The Capability Driven Development (CDD) methodology [5] operationalizes capabilities by defining their associations with other concepts used in enterprise modeling (EM) and IS development as well as by elaborating processes for developing

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information systems enabling capability delivery. The objective of the CDD is to create IS providing the expected performance in various circumstances. The expected performance is characterized by enterprise goals and indicators and the circumstances are specified using contextual information. The process of capability development includes stages of design and delivery. During the delivery stage, adjustments are invoked to adapt the capability delivery to the specific context situation. Capability delivery knowledge in a form of patterns is used to suggested solutions for coping with context situations encountered.

Development of the CDD methodology was motivated and guided by requirements of three in industrial use cases [6]. These use cases were provided by companies participating in a consortium involved in a joint research project. In order to validate the methodology beyond the boundaries of the project consortium, several workshops with other representatives from industry were also organized. The CDD methodology was presented and its potential for wider application areas were identified.

This paper reports the course of action and results of one of the workshops with industry representatives.

From the scientific perspective, the workshops were aimed at validating the concepts used in the CDD methodology. From the practical perspective, companies were introduced to the methodology and new potential application areas were identified. The specific research questions explored at these workshops were:

- Do industry representatives recognize concepts used in capability modeling?
- Are they able to define capabilities and identify goals, context, and adjustments?
- Are there common patterns emerging across cases?

Representatives of companies were actively involved in explorative activities following the principles of dialogical action research [7].

The rest of the paper is organized as follows. The theoretical foundations of this work are discussed in Sect. 2. Section 3 describes the research method. The main findings are presented in Sect. 4. Section 5 concludes.

2 Background

The capability meta-model [8] provides the theoretical background for designing the workshop with practitioners, and the related work highlights some of the challenges associated with promoting and introducing new development methods in practice.

2.1 Capability Modeling

A simplified overview of the key elements used in capability modeling is provided in Fig. 1. Goals are business objectives the capability allows to achieve. They are measured by Key Performance Indicators (KPI). Each capability is designed for delivery in a specific context defined using context elements. The context elements represent factors affecting the capability delivery while context situations refer to combinations of context element values at runtime. A process element specifies a capability delivery solution. In order to ensure that capability is delivered as expected in different

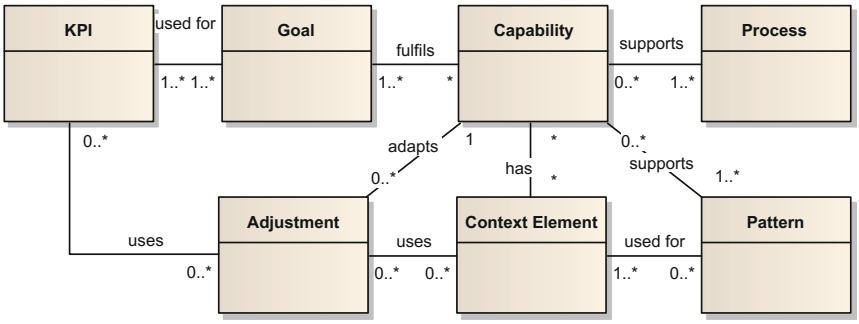

Fig. 1. A fragment of the capability model focusing on adjustments

contextual situations, adjustments are used to adapt capability delivery [9]. The adjustments take the context data and KPIs as input and evaluate potential changes in capability delivery according to an adaption algorithm. Reusable knowledge of capability delivery is represented using patterns. They are used to streamline capability delivery (i.e., what kind of adjustments could be incorporated in the capability design if specific context situations are expected) as well as to suggest capability delivery modifications (e.g., are there any patterns suggesting appropriate actions in the observed context situation). The patterns are intended for application in specific context situations.

2.2 Related Work

Concerning related work, three dimensions are relevant to this investigation, namely, role of capabilities in development of supporting information systems, validation of modeling concepts, and acceptance of new development methodologies.

The capability concept is used in different areas of business and IS development [10]. For example, ArchiMate defines capability as an ability possessed by an active structural element [3]. There are various ways of realizing the capability by combining elements of enterprise architecture. TOGAF [2] advocates capability-based planning to engineer and deliver strategic business capabilities. As an architectural framework, it focuses on structural elements required to deliver the capabilities. Differences among frameworks and their support for capability based development is analyzed in [4].

Although capabilities ought to improve business and IT alignment, empirical evidence is required to prove this assumption [11]. Mohd Salleh et al. [12] show that appropriate information systems are vital to enact capabilities. Capabilities are also identified as important for linking motivation and implementation [13] or strategic planning process and enterprise architecture [14].

Capabilities and capability-based development approaches are novel propositions to many practitioners, and therefore evidence that new modeling and development methods are better perceived if users are involved in early stages of elaboration and adoption should be provided [15]. If modeling methods are viewed through the prism of new product development, customer focused idea generation and early feedback also

feature among the critical success factors of the method's adoption, as discussed in [16]. The process of selecting an appropriate EM method is analyzed by in [17] and it is concluded that method adoption facilitators and experts play an important role. The method adoption also can be viewed as a process of knowledge transfer. Methods also should be suitable for the needs of a particular enterprise or project team [18] and should provide a balance between the effort required and results achieved [19]. Evaluation of methods is preformed following multiple generation and enactment activities [20]. That includes internal, theoretical and empirical evaluation activities. This paper focuses on the empirical evaluation.

3 Research Methods

The investigation was a part of the CaaS research project that followed the principles of Design Science Research (DSR) [21] with CDD methodology and environment being the main design artifacts. The research process consisting of several use case driven design-evaluation iterations, i.e., the theoretical concepts of capability driven development were elaborated according to the needs identified by the industrial use-case partners involved in the project [6]. This information was used to refine the capability meta-model, to develop the CDD methodology, and to apply it at the use case companies. The use case partners had a good understanding of the methodology and an immediate access to additional experts which lead to good results of applying CDD to solve the business cases of the use case companies as well as generally good appreciation of the methodology. Somewhat contrary, initial presentations of the CDD methodology to a wider industrial community showed that much time had to be spent on general discussions about the meaning of various concepts, such the difference between the concepts of capability and service, and limited insights were made about the actual applications of the methodology. The industry representatives were also involved mainly as passive observers. These presentations were made as part of the first industry CDD workshop held in 2015.

The second industry workshop was organized in 2016 to spark active participation of the industry representatives. The workshop was organized as the diagnostics phase of the action research cycle [22]. In particular, the dialogical approach was chosen to involve industry representatives in an open discussion about capabilities and their role in enterprise evolution. To achieve this the capability modeling concepts were conveyed in terms familiar to the industry representatives and the presentation of the CDD methodology focused on the benefits, assumptions, and examples rather than on methodological procedures. The workshop agenda was as follows (duration of the workshop was three hours and one hour for post-meeting discussions):

1. Overview of CDD
2. Exploration of travel management case; step-by-step capability model development;
3. Summary of key elements of the capability model using a tabular template;
4. Identification of use cases;
5. Description of the use- case following the tabular template;
6. Discussion of the use cases.

The tabular template for capability definition includes fields for naming the capability as well as defining KPI, context, and adjustments. Its purpose was to highlight the crucial aspects of capability development, i.e., the interplay among goals, context, and delivery mechanisms, and to abstract from intricacies of the capability meta-model by hiding specific aspects of representing these concepts.

The meeting was attended by representatives from five companies. Their positions at the companies were board member, chief information officer, and system architect. Their companies has only limited experience with EM techniques. Their areas of interest used as precursors for the use case and capability identification were:

1. Logistics (Postal terminals)
2. Wholesale (Spare parts of agricultural machinery)
3. IT management (Incident management)
4. Software development
5. IT infrastructure management

The concepts defined in the interactive section were later confirmed with the company representatives. Preliminary, capability models were developed after the meeting. Some of them were subsequently used to explore possibilities for future collaborative capability development activities.

4 Results

During the workshop a number of use cases were suggested according to the profiles of the involved industry representatives although they were free to choose their own use cases. The selected use cases were briefly discussed and the industry representatives filled out the template and clarifications were made as necessary. The identified capabilities are described in Table 1. In the first two cases the most important capability was easily identified by the experts. The Incident management and User satisfaction management capabilities were selected as one of many related capabilities in the third and fourth cases. For example, in the IT management use case, provisioning of computational resources and help desk services possessed similar importance and characteristics. In the case of IT infrastructure management, the expert mainly focused on consumer value of the services provided. However, he found difficult to clearly separate capabilities of the service provider and the service consumer, probably, due to the wide scope of the capability definition.

The capabilities identified were further elaborated by defining associated concepts. The participants easily recognized the concepts to define the capabilities. Definitions for KPIs were readily available while they recognized that in part they have not attempted to think about the problem in terms of context and adjustments. Identification of context seemed somewhat natural and sometimes perceived as an organic part of the business. However, the participants acknowledged that explicit representation of the context becomes important when quantitative context measurements are to be taken into account. Previously, much of the contextual information has been addressed in an intuitive manner.

Table 1. Identified capabilities

Name	Use case area	Description
Automatic parcel delivery	Logistics	A company operates automatic parcel delivery machines to ensure speedy and accessible deliveries. Its ability is to provide last mile logistics services and capacity is parcels delivery lockers
Spare parts management	Wholesale	A company supplies spare parts for agricultural machinery to ensure continuous operations. Its ability is inventory management of slow moving and critical parts and its capacity is a distribution network
Incident management	IT management	A company support users of large-scale enterprise applications to ensure reliable service delivery. Its ability is to provide application support and its capacity is support infrastructure
User satisfaction management	Software development	A company develops e-government systems and aims to improve user acceptance and usage intentions
E-health service provisioning	IT infrastructure management	A company develops un runs data processing and networking solutions for large organizations. Its ability is development of scalable data processing infrastructure and its capacity is computational resources

The participants found the adjustment concepts of particular value because it provoked thinking about potential solutions for different contextual situations. In particular, they were willing to think about adjustments in relation to context and KPIs even though identification of the relations was beyond the scope of the session. It was noted that despite numerous discussions at companies about decision-making policies, these kind of response mechanisms to changes in the context situation have not been formalized.

The results of capability identification are summarized in Table 2. In the case of Automatic parcel delivery, the company is interested in processing as many parcels as possible within the required delivery timeframe and it is not interested to maintain many empty lockers or to have parcels that are not retrieved by customers. Predictable events such as the Holiday Season can be accounted for up-front in the systems design while context-based adaption is mainly important for unexpected events. For instance, beginning of the gardening season can vary by as much as a month and may overlap with other contextual factors. The contextual elements have varying degrees of predictability and data availability. Clients share information about the number of parcels in transition and this information comes from various sources and requires context processing. The clients' marketing campaigns are often not shared with the company and data can be obtained using context monitoring facilities. The Buffer warehouse adjustment implies that parcels are stored in intermediate facilities if lockers are full and these facilities are often identified in a dynamic manner. Clients dispatch parcels only if there are free lockers in the case of the Storage at the client side adjustment.

Table 2. Capability description

Name	KPI	Context	Adjustment
Automatic parcel delivery	Terminal load percentage Late deliveries Returns to warehouse Number of parcels processed	Calendar events Season Number of parcels in transition Clients marketing campaigns	Buffer warehouse Storage at the client side Transfer of portable storage modules Variable storage size
Spare parts management	Order fulfillment rate Delivery time Demand Delivery cost Fixed cost	Shipments transit time from manufacturers Data accuracy Season	Dynamic stock planning Direct shipment Transshipment among warehouses
Incident management	Number of new/open incidents Resolution within SLA	Irregular events Seasonal events	Resource allocation Scheduling of services
User satisfaction management	User satisfaction level Number of logged user errors Number of helpdesk request	Computational load Irregular events Seasonal events	Provisioning of computational resources Automated recommendations
E-health service provisioning	Treatment waiting time Treatment success rate Number of customers requests Customer request response time	Season Irregular events	Dynamics resource planning

That does not incur direct costs but might lead to the loss of client's goodwill. The Transfer of portable storage modules and Variables storage size adjustments dynamically change physical dimensions of stations and lockers, respectively.

The CDD approach envisions that best practices defined as patterns can be identified and used to deal with various unexpected contextual situations including usage across various related patterns. E.g. context elements such as season and events are present in several of the identified capabilities. However, it has to be acknowledged that they are measured very differently from case to case. Hence, the response mechanisms (i.e., adjustments) are transferable only at the high level. The common adjustments are resource allocation and used of various advanced inventory management policies.

The results of the workshop were processed and initial capability model was created for the Automatic parcel delivery capability (Fig. 2).

The model shows KPI (identified by suffix "KPI"), context (identified by suffix "Ctx" and adjustments (identified by suffix "Adj") discussed at the workshop. According to the CDD methodology, context elements are associated with capability by using a

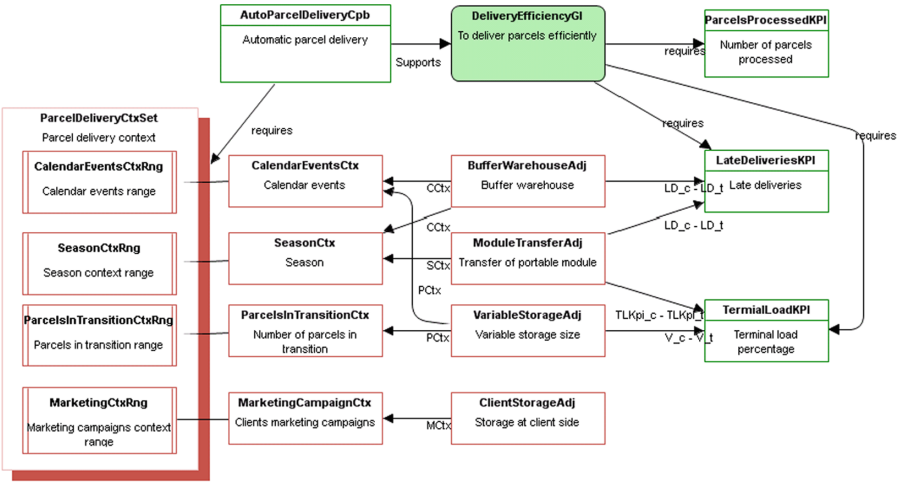

Fig. 2. Initial capability model of automatic parcel delivery

bundle of related context elements or context set. This aspect was not explicitly discussed during the workshop. The goals are kept at a relatively high level of abstraction because they were not explicitly discussed at the workshop. The associations among the elements are introduced. They show, for example, the *VariableStorageAdj* uses *CalendatEventsCtx* and *ParcelsTransitionCtx* context elements and attempts to improve *LateDeliveryKPI* and *TerminalLoadKPI*. *ParcelsTransitionCtx* is not used in *BufferWarehouseAdj* because this adjustment has a longer planning horizon. It is also observed that there are no KPI associate with *ClientStorageAdj*. Although it is permissible to have goal independent adjustments, this observation suggests that not all of the KPIs have been identified during the workshop.

Thus, representation of the workshop finding in the form of the capability model introduces technical aspects of capability design, clarifies associations among the elements and identifies potentially missing elements of the model.

5 Conclusions

The workshop was successful in introducing the CDD methodology to the industry representatives and the dialogical approach proved more efficient than previous attempts based on presentations and discussions but without actual modeling. The usage of the capability definition template rather than a fully-fledged modeling effort was efficient time-wise because it required less time for explaining the modeling process and left more time for the actual definition of capabilities. This approach also has some limitations. There is a relatively wide gap between naming of the concepts and a reasonably complete capability model. The experiment does not provide evaluation of the overall model or the methodology as a whole. However, the experiment

shows that the capability concept is considered useful and KPIs, context and adjustments are useful for analyzing the capabilities.

The workshop with industry representatives was one of several activities aimed at promoting the CDD methodology to industry representatives. In terms of the DSR, the workshop contributed to additional validation of the design artifact as well as helped to explicate additional problems related to the adoption of the CDD methodology in practice. In response to the latter, a lightweight version [23] of CDD was proposed, particularly to advance its usage among start-ups and small and medium size enterprises.

Currently, it is too early to judge about the potential for take-up of the methodology in industry. However, two applied research and technology transfer projects were initiated as the result of the workshop. In these projects, the CDD methodology is not used as a whole; rather its selected method components are used. This is in accordance of what was envisioned during elaboration of the methodology by making it a component-based methodology [24, 25].

References

1. Teece, D.J.: Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. Strateg. Manag. J. **28**, 1319–1350 (2007)
2. Open Group. TOGAF-enterprise architecture methodology, version 9.1 (2012). http://www.opengroup.org/togaf/
3. Open Group. ArchiMate 2.1 Specification. The Open Group, December 2013 (2013)
4. Zdravkovic, J., Stirna, J., Grabis, J.: A comparative analysis of using the capability notion for congruent business- and information systems engineering. CSIMQ **10**, 1–20 (2017)
5. Grabis, J., Henkel, M., Kampars, J., Koç, H., Sandkuhl, K., Stamer, D., Stirna, J., Valverde, F., Zdravkovic, J.: D5.3 The final version of Capability driven development methodology, FP7 proj. 611351 CaaS. https://doi.org/10.13140/rg.2.2.35862.34889
6. Bravos, G., Grabis, J., Henkel, M., Jokste, L., Kampars, J.: Supporting evolving organizations: IS development methodology goals. In: Johansson, B., Andersson, B., Holmberg, N. (eds.) BIR 2014. LNBIP, vol. 194, pp. 158–171. Springer, Cham (2014). https://doi.org/10.1007/978-3-319-11370-8_12
7. Mårtensson, P., Lee, A.S.: Dialogical action research at Omega Corporation. MIS Q. Manag. Inf. Syst. **28**, 507–536 (2004)
8. Bērziša, S., Bravos, G., González, T., Czubayko, U., España, S., Grabis, J., Henkel, M., Jokste, L., Kampars, J., Koç, H., Kuhr, J., Llorca, C., Loucopoulos, P., Pascual, R.J., Pastor, O., Sandkuhl, K., Simic, H., Stirna, J., Giromé, F.V., Zdravkovic, J.: Capability Driven Development: An Approach to Designing Digital Enterprises. Bus. Inf. Syst. Eng. **57**, 15–25 (2015)
9. Grabis, J., Kampars, J.: Design of capability delivery adjustments. In: Krogstie, J., Mouratidis, H., Su, J. (eds.) CAiSE 2016. LNBIP, vol. 249, pp. 52–62. Springer, Cham (2016). https://doi.org/10.1007/978-3-319-39564-7_5
10. Wissotzki, M.: An exploration of capability research. In: Proceedings-IEEE International Enterprise Distributed Object Computing Workshop, EDOCW, pp. 179–184 (2015)
11. Offerman, T., Stettina, C.J., Plaat, A.: Business Capabilities: A Systematic Literature Review and a Research Agenda (2017)

12. Mohd Salleh, N.A., Rohde, F., Green, P.: Information systems enacted capabilities and their effects on SMEs' information systems adoption behavior. J. Small Bus. Manag. **55**, 332–364 (2017)
13. Aldea, A., Iacob, M.E., Van Hillegersberg, J., Quartel, D., Franken, H.: Capability-based planning with ArchiMate: Linking motivation to implementation. In: ICEIS 2015-17th International Conference on Enterprise Information Systems, Proceedings, pp. 352–359 (2015)
14. Blomqvist, S., Halén, M., Helenius, M.: Connecting enterprise architecture with strategic planning processes: case study of a large Nordic finance organization. In: Proceedings-17th IEEE Conference on Business Informatics, CBI 2015, pp. 43–50 (2015)
15. Mohan, K., Ahlemann, F.: Understanding acceptance of information system development and management methodologies by actual users: a review and assessment of existing literature. Int. J. Inf. Manage. **33**, 831–839 (2013)
16. Yilmaz, N., Stirna, J.: Factors influencing productization of enterprise modeling: a qualitative inquiry into the scandinavian strand of methods and tools. In: Ralyté, J., España, S., Pastor, Ó. (eds.) PoEM 2015. LNBIP, vol. 235, pp. 193–208. Springer, Cham (2015). https://doi.org/10.1007/978-3-319-25897-3_13
17. Persson, A., Stirna, J.: Organizational adoption of enterprise modeling methods – experience based recommendations. In: Frank, U., Loucopoulos, P., Pastor, Ó., Petrounias, I. (eds.) PoEM 2014. LNBIP, vol. 197, pp. 179–192. Springer, Heidelberg (2014). https://doi.org/10.1007/978-3-662-45501-2_13
18. McBride, T., Henderson-Sellers, B.: A method assessment framework. In: Ralyté, J., Mirbel, I., Deneckère, R. (eds.) ME 2011. IAICT, vol. 351, pp. 64–76. Springer, Heidelberg (2011). https://doi.org/10.1007/978-3-642-19997-4_7
19. Kacmar, C.J., McManus, D.J., Duggan, E.W., Hale, J.E., Hale, D.P.: Software development methodologies in organizations: field investigation of use, acceptance, and application. Inf. Resour. Manag. J. **22**, 16–39 (2009)
20. Sandkuhl, K., Seigerroth, U.: Balanced scorecard for method improvement: approach and experiences. In: Reinhartz-Berger, I., Gulden, J., Nurcan, S., Guédria, W., Bera, P. (eds.) BPMDS/EMMSAD -2017. LNBIP, vol. 287, pp. 204–219. Springer, Cham (2017). https://doi.org/10.1007/978-3-319-59466-8_13
21. Hevner, A.R., March, S.T., Park, J., Ram, S.: Design science in information systems research. MIS Q. **28**(1), 75–105 (2004)
22. Baskerville, R.: Investigating information systems with action research. Commun. Assoc. Inf. Syst. **2**(19), 1–31 (1999)
23. Koç, H., Ruiz, M., España, S.: LightCDD: a lightweight capability-driven development method for start-ups. In: Krogstie, J., Mouratidis, H., Su, J. (eds.) CAiSE 2016. LNBIP, vol. 249, pp. 15–26. Springer, Cham (2016). https://doi.org/10.1007/978-3-319-39564-7_2
24. Sandkuhl, K., Koç, H.: Component-Based Method Development: An Experience Report. In: Frank, U., Loucopoulos, P., Pastor, Ó., Petrounias, I. (eds.) PoEM 2014. LNBIP, vol. 197, pp. 164–178. Springer, Heidelberg (2014). https://doi.org/10.1007/978-3-662-45501-2_12
25. Stirna, J., Zdravkovic, J., Grabis, J., Sandkuhl, K.: Development of capability driven development methodology: experiences and recommendations. In: Poels, G., Gailly, F., Serral Asensio, E., Snoeck, M. (eds.) PoEM 2017. LNBIP, vol. 305, pp. 251–266. Springer, Cham (2017). https://doi.org/10.1007/978-3-319-70241-4_17