

# Coordination in the Large: A Research Design

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## ABSTRACT

The public sector is facing a massive digitalization process in order to provide faster and more automated services to the public. Several new projects in this sector are developing software using agile methodologies. There is, however, a lack of empirical research on how these methods are used in practice, how they are adapted to these complex and large settings, and how the projects achieves good coordination. In this paper we outline our initial research proposal to study a large-scale agile development program in the public sector. Our primary focus is to make sure the research is grounded in the reality of the practitioners and so we seek to follow an engaged scholarship model in order to make our research relevant as well as rigorous.

## CCS CONCEPTS

•Software and its engineering → Agile software development;

## KEYWORDS

Large-scale agile development, research design, public sector, coordination

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## 1 INTRODUCTION

Large scale development programs in the public sector today is often critical for our society, yet most advice on how to conduct such projects are based on word of mouth and individual experience rather than empirical research. This paper details parts of our initial research plan for a longitudinal study of just such a system, in order to gather empirical evidence on the processes necessary to scale agile methods in a large and complex project setting. There are several researchers involved in the project and several focus areas, but for this workshop paper we will go into details on the area of inter-team coordination.

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Agile methods have grown from the initial recommendation of small co-located teams, to increasingly being used in large projects with multiple development teams, introducing a host of new problems relating to complexity, coordination, integration, and stakeholders [3, 4, 13]. Coordination, which is our focus for this paper, has been investigated at the intra-team level [16] for agile teams, yet scarce literature exists on the effect of inter-team coordination [14] in an agile setting. This sentiment was also echoed by the workshop participants of the 5th International Workshop on Large-Scale Agile Development.

In this paper we present our research plans for a longitudinal study of an ongoing software development project in a large public welfare organization. More specifically we will examine how coordination across teams is carried out in the project. Thus we position ourselves within areas marked as high priority in previous efforts at establishing a research agenda within large-scale agile [4].

We adopt a definition from [7] in that coordination can be understood as "management of interdependencies between activities". Where we understand interdependencies to include sharing of resources, synchronization of activities, and prerequisites activities. We also adopt a definition from [11] in our understanding of coordination mechanisms as "the organizational arrangements, which allow individuals to realize a collective performance".

Concerning which teams to study we lean on the definition of a multi-team system (MTS) in [9] "...two or more teams that interface directly and interdependently in response to environmental contingencies toward the accomplishment of collective goals. MTS boundaries are defined by virtue of the fact that all teams within the system, while pursuing different proximal goals, share at least one common distal goal; and in doing so exhibit input, process and outcome interdependence with at least one other team in the system". This definition encompasses not only the core development team, but all teams and stakeholders involved in making the final product. This might be to broad a definition and further narrowing of scope might be necessary as the project progresses.

The project in questions is part of a large initiative to modernize the organizations ICT systems and has a budget of more than 130M Euro. The project is characterized by high complexity and many system integrations. We are mainly interested in how the project participants deal with the scale and coordination aspects of the project.

In the rest of the paper we will first describe relevant theory for our initial research area. We then provide an overview of the case project, give a general research design, before going into more

detail on the initial research phase. We conclude by summing up future work in an initial research agenda for the project.

## 2 BACKGROUND

Our initial interest in the field relates to coordination, we briefly introduce the area here.

### 2.1 Coordination

Coordination is more important to team performance in large development projects than in small one-team projects [5]. Marks et al. [8] also suggests that in multi-team systems cross-team processes appear to predict performance more than within-team processes.

Agile methods were originally designed to cope with uncertainty and change for small teams. These methods "de-emphasize traditional coordination mechanisms such as forward planning, extensive documentation, specific coordination roles, contracts, and strict adherence to a pre-defined specified process" [16] and mainly promote informal coordination [19].

Strode et al. [16] provides a comprehensive review of coordination studies in agile software development projects, and have developed a model of coordination strategies at the team level for such projects. They describe strategies in terms of synchronization, structure and boundary spanning.

When scaling agile development, coordination across teams becomes a major challenge. Rolland et al. [13] investigated fundamental assumptions within large-scale agile development, and characterises such projects as having complex knowledge boundaries within them, as well as having an interactive complexity and tight coupling with technology and processes outside the project. Hence, Rolland et al. [13] emphasize that other kinds of coordination, often with actors outside the formal project organization is crucially important. In large-scale projects these actors might vary as the project proceeds, and new actors become relevant to mobilize and enrol in the project. For example, when integrating with an existing IT-system, actors that do maintenance, IT operations, and end-users potentially need to be involved in coordinating activities.

Building on [18], Dietrich et al. [2] suggests three coordination modes that they use in studying multi-team projects. The modes are Group mode of personal coordination (scheduled and unscheduled meetings), individual mode of personal coordination (through horizontal or vertical channels), and impersonal mode of coordination (codified mechanisms like process documentation).

Seeing large-scale agile development as a multi-team system, Scheerer et al. [14] provides an overview of the scarce literature on inter team coordination in large-scale agile development. They draw on the theory of multi-team systems to formulate theoretical coordination strategies based on the amount of three coordination types present in the project: Mechanistic, organic and cognitive coordination.

## 3 CASE

The growing cost of public welfare in many European countries has called for rationalization and streamlining of public welfare services. Automating case work and offering on-line services to the public are important components in this rationalization.

Our empirical work involves the investigation of a large welfare organization that administers a large part of its countrys national budget through schemes such as unemployment benefit, work assessment allowance, sickness benefit, pensions, child benefit and cash-for-care benefit. The welfare organization has approximately 19 000 employees, of which 14,000 are employed by the central government, and around 5,000 are employed by the local authorities. In addition to the local offices, there are more than one hundred special units. The special units perform centralized duties that are not appropriate for front line local offices to perform. The organization was subject to a large public reform in the mid 2000s, where the centrally controlled employment and national insurance administrations was merged with locally controlled social services.

Establishing new integrated ICT solutions was recognized as a prerequisite for the reform. Ideas of one unified system to support the entire organization were however abandoned in favor of smaller, integrated systems. At the time of the merger, the organization had 12 core ICT systems, and close to 300 smaller applications. The oldest system dating back to 1978. Because of the limited time frame, the Government chose to implement the ICT changes in two phases. In the first phase, a new temporary ICT infrastructure based on existing systems was to be rolled out. In the second phase, there would be developed new software systems, better adapted to the needs of the merged organizations. The first phase of the ICT changes was successfully completed in 2010, and the planning of the second phase, which we will refer to as the Modernization program, started in 2012. The Modernization program was organized as three consecutive projects, where the commencement of one project would depend on the successful completion of the former. The projects would gradually replace the old benefits system that had been in function since 1978. The organization administers the payment of 53 individual benefits. Although fully functional, the old system does not allow for major changes to functionality and is hard maintain. It also lacks process and decision support, fails to meet requirements relating to financial regulations and traceability, and has no integration with the organization's standard economy system. The first project in the Modernization program implemented functionality to support legislative changes relating to disability benefits. The project had also planned to develop generic platform functionality that could later be reused when implementing other benefits. Unfortunately, the project was stopped after just 6 months, on grounds of "unforeseen complexity", "unsatisfactory project management" and "a failure to include subject matter experts in the system development process". The project was re-planned, re-organized and completed with reduced scope. Due to the urgency of delivering the Disability reform, the project did not develop a new generic platform. Instead, the reform was implemented on an existing platform.

The next project in the Modernization program, known as Project 2, is ongoing, and will be the focus of our empirical work. The project was approved and initiated in 2016, and is scheduled to last for 3 years. The new system will provide functionality for supporting a reform of legislation relating to Parental Benefit. The reform will take effect from 24. Mai 2019, on which date the new solution must be completed. The project will deliver functionality relating to electronic dialogue between case worker and user, an online self-service solution for end users, and decisions support for

automatic (or manual) processing of applications. The project will also attempt what Project 1 had failed; namely to develop a reusable platform for administering individual benefit payments. The new benefits solution will be integrated with 42 existing systems. Of these, 26 systems will have to be modified. Many of the systems that have to be changed are developed and maintained by external suppliers. Several common public ICT components and services have to be used by the project. These include components for communication with employers, the National registry, authentication, exchange of health information, tax and employment information, secure digital post, and the contact and reservation register. The organization has at any given time a range of ICT projects aiming to change or upgrade the ICT infrastructure. At present, more than 20 ICT projects are in progress. Many of the projects will propose and implement changes to the same systems as the Modernization program needs to change. Many actors and roles are affected by the development of new benefits solution. These include employers, users, health workers, numerous departments within the welfare organization, the responsible ministry, and external suppliers of ICT solutions. External suppliers are both suppliers of systems internal and external to the organization. More than 60 salary and employment systems will have to deliver information to the new benefits solution to ensure automation. All these integrations need to be specified and coordinated by Project 2. Software development and project management has been awarded 2 external contractors. One of the contractors are responsible software development, while the other contractor is responsible for assisting the welfare organization with functional specification and quality assurance.

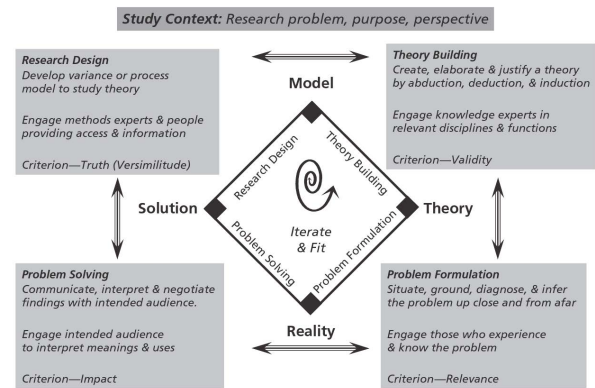
The Parental money project must adhere to a number of laws and regulations. These include Public administration acts, Personal data acts, National insurance acts, Archives acts, eGovernment regulations, and state financial management regulations. All public ICT projects are obliged to follow a number of architectural principles for the public sector. The principles relate to service orientation, interoperability, openness, availability, safety, flexibility, and scalability. All new ICT systems must be resilient to political or legal changes. They must also reuse existing software solutions as far as possible.

A number of actors and roles are affected by the new benefits solution. These include employers, users, health workers, numerous departments within the welfare organization, the responsible ministry, and external suppliers of ICT solutions.

With the long history, complexity, number of integrations, number of actors involved and the dependence on changing laws and regulations, we consider the case an extreme, and it is thus well suited for investigation in a longitudinal case study.

### 3.1 Coordination challenges

At the first glance, several coordination challenges can be identified in the project. First the core development team, consisting of up to six agile teams will need to coordinate between themselves. They will also need to coordinate with the stakeholders to meet the functional requirements specified by the user organization which has enlisted another consulting firm to help them deal with specifications. There are multiple dependencies between projects that use the same infrastructure both internally and externally. A lot of



**Figure 1: The engaged scholarship diamond model. Source: [17]**

effort will be spent on system integrations, often relying on sub-contractors to change existing systems. As such we believe our boundary definition from MTS [9] is appropriate and builds upon the arguments of Rolland et al. [13] that also coordination outside the formal project organization is crucially important. It will be interesting to observe how the coordination challenges are dealt with in the project, and also how the challenges, and attempts to deal with them, change over time. As Jarzabkowski et al. [6] points out, little research exists on how coordination mechanisms change over time.

## 4 RESEARCH DESIGN

We agree with Van de Vens view that the world is complex and it can be better understood through multiple perspectives [17], and we will use his engaged scholarship model to further describe our research. In his book on how to conduct engaged scholarship he underscores that research should be conducted rigorously alongside stakeholders who are connected to and experience phenomena firsthand in order to ground problems, theory and solutions in the real world of practitioners. The engaged scholarship model (See figure 1) consists of four steps: Problem formulation, theory building, research design and problem solving. These steps are iterative and interdependent and seek to provide relevance, validity, truth and impact from a study.

Since the steps of research model is iterative and interdependent we can enter the process from many directions. We have chosen to focus our initial entry on the problem formulation in order to ensure relevance of our study. Even if we ideally should follow all parts of the project, resource constraints force us to focus on some initial areas: coordination which is the focus of this paper, as well as some related areas that are still to be decided. However, these initial focus areas will be grounded in previous attempts at establishing a relevant research agenda within the field [4] and should thus provide an interesting point of entry.

In the next section we will delve deeper into our initial research methods for engaging those who experience and know the problems within the project in order to ensure the necessary relevance of our study.

#### 4.1 Problem

The software systems at the public welfare organization has evolved over several decades, and has been shaped by a variety of political, organizational and technical needs. The evolution has been a constant negotiation process between different, and often conflicting interests. In our research we will investigate how the different interests are communicated, negotiated and coordinated. Both within and hopefully outside the project boundaries, depending on access to informants. We have already mentioned the coordination challenges and these form the basis of our attempt at establishing a problem formulation grounded in the practitioners daily challenges.

#### 4.2 Theoretical frameworks

The theory identified in the background chapter provides a starting point for our theoretical perspective on the case, but a more thorough review of the literature is needed once we have established a grounded problem formulation. Yet, some initial implications can still be discussed.

Rolland et al. [13] influences us to look outside the traditional project boundaries in order to challenge assumptions about coordination in large scale agile development. Jarzabkowski et al. [6] leads us to a longitudinal study in order to study changes over time, and the system definition of Mathieu et al. [9] allows us to define the boundaries of the system outside the core project.

Strode et al. [16] provides a theoretical model on coordination, yet this is at the team level and cannot be applied directly to the inter-team level without further study.

Dietrich et al. [2] suggests three coordination modes, which can be used to organize data and provide insights into which arenas we should look at to achieve a balance in our observations. Likewise Scheerer et al. [14] also provides a model that could influence our collection of data and which coordination modes to look for in our observations.

#### 4.3 Initial research methods

To study this project we intend to use a combination of longitudinal ethnographic studies and document analysis. To cope with the size and complexity of the infrastructure, we intend to use two ethnographic approaches: (1) Several researchers will be involved in the data collection. In this way we can collect samples of parts

that can later be used for generating an understanding of the whole. More researcher are able to collect more samples, that will gives a better overall understanding. (2) We will be studying scaling activities as used by actors in the case. Rather than just trying to match the scale of the object of investigation, we will also focus on the work of actors as they go about knowing and managing that large-scale object [12].

Throughout the longitudinal study, we will need to gather information through interviews. Our approach to interviews will largely be based on the method paper of Schultze and Avital [15]. Seeking to address the lack of methodological sophistication of interview based information system research as noted by Myers and Newman [10], they "...contend that more attention needs to be paid to means of generating rich data during interviews in order to live up to the interview method's promise of gaining insight into people's life world based on their own experience and the meaning they make of it."

Schultze and Avital base their starting point on Alvessons [1] distinction of the neopositivist, romantic and localist perspectives, which differ according to the epistemological and discursive assumptions made of the interviewing endeavor, and his arguments for moving beyond these paradigms in what he calls pragmatic reflexivity. They mix the elements of the romantic and localist perspectives on interviewing and "adopt a view on interviewing that highlights the researcher's active engagement in the interview and the interview as an occasion for producing situated and morally adequate accounts." They introduce three methods for interviews that meets their characteristics for generating rich data. The three characteristics are: (1) grounding the interview in participants' own experiences, (2) acknowledging and valuing participants' narrative (re)construction of their experiences, and (3) providing an explicit framework for guiding the participants throughout the interview to articulate and interpret their experiences.

In table 1 we provide a short overview of the interview approaches suggested in [15]. The appreciative and laddering approach are particularly suited for organizational contexts. However, the photo-diary approach might provide us with a novel approach to study the setting in periods where direct observations by researchers are not feasible. This might possibly alleviate the geographic challenge in the research project in that the researchers are situated in another city than the development project.

**Table 1: Interview methods, adopted from [15]**

Interview approach	Appreciative interview	Laddering interview	Photo-diary interview
Study objective	Core capabilities, design requirements, success factors, and aspirations	Personal constructs systems, its structures and hierarchical relationships	Meaningful incidents and explanation of events, behaviors, and emotions in that context
Interview questions disposition	Positively deviant and action oriented	Structure and pattern seeking	Re-constructive, critical, and self-reflexive
Data generation logic & discussion aids	Reframe lived experience with a positive lens to construct pathways to aspired futures	Compare and contrast through triads and means-ends analysis	Reflect through annotated visual snapshot to capture event and informant's situated emotions and thoughts
Interviewer role	Help with positive reframing	Give examples and probe	Facilitate the interpretation of photo-diary entries

## 5 A RESEARCH AGENDA

Following the diamond model of engaged research we first aim to situate, ground, diagnose and infer the problem or challenges within our chosen research area. This will happen through observations, document analysis and interviews of key stakeholders within the project. We have started with observations and have access to key documents of the project at a secure network in a local office, thereby alleviating some of the challenge with studying the project in a remote location. The first round of interviews will happen in the fall of 2017. Our initial research questions for inter-team coordination are:

- (1) What coordination- practices and artifacts are used in large-scale agile development?
- (2) How are the coordination- practices and artifacts used?
- (3) How do coordination- practices and artifacts change over time?

Building on the feedback from the workshop some items to keep in mind while deciding what to observe and who to interview could be:

- Large-scale agile projects often establish committees and meetings. Study how these arenas coordinate some issues and perhaps fail to coordinate others.
- Focus on episodes where coordination mechanisms break down
- Focus on how various digital as well as physical artifacts are used as coordinating mechanisms (boundary objects)
- Study arenas, artifacts and roles that are supposed to help scaling the project.
- Focus on down-scaling as well as up-scaling
- Focus on formal roles that coordinate, and that over time is substituted with more informal coordination mechanisms.
- Focus on tribes or a cluster of teams, rather than teams themselves.

In addition to identification of the challenges faced by the practitioners, the most critical work in the initial phase will be to identify arenas and artifacts for coordination as well as the structure of teams and how they coordinate between themselves and with exterior teams and stakeholders. Building this dependency map will provide us with an overview that will let us pin point our observations and interviews with greater accuracy.

Building on the identification of the challenging areas and the dependency map, we will move to the theory building part of the method, and see if our identified starting theories are enough to cover the identified problem area, or if other theories might be more relevant.

This will then be followed by the next phases of research design and problem solving, with options of iterating on the phases as needed. With an iteration length of half a year we should be able to conduct four iterations after getting to know the project, the initial one in the fall of 2017, then two in 2018 and one in the beginning of 2019 before the project ends.

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