

# Capabilities and Work Practices - A Case Study of the Practical Use and Utility

Anders W. Tell, Martin Henkel

Stockholm University, Stockholm, Sweden,  
{anderswt, martinh}@dsv.su.se

**Abstract.** There exists a multitude of approaches, frameworks, and methods that are used for analysis, design, and planning of strategic capability systems, military capabilities and IS/IT systems. These approaches commonly dictate a single capability definition and practice that should be applied across an organisation or project. This paper examines the practical use and utility of the capability concept with special focus on examining differences between work practices of people with similar job to be done. The examination was done through a case study of a mega-scale programme. It was found that there exist varying common-sense meanings and overlaid practices of the idea capability. When the concept of capability evolved through learning-by-doing, usage of the capability concept was considered as very valuable, this opposed to when a ready-made enterprise architecture framework was introduced. Furthermore, analysis revealed that reported uses were many, varied significantly between work practices, and sometimes incoherent, contradictory and vague.

**Keywords:** Capability, Enterprise Architecture, Performance management, Situational Knowledge, Situational Viewpoint, Air Traffic management.

## Introduction

The concept of capability provides the basis for a genre of analysis, design and planning methods. The concept has a long history and has acquired common-sense meanings. A search on the keywords ‘capability’ and ‘ability’ in the abstract and citation database Scopus reveals a coverage of over 27 different subject areas. The wide spread and general sense of capability may become a problem when introducing capability based methods, such as NAF [1] or CDD [2] into larger organisations with a multitude of departments, professions, roles, positions, jobs-to-be-done, and complex use situations. If the method or framework provides a single definition, kind or type of capability and fixed recipes on how to think about and work with capabilities it may be problematic to fit it into complex use situations. Thus, the question arises if a single definition fit with all job descriptions and the variety of work-to-be-done?

In this paper, we examine how different work practices use and experience the utility of the concept of capability. Our focus is to examine the use and utility in a coherent and large-scale setting, such as large programme or projects, where there is an explicit or implicit desire so align the use of the concept among work practices.

The use of the concept of capability as a way to describe organisations stems from the field of strategic management where it was used in the 90ties to describe resources and core competencies that a company needs in order to compete in a market [3]. Further uses of the concept in a descriptive manner point towards its use for documenting capabilities as the combination of resources, such as physical, human and intangible resources [4]. It can be seen from existing use that the concept has lately been used from different perspectives, such as functional grouping [5], process oriented perspectives [6], or actor centred perspectives [7]. It also has been proposed that information system design could be based upon the use of capabilities [2]. Thus, that the use of the concept of capability differs between application areas is clear. However, the examination in this paper focuses on the differences in use within a single programme. This makes it possible to highlight the differences in use that exist even though there is a shared understanding of the programme goals, and a potential need to conciliate the perspectives within the programme.

A work practice refers to interweaved skills, knowledge, tools, and exerted typical actions to perform something. Examples of practices are carpeting, authoring, organisation and information systems design. While a practice is difficult to define, [8] point out five characteristics that show that a practice should be interpreted in a wider sense compared to a profession: 1) it's a process of doing something, 2) it contains repetitions of actions, 3) it can be performed correctly or incorrectly, 4) it rests on accumulated knowledge 5) it combines use of communication and the material world. Furthermore, [9] points out that a practice is driven by tacit knowledge. Commonly, activities carried out in an organisation can be seen as a fluid scene of multiple practices carried out at the same time [10]. In this paper, we use the concept of practice to characterise the work done within the studied programme. In our examination, we refrain from used fixed roles or professions, to avoid preconceived perceptions of the work being done.

The approach of this paper is an interview based case study of a mega-scale programme that aims to reform Air Traffic Management (ATM). The very large-scale size, political and economic natures, and performance orientation of this program provides a relevant and interesting setting for the study of the use of capabilities. A conscious decision was taken to ask questions about use and utility of capabilities instead of capability definitions. For a throughout discussion about existing definitions of capabilities we refer to [11].

The problem addressed in this paper is that there is a lack of knowledge on the potential variety of use of the capability concept within a project or programme. The research questions addressed in this paper are part of a design science inquiry into the problems and requirements that influence the design of a situated capability Viewpoint, an (Enterprise) Architecture Viewpoint [12]:

RQ 1. What are the uses and utility of using the capability concept?

RQ 2. Are there differences in the application of the concept of capability between work practices in a project or programme?

The contribution of this paper are firstly insights into the use and benefits of capability in a large-scale setting with a multitude of work practices. Secondly, that several work practices are interested in capability but may not be well served using a framework with a single definition.

The paper is organized as follows: Section 2 presents the case and research method. In Section 3 the thematic coding and analysis of the case study are presented. Section 4 discusses additional results and findings, and in section 4 we conclude.

## 2 Case and Research method

The case studied was a research programme, with a +5 Billion Euro budget, which aims to reform Air Traffic Management (ATM). It is part of an initiative launched by the European Commission. It is a performance approach to meet future efficiency, capacity, environmental and safety needs at a European rather than a local level.

The programme aims to eliminate the fragmented approach to ATM, modernise the ATM system, synchronise key stakeholders (airlines, air navigation service providers, airports, network management, meteorological and aeronautical information service providers, suppliers and manufacturers) and federate resources. The programme is divided into three key phases:

The *definition phase* (2005-2008) was a *feasibility study* focused on delivering a vision and plan of action for the way ahead. The work was organised around a political process, and the creation of a fixed set of deliverables, including the ATM master plan and work programme.

In the *Development phase* (2008-2016) the nature of the programme shifted to a *structured engineering approach*. The work programme included well over 200 projects and was broken down into several levels of work packages and projects addressing various distinct areas such as business cases, master planning, ATM Architecture based on a modified version of NATO Architecture Framework (NAF), operational topics, technical systems, and system wide information management. The large-scale System Engineering (SE) approach included requirement development & management, enterprise architecture views development & management, validation & verification exercises, technical coherence, and ATM performance monitoring. The used framework includes capability modelling with a set of capability views and a single capability concept.

The programme continues with industrial research and large-scale demonstrations.

The main author of the paper participated in the development phase in various capacities as a nationally appointed expert.

**Research methodology:** The research method used in the study was an empirical inquiry in the form of a case study [13]. The study aims to inform the design science inquiry by characterising the overall situation and problems occurring when a concept such as capability is used within several work practices. Data were gathered through semi-structured interviews with experts in five identified work practices that were using or expected to use capabilities. The interview questions were focused on the participant's experiences of their own use and utility of the concept of capability. We explicitly avoided asking about how they defined "capability". From each work practice, at least 2 persons were interviewed, in total 11 persons. All interviewees were assigned to the programme as senior experts.

The acquired **data** was analysed using thematic analysis [13] and the process outlined by Virginia Braun & Victoria Clarke [14]. The analysis focused on surface and

semantic meanings of what participant said and not on an examination of underlying meanings [13].

### 3 Results and analysis

The results presented in this section are grounded in a thematic coding and analysis of 2 groups of questions. The first group covers the interviewee's *use* of the concept of capability in their own work. The second group covers perceived *positive and negative utility* of their use.

Based on the interviews within 5 work practices, we identified 14 general themes, representing concrete use and utility of the capability concept within the case (corresponding to RQ1). We also identified cases where there were little and no use of the concepts. This is further described in Section 3.1.

All uses and utilities found were cross-coded with identified work practices in order to be able to analyse and characterise differences between work practices (corresponding to RQ2). The results of this work is summarized in Section 3.2.

#### 3.1 Use and utility themes

During the interviews, it became clear that the participants were using the concept 'capability' in a variety of common-senses and purposes. Generally, the concept was used within activities such as an instrument for acquiring consent, modelling, and planning (table 1). The identified themes represent broad areas of application of the concept of capability and also utility of use. Two additional themes were found, describing the extent of use rather than an application area, these were labelled "Little Use" and "Not-Seen Utility".

The theme *Little Use* of the capability concept relates to statements where capabilities were used very little or not used, even if there were personal or programme expectations that capabilities could or should be used. For example, an interviewee in the operational work practice stated;

*"... my impressions is that the use of capabilities came in within [the programme] very late so I didn't use them very much because we focused on modelling processes and activities ..."*

In other cases, "old fashioned concepts" were used instead of capability;

*"... we classified the operations into old fashioned concepts or OI steps from mostly budgetary team. And the technical systems were broken down into systems, sub systems, non-functional system." [Technical work practice]*

The theme *Not-Seen Utility* relates to that interviewees expressed that there was no utility with the capability concept, a utility was "supposed to", or is expected but had not yet to materialised. Specifically, the Strategy & planning and Operational work practices reported not-seen utilities. From Strategy & planning work perspective;

*"We start seeing the benefits but it's not yet the institutionalized. This is still something that is used for the architecture ... but not for communicating we don't talk in terms of capabilities, not yet. I feel we are moving there, but not yet"*

Table 1: Summary of themes for use of capability and utility of use found in the case

Theme of use and utility	Description
Managing Change, Accepting, Agreeing	Manage change, acquiring of buy-in, obtain acceptance and agreements amongst participants.
Creating Awareness, Understanding	Discover and manage knowledge.
Visualising	Visualise the big picture and dependencies.
Communicating	Communicate work and progress in programme.
Shared stakeholder point-of-views	Bring team members together internally and with external parties, focus, and narrow the scope of discussions.
Architecture Management	Manage the ATM architecture model, its consistency, and the architecture model repository.
Modelling	Model capabilities within the ATM architecture and the ATM system, during R&D and deployment phases.
Mapping and Linking	Link capability with other constructs in the programme and the ATM architecture model.
Designing & Analysis	Design and analyse the ATM system, finding gaps and to solving problems early.
Performance Management	Integrate capabilities with the performance framework
Master planning	Develop and maintain the ATM masterplan
Investment planning	Calculate and assess benefits, costs, and investments for stakeholders.
Manage Programme and Work	Manage the programmes work, integration of deliverables, and rewriting performance and validation targets
Integration with External world	Integrate the ATM architecture with external (international) efforts

### 3.2 Use and utility in Work Practices

The reported uses and utilities varied across work practices. In this section, we characterise work practices by highlighting distinguishing reported uses and utilities. The work practices were selected from the programme based on similarity of work and that the participants were using or expected to use the concept of capability.

Table 2 Description of work practices (WP) with coherent work to be done

WP	Phase	Description of participants work to be done
Feasibility Study	Definition	Feasibility study, overall strategy development, and content integration
Strategy and Planning	Development	Top level policies and strategy development, and ATM master planning
Architecting	Development	Architecting the ATM Architecture
Operational	Development	Operational concepts development
Technical	Development	Technical system and services concepts development

### **3.2.1 Feasibility study**

The interviewees from the feasibility study work practice were distinctly the most positive of all work practices to the use and utility of capability:

*"It was absolutely vital to use capabilities of course because there wouldn't have been a result. We wouldn't have been able to get to go forward and get to where we are"*

The work practices Feasibility study and Strategy & master planning shared many utilities, such as managing change, acquire buy-in, as a tool to bring people together internally and externally, linkage to performance expectations, integrated deliverables and ATM masterplan. Noteworthy is that the concept of capability was referred to as Capability Level in the development phase ATM master plan.

The meaning and use of capability evolved through a learning by doing process. As a result, capabilities were considered as important talking points that established a shared language for explorations of ATM system factors and investments that contribute to ATM performance. A noteworthy point is that the capability talking point enables a respect for *"decision making in the firm and the people's mind"*, since they can implement a capability in their own way.

### **3.2.2 Strategy & planning**

The interviewees from the Strategy & planning work practice were supporting the use of capability and optimistic that a use of capabilities could be useful, although they often expressed that they have not yet seen the expected utility in the programme.

*"It is accepted that they [capabilities] are visible, they are restructuring [the programme] and they are helping the architecture, ..., from our point of view we are still very immature, we still need to better understand why we need them."*

For master planning, capability was used as a mental concept but not used in the ATM master plan.

### **3.2.3 Architecting**

The interviewees from the Architecting work practice were the main users and advocates of the use of capabilities in the programme, since they were the guardians of the enterprise architecture framework. They were well aware of the challenges:

*"its maturing journey we had a problem to solve and so we went out to solve it. Over time it's matured and we've looked at ideas and moving to the capability driven architecture approaches I think is well understood ..."*

They were positive to the use of capabilities and saw capabilities as a tool to interconnect the programme deliverables in order to deliver performance to stakeholders.

*"... if we collected the information together that were related to what was being produced in the program and linked it against a framework and showed how it linked across the program we could start look at the gaps and overlaps inside the program."*

### **3.2.4 Operational concept development**

The interviewees from the Operational work practice reporting that they not did use and didn't consider capabilities as relevant until the end of the development phase.

*"I believe it has very little value for me in everyday work."*

Although, they noted that operational activities in their architecture framework were linked to capabilities, but not to their conceptual work. They wondered why, since operational concepts are strongly related to the overarching performance framework and performance targets (see 4.2). Noteworthy is that interviewees from other work practices mentioned operational activities.

### **3.2.5 Technical concept development**

The interviewees from the Technical work practice were not actively developing capabilities, although they mentioned technical capabilities. Instead, they were primarily mapping and linking their 'old-fashioned' engineering artifacts such as system, resources, and services to capabilities.

*"But when you're in complex system like in the ATM, it's difficult when all the systems are evolving to have a clear view of what are the input and the output of the overall systems of the overall capabilities, while they are still moving in R&D."*

Interestingly, capabilities were seen as add-ons.

*"So, I think for the project members the operational activities and other requirements were considered to be more basic and then the capabilities as something add-on to get to the next level of quality but not the most important."*

In several cases, they mentioned that capabilities and their use were not clearly defined, communicated or supported.:

*"...I don't know what capabilities are.", "But for me it's for, it's a mess.", "... I have not seen the very clear purpose and plan for how this enterprise architecture was going to be used and for what in this program."*

## **4 Discussion**

The interviews produced a wealth of data and findings. In this section, we discuss findings that have an impact on answering the research questions. We summarise with a discussion about differences between work practices.

### **4.1 Vagueness in reported use and utility**

In several cases, interviewees made statements that were vague in the sense that it was unclear if they referred to real experienced or potential use, and to perceived or expected utility. When asked about which specific problems and decisions capabilities helped with, the answers and examples became significantly fewer and vaguer.

The reported negative utilities were fewer than the positive and sometimes contradicted reported positive utilities. A noteworthy negative utility from the Technical work practice is that a capability can be considered as too abstract and lead to misinterpretation, which can give a false impression of dependencies.

*"...there is always a risk that if the capabilities and both the concept and the actual identified capabilities are not every well-defined and/or not very well understood, there might be some result which can be interpreted in many different ways. And then there is a risk of this information actually does not contribute to a clearer picture but the opposite."*

A question arises, if the vagueness depends on that capability came in late and early use was a framework solution looking for a problem?

## 4.2 Capability variety

An examination of capability meanings and kinds amongst the interviewees reveals that capability was a multi-sense word. We decided to code major capability meanings. The codes have not been analysed in detail yet, although the variety of meanings is noteworthy. Capabilities were referred to as: Capacity, Enabling Technology, Infrastructure, Master planning, Needs, Operational, Organisational, Outcome, Skilled People, System, Talking point, Technical.

A leading architect reported the challenges:

*“It’s also a frequently used concept and not always used in the same way. So, you are up against people who come with it with a certain perception, and expect it to be used in a particular way, and have to work with them to try and make sure the way it’s used it fits with the framework, which you’ve adopted.”*

In a quote from the operational perspective, a question is raised on why operational concepts are not considered as capabilities or linked directly to a capability.

*“The ATM architecture work is to my understanding mapping capabilities but it has not been directly linked to the conceptual work which is really something that is, one can ask why?”*

From the technical work practice, a contradiction is reported.

*“I would say it was maybe not that clearly defined with these three kinds of capabilities, but in reality, it was operational capabilities what we talked about.”*

The idea of capability played a central role in the feasibility study and in the first definition phase ATM Master Plan, where investments lead to higher ATM Capability Levels, which enable higher ATM Service Levels that satisfy performance requirements. In the development phase, the direction of influence changed to - service aims to achieve capability.

## 4.3 Learning by doing vs. engineering approach

The attitudes towards the utility of capability were, in general, significantly different between the definition and development phases. In the first phase, capability was considered as vital, something to talk about, something important that people wanted and invest in. While in the second programme phase the attitudes were in general neutral to cautiously negative and different across work practices.

Architects considered use of capability as positive and a maturing journey while the operational concepts developers did not see the value in use. The interviewed master planner thought about planning in terms of capabilities but did not explicitly work with capabilities in the ATM master plan. The technical concept developers considered capability as hard to understand and work directly with. For Strategy and planning, the expected positive utilities were not seen and use was not yet mature and institutionalised.

There are several possible explanations for this distinction between phases. When the development phase started, new experts arrived and the approach changed to a



comprehensive systems engineering approach, leading to delays in uptake and methodological maturity.

Another and complementary explanation is that the first phase evolved into a use of capability through a learning by doing process, while the second phase introduced a ready-made and military framework, with a single capability. This leading to a situation where each project, with an assigned jobs-to-be-done, were externally introduced to one and a specific capability construct that may not match their actual needs, work and mental models.

A question arises, whether learning-by-doing was a better process to adjust and situate the idea of capability to fit with work practices and their work-to-be-done?

#### **4.4 Superimposed aspects and practices on-top of capability**

An examination of the use-themes revealed that capability was expected to be a *highly interlinked construct* in the programme. In a surface examination, we identified a number aspects that were superimposed and overlaid on top of the general concept of capability. Each work practices empathised different kinds of aspects. *Aspects*: talking point of the most important topics, tool for acquiring consent, mapping to and linking between underlying concept (business, operations, technical, etc.), allocation of resources and business case, benefits realisation, performance framework, specification and realisation, resource configuration, influence diagram, validation exercise, deployment solution, master planning and change.

A question arises, can the identification and exploration of superimposed aspects provide hints to where and how the concept of capability fits within strategy, business, operational technical, and/or engineering methodologies?

#### **4.5 Difference between work practices**

The reported uses and utilities varied across work practices, see sections 3 and 4.1 to 4.4. Each work practice was found to exhibit distinguishing uses and utilities, see sections 4.1 to 4.4. No work practice rejected a use, although their experiences and attitudes ranged between positive, wait-to-see, neutral, and negative.

While it is easy to assume that an engineering approach delivers a coherent view of a concept such as capability, the results indicate that the views were manifold and varied. The late implementation may be an explanation together with that a single definition of capability may not be sufficient to cater for various work-to-be-done.

## **5 Conclusion**

In this paper, we have examined how people performing different work practices use and experience the utility of the concept of capability. The mega-scale programme was and continues to be an effort with high ambitions, with participation of many kinds of domain experts. The results indicate that the concept of capability appeared in the programme in a variety of meanings, and was expected to be highly interconnected with work done throughout the programme.

We found that when the use of the concept of capability evolved through learning by doing it was perceived as significantly more beneficial than when it was reintroduced through a systems engineering approach and an architecture framework with a single definition of the concept of capability.

The reported uses and utilities were many, varied significantly between work practices, and sometimes incoherent, contradictory and vague. We also found cases where capability was not or little used, and cases where the perceived utility was not seen or not yet mature.

The idea of capability was considered as a talking point, something of importance with capacity, and something that contributes to performance. As such it has a place in enterprise architecture frameworks, although the study raises questions. Should the concept of capability be adapted to and situated by people's work they do with others, to establish actual use and materialised utility across work practices? How should the concept of capability be constructed to align well with strategic, business, operational, and technical concepts such as those present in the programme? This study further informs the ongoing development of an artefact that addresses these questions.

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