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Post-adoption of agile in large scale organisations: a case study investigating their interrelation

Master's Thesis in Software Engineering

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Abstract

Agile Software Development has been put forward in response to the industry's need to embrace and adjust to change quicker to be able to deliver higher business value. Even though agile's practices has been originally defined for small, single-product companies, their successful implementations have lead to being recognised by large multi-site and product corporations. Transitioning towards a new work environment embodies challenges of different natures, especially for the bigger, less flexible, companies. This thesis presents a case study performed at Ericsson AB where the challenges related to information and communication flow within a large scale agile organisation are investigated. The findings are then put into organisational context and related to the productivity characteristics of Cross Functional Teams (XFT).

Keywords: agile at scale, information, communication, XFT empowerment

Acknowledgements

Contents

Acronyms & Abbreviations

CVM Competing Values Model

XP eXtreme Programming

XFT Cross-Functional Team

OPO Operational Product Owner

APO Area Product Owner

TPO Total Product Owner

PG Product Guardian

FPjM Feature Project Manager

OPO Operational Product Owner

SM Section Manager

DM Department Manager

DOI Declaration of Interdependence

TC Team Coach

PDU Product Development Unit

PgM Program Manager

PO Product Owner

DSD Distributed Software Development

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Introduction

Agile Software Development's ideas and principles go back to the early 1960s and have been laid down in 2001 with the Agile Manifesto [2]. Ever since the industry's need to adjust and respond to change quicker to deliver higher business value did not lose importance. Partially promising these results, agile is geared towards being applied within small, loosely coupled teams all working mostly independently [63]. Embracing and transitioning towards any new work environment embodies barriers on a people and organizational level, both in their scale of magnitude being company dependent [55]. The general acceptance of Agile grows towards 84% but it is mostly applied within companies of intermediate size [69]. This is where bigger corporations tend to be confronted with a larger set of issues brought about by more defined practices and processes and a strict and well-defined organizational structure [55]. These structures are not always fully static and are often subject to change but still can not be fully left behind in favour of agile as they are motivated by a need for coordination within a big scale.

Research has largely focused on general advice towards transformations from waterfall to agile development models, characterization and assessment of process maturity and the use of comparative measurements for its assessment. Nevertheless, it has been less concerned with belated integration difficulties that follow after the adoption of agile methods [29]. This area is worthy of attention as agile's popularity increases and gains attention from organisations of different context and size.

The thesis reports on a case study conducted over 4 month period in cooperation with one of the software development organisations at Ericsson AB. As organisation's performance fluctuations and discrepancies became visible over the course of the adoption of agile methodologies, it seems that especially issues around communication and information hinder taking full advantage of agile software development. The thesis investigates and questions agile's compatibility with large organizations' structures with a focus on problematic aspects relating to communication, its paths and intersections and the resulting information flow with potential blockages. It contributes to the existing research by exploring challenges associated with information sharing and gathering caused by the interplay of communication and the organisation's scale. Finally, it discovers the organisation's influence on the work of its Cross-Functional Teams (XFTs) from the

perspectives of productivity characteristics.

The study employs both quantitative and qualitative methods in form of daily surveys and semi-structured interviews. Week long daily surveys with the 2 groups of participants of 20 people in total highlight the paths and intensities of different types of communication. Qualitative research grounds the theory and addresses the research questions and is performed with a subset of 13 survey participants of different roles within the organisation.

The results, as illustrated without greater detail in figure 1.1, give an explanation of how challenges within communication and information relate to the benefits of their overcoming and which potential improvements are needed to yield associated benefits. Ultimately, it raises awareness and an understanding towards multiple trade-offs to be made by the organisation within XFTs empowerment, their work flow and environment to impact their productivity.
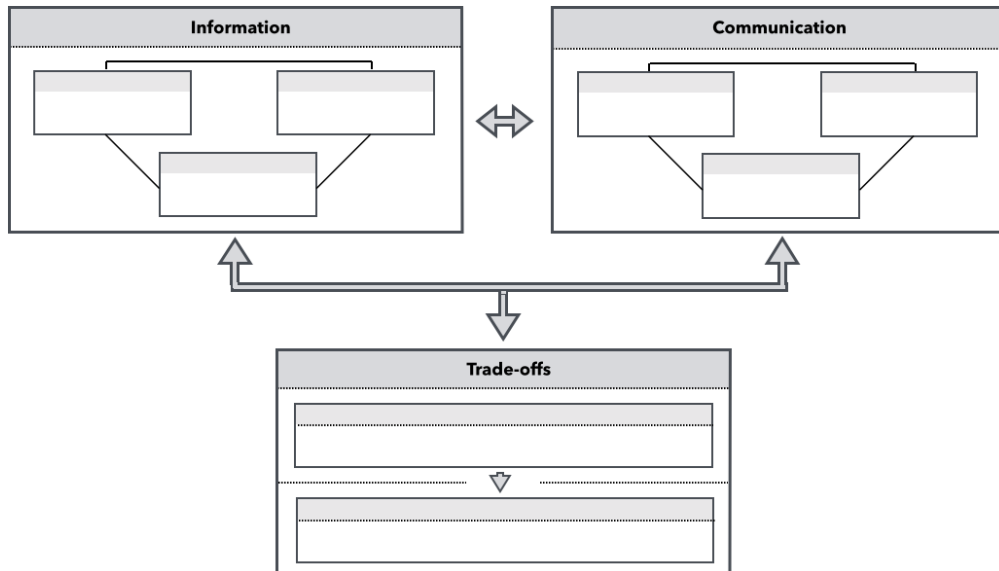
Figure 1.1: Overview of relationship between information, communication and trade-offs

This remainder of this thesis is structured as follows: Section 2 presents related work in the area of Agile at Scale, Agile and Organisational Culture and Agile Coordination and Communication. Section 3 lays a foundation regarding theoretical concepts such as communication and information, heat maps, social networks and organisational structures. Section 4 describes the case study's research methodology from its context to data collection and analysis and elaborates on threats to validity. Section 5 presents findings which are discussed and interpreted in Section 6. Section 7 concludes on the thesis' work while also providing implications and potential recommendations for further research.

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Related Work

Prevailing research of interest for this study mainly spans across areas which cover applying agile methodologies at a large scale. First, a foundation will be laid by briefly outlining agile's principles and values which then leads to more profound explanations regarding agile at scale, the interferences by agile and organisational culture and communication and coordination in agile software development.

2.1 Agile's Principles & Values

Almost all agile practices and methodologies are based upon a set of common values and principles. The original proclamation of agile's values, "The Agile Manifesto", states four core values [2]:

Individuals and interactions over processes and tools.

Working software over comprehensive documentation.

Customer collaboration over contract negotiation.

Responding to change over following a plan.

The values are contemplated with 12 principles which themselves are built around three main categories: delivery, communication and quality [3]. By taking both, values and principles, into account the community around them termed various agile methods, such as Scrum [62], eXtreme Programming (XP) [1] or the Crystal methodologies [13]. These extend agile's basic notion by custom foundations such as Scrum's five values in commitment, focus, openness, respect, courage [57].

It is important to note that agile left alone does not aim at increased productivity or alignment with business expectations. The focus is upon agility itself to move fast without imposed friction embracing change while overcoming its obstacles [38]. In that regard, the manifesto has been scrutinized recently as its values are perceived as

too vague for either academic research, business application or methodology development [37]. Only by using the principles as input to found new methods one can in turn attempt to yield business benefits by increasing productivity, quality and satisfaction [39]. Later, Cockburn [14] defined the Declaration of Interdependence (DOI) linking people, project and value to change the focus from a team to a project level.

Agile promises to yield several benefits such as reduced time-to-market, increased quality and the ability to respond to market change quicker, thus it is becoming a competitive advantage to apply agile correctly [10]. As pointed out by Cardozo et al. [9] successful development tends to have a strong correlation with agile, customer satisfaction and team motivation. Productivity, on the other hand, does not have to precede success and does not always show a causality towards it. Requirement creation and use, for instance, may also cause delays impacting productivity with in turn different impacts upon Scrum teams finally feeding back through the organisation [18]. Adopting some of agile's methodologies is not a silver bullet and a straight route to success. As pointed out by Grenning [26], the utilization of XP embodied unexpected issues mostly caused by varying personal expectations especially on different levels of the organization. The importance of understanding the organization's status quo in order to improve towards a higher level of agility has already been emphasized early by Zhang and Sharifi [74] for manufacturing businesses. Kettunen and Laanti [33] take this approach further stressing the fact that some parts of an organization are more leaning towards agile than others. The same study also identified clear friction between larger corporations' business models and an unpredictable development process. By the same token the agile feedback loop tends to be slown down by defined processes, complex dependencies and product life-cycles.

2.2 Agile at Scale

Agile's growing support and appreciation leads to it being used in bigger contexts or even throughout large organisations, introducing different but also overlapping challenges.

Scaling agile from ground up to a larger number of teams has recently caught attention in industry and literature. Larman and Vodde [38] emphasize that Scrum should not be evolved towards a new general methodology for a scaled context. It should rather remain a set of roles and ideas which every organisation takes into consideration and adjusts to their needs. A loose definition may leave ground for misunderstandings giving little advice for larger organisations but has advantages as it allows for a custom application [37]. Spotify, for instance, [28] embraces the notion of flexible guidelines within agile to scale it differently from suggested approaches by, for example, Larman and Vodde [38]. Scaling in itself should be aligned to the product and its expectations and leave room for design of beneficial communication flows and coordination between teams as it mostly evolves among the multiple teams or even units [38]. In any case, dependencies between teams increase with the number of concurrent working teams in turn causing constraints and blockages on the order of tasks carried out [43]. In this regard Sekitoleko et al. [60] investigate the challenges associated with technical dependencies and point

out that these impinge each other causing domino effects and potentially vicious circles thus blocking progress.

The adoption of agile practices within an established enterprise environment also entails issues extending solutions prescribed by the standard perception of agile at scale [38]. Moving towards a new process and leaving old, established ways of working behind brings change which is not necessarily appraised equally among the organisation [4]. Here especially educating practices and continuous coaching are perceived as vital to success to lower dysfunctional patterns such as managerial control over teams and resources, as high level business procedures can not always be changed and have a proven right to exist. Turk et al. [67] question agile's applicability in any context and suggest classifying processes among a spectrum of agility allowing a more context sensitive application, reasoned in the fact that any distinct mix of methods yields different outcomes for the overall development process. Eklund and Bosch [20] focus on embedded systems development and propose a model for applying agile within a plan-driven corporate environment. Their investigations put significance on interactions between the agile and plan-driven parts of the organisations. They argue that the awareness and definition of interactions regarding requirements, product project gates and validation reduces friction with non agile parts of the organisation. The border should be wisely placed as the application of Scrum solely on a team level excludes synchronisation on a product level and among development teams [35]. By the same token management concerns and long-term planning should be combined with short-term development strategies leading to longer development cycles but improved alignment with product visions.

Boehm and Turner [5] take a broader view and categorise the potential problems to be mostly of three natures: development-, business process or people conflicts. Each of these have different root causes and means to be addressed. Mitigating and avoiding software variabilities and evolving legacy systems can be achieved by thorough planning, risk awareness and creating a customized process. Such methods according to Boehm and Turner [5] do not necessarily always align with agile's principles but are complementary to piloting projects and continuous measurements to react to business process challenges which also embody expectations carried over from previous processes.

Kettunen and Laanti [33] continue from accepting the heterogeneous distribution of agility within an organisation by extending a model to systematically assess agility of separate units. At its current state it envisions understanding and measuring agility through understanding enablers, means and goals. Gained understanding might also reveal local optimizations and unintended accumulations of knowledge.

2.3 Agile and Organisational Culture

In many ways agile embodies essential changes to management and organisational culture feeding back into the demeanour of individuals and the company's values [45]. The transformation moves towards an environment in which decisions are often made collaboratively and responsibilities are shared. This in turn also changes the management's range of duties from controlling most processes to fostering and mitigating obstacles

of development teams [39]. In addition, Schweigert et al. [58] stress agile's significant influence by rather theoretical organisational culture aspects such as power distance and uncertainty avoidance. In this context, Nerur et al. [45] argue that a transition from development- over process- to a people centric environment has taken place. More specifically, Cockburn and Highsmith [15] strongly hold the belief that any project is shaped by personalities, different skills and the working environment paired with the organisational culture. At the same time, organisational culture is formed by focusing on individuals by empowerment and promotion of mutual trust to minimize the need for processes [15]. Ultimately, it helps to form an organic organisation by moving away from its mechanic counterpart to embrace social action on a corporate level [45].

Culture left alone is also often perceived with a predefined and static degree of fitness in terms of its agility [29]. The academia has followed transformations from plan-driven to agile software development in organizations of various size to investigate possible obstacles and encountered issues [36]. Here a lack of profound body of knowledge in the area of agile adoption in large organizations has been pointed out especially as new practices do not tend to be equally appreciated even among employees within a single level of the organisation. In this context Iivari and Iivari [29] abstracts further and applies the Competing Values Model (CVM) of organizational culture to propose a number of hypothesis to mostly relate hierarchical structures with agility. Anyhow, open ends remain in relation to an emerging perspective towards culture in which practices and beliefs are connected and ever changing. In this context, Gallivan and Srite [24] pays significance to the fact that organizational structures and cultures have mostly been analysed separately and calls for an integrated analysis. In particular as company structures tend to be fixed in theory in contrast to their behaviour in a working environment in which participants just be perceived more individual and within a set of layered forces [24]. Individuals are constantly reshaping and reinterpreting a given organisational structure to make it more compatible to a changing internal and external environment [30]. This belief is shared by Robey et al. [50] who points out that organisational learning as a constant persistence of learnings in an evolving environment is usually underestimated in industry.

Schneider [56] looks deeper into the compatibility of cultures, processes and working environments. They suggest a scale of people- to company orientation and reality to possibility focus in order to identify companies' degree of fit towards different practices. Yet the scale is not to be confused with maturity as it is just meant to raise awareness in respect to a potential need for change to apply certain practices [56].

2.4 Agile, Coordination and Communication

Incorporating and scaling methodologies within an existing organisational culture which comprise a redefinition of established ways of working will inevitably affect communication and task coordination.
Pikkarainen et al. [47] point out that agile methodologies increase formal and informal communication within an organisation as intended and anticipated by practitioners.

Nevertheless, ways of handling the increasing amount of available information are not always in place limiting its potential advantages. For instance, information regarding long-term goals of multiple dependent features can be present in some but not communicated to all parts within the organisation [47]. Cohn and Ford [16] take a step further and argue that even though agile increases communication within development units, upper management quickly loses the ability to track progress and to plan and control the underlying development process. This loss of control is to be expected by structural empowerment which aims at distributing and delegating the decision making power towards development units [42]. According to Tessem [66], agile developers are often more empowered by gaining a higher level of managerial influence and task selection possibilities leading to an increased work motivation. Still, the empowerment and shift of responsibilities often causes friction between parts of an organisation caused by scepticism and uncertainty eventually resulting in counter-productive behaviour [42].

Still, the coordination within the development of large software systems has become one of main managerial challenges and shows limits for empowerment [34]. Large scale systems of high complexity entail a high level of interdependence of separate components developed by large teams. According to Kraut and Streeter [34], the coordination mostly relies on informal communication which does not solve issues around the search for a consensus and information sharing. Coordination grows to become particularly challenging in software development with the rise of Distributed Software Development (DSD). Distance tends to hamper communication which is the main intermediate towards engaging in collaboration and control with projects. With the great chance of communication being too sparse or single pieces being distorted, threats for the whole software development process, such as activities within requirement engineering, arise [49].

Lastly, issues with adopting a new process might even arise before processes are changed and methodologies are in place. As Cohn and Ford [16] state, different parts of an organisation might be favouring a change trying to eagerly deploy it while other parts may arouse opposition [16].

In general areas of concern regarding coordination and communication in respect to agile tend to be manifold and span over an organisation as a whole and can be seen as an enduring challenge not to be overcome at a specific moment in time.

3

Background

This chapter describes the theoretical concepts of importance for the thesis along with the specifics of scaling agile in the organisation under study.

3.1 Conceptual Background

This section presents the primary concepts the researchers operate throughout the study: it explains information and communication and the difference between the two; presents the notions of heat maps and social networks; defines an organisational structure.

3.1.1 Communication & Information

Communication is the exchange of meaning between various parties. Within this exchange, the medium's specific channel type or physical nature to exchange meaning is not of interest in most theories [53]. Shannon [61] defines a model which envisions the role of a transmitter and receiver between which the signal is transferred while being prone to potential external noise. Internal noise on the other hand can emerge during the encoding or decoding process of a sender or receiver [68]. In addition, messages are exposed to an exponentially increasing amount of noise in relation to the nodes they pass through. This specially applies for large organisations with long distances between the sender and final receiver [61]. Finally, whenever the meaning conveyed constitutes something previously unknown, Gleick [25] acknowledges actual information being transmitted.

Looking at communication and information Cockburn and Highsmith [15] draw a clear distinction between communication and collaboration by defining communication as the process of exchanging information. Collaboration on the other hand is the activity of multiple parties working together to commonly achieve a task while communication helps to align one another's perceptions. Communication is therefore carried out in order to fulfil the task and lower uncertainty in the process [32].

Information coheres to communication as it is perceived as the message which travels between parties [22]. Just as Savage [53] attempts to declare communication in

mathematical model, information theory formalises areas of signal processing and data compression. Signals are not independent of their context and static in how they are understood during interpretation and transmission [70]. Whenever a single piece of information is accessed, a human processes it which is a dynamic procedure strongly influenced by the context of the actor and its ability to understand the information's complexity [70].

Agile software development itself relies heavy on internal communication within a team and external communication with the customer. It embraces the high degree of tacit knowledge aiming at reducing the need for formal documentation [2]. A high degree of informal communication within XFTs however does not inevitably ensure a project's success. Potential lack of communication between different roles which do not directly fit into agile practices can entail threats to success [17], especially as uncertainty about ways of external communication with development teams comprises potential to optimize collaboration outcomes [64].

The stated definitions and meanings for agile show clear distinctions between concepts linked to information and communication which leads to both being handled separately in further discussions.

3.1.2 Heat Maps

Heat maps were first used over a century ago to illustrate social statistics across various districts in France [72]. Over time statisticians have worked on different algorithms to perform various types of clusterings involving permutations of the heat maps' rows and columns [72], allowing the heat map to be more powerful visualization tool communicating the data's statement clearly. As a result, heat maps are often used to visualize dense, three-dimensional data of a table format. Data in regards to an observation can be collected continuously over or at a discrete point in time [46]. Colour coding is then used to give structure and illustrate clusterings or gradients. All in all it allows for an easier interpretation of the original data [46]. Their data independence allows heat maps to be applied in different fields such as social science, biology or meteorology.

In Software Engineering Feldt et al. [21] use heat maps to visualize code churns over time of different code elements to predict potential integration problems. Other investigations visualize the change status with a file and project view using colour coding for each line's status [71]. The aggregated project view gives a dense view of the overall status also linking progress to single developers.

Heat maps are used in the context of this thesis to demonstrate the intensities of communications of different natures. A communication instance between roles A and B is reflected in a table cell which is colour-coded in accordance with its intensity. The more intense a communication the darker colour it is visualised with. A heat map illustrates the absence of a contact with empty cells (as it will be further elaborated on in the Chapter 4, the study collected the data on communication only from a subset of the employees which corresponds to the rows of the heat map thus resulting in appearance of a number of columns corresponding to roles that were contacted by the initial subset of respondents but did not provide the communication data themselves).

3.1.3 Social Networks

Social networks are a concept vastly used in sociology as a mean of representing social groups as networks of their interrelations. Their analysis has been mathematically formalised and, as outlined by Scott [59], is closely related to the methods of graph theory. Using the terminology of the latter, individuals (or groups of individuals) in a social network are represented as nodes while their interrelations are depicted by edges. Scott [59] mentions the measures of network density and centrality, examination of cliques and clusters as a few aspects of a social network that can be investigated using existing methods and theories.

Linguistics, criminology and demography are among other research areas that over time incorporated the analysis of social networks in their field of study.

In Software Engineering body of knowledge social networks have been used for instance by Cataldo and Herbsleb [11] for communication analysis in a geographically distributed software development to study the core of communication networks and the level of technical proficiency of those in the core.

The thesis uses social networks to show the communication paths between a subset of the employees of the studied organisation. It collects the data form the two XFTs and constructs two networks that allow for investigating their differences, the potential islands or unnecessary long paths between the roles.

3.1.4 Organizational structures

It is important to notice that from a theoretic perspective an organization at large is perceived as a social system. Social systems themselves can be categorised in accordance to their criterion for demarcation. The different manifestations of demarcations lead to form a shared identity and alignment towards common goals. Organizations as a social system most fundamentally delineate themselves in regards to its constitution and rights of authorising their members. This usually forms a tight bond and prescribes processes and interactions. Groups on the other side of the spectrum solely define themselves by their interaction frequency. Coalitions on the other hand are formed in connection to actions towards third parties. The notion of a companionship takes this approach further by members accepting limitations of their behaviours and allowed actions to achieve a common goal collectively. In addition, organisational structures are aligned to the company's goals and strategies. They therefore also vary depending on their level of formality and should follow the company's strategy [12].

Organisations are also often categorised according to their division of sectors. *Functional structures* devise units by types of work achieving a high degree of specialization and expert knowledge but tend to fail at self-managing themselves requiring higher levels of management for coordination and integration [54]. *Divisional structures* segregate units based on single products or complete product ranges, allowing for sections to gain comprehensive knowledge within their product range. Potential drawbacks can manifest themselves in insufficient communication between divisions again leading to low coherence and eventually diverging productivity level [54]. *Matrix structures* combine func-

tional and divisional structures adding another layer coordinating product units. The matrix originates from each functional area of a division being coordinated by two superior entities. The intent is to faster distribute knowledge horizontally among functional sectors while taking in advantages from both functional and divisional structures [23]. Finally, hierarchical structures add a chain of command and show superior and subordinate units or roles [27]. They can be added to *functional* and *divisional* structures at various levels of detail.

3.2 Agile at Ericsson

Increasing productivity remains the main force behind the application of agile methodologies in industry. Nevertheless, Deepika Badampudi [18] point out that most companies' adapting agile do not manage to strictly follow all of its main ideas. Adjustments are made to integrate agile with the large scale and existing processes, with both positive and negative impacts upon productivity. Similarly, Ericsson has its own peculiarities of scaling Agile which will be discussed in this section.

3.2.1 History of Transformation

Dissatisfied with performance, around 2008 Ericsson started a transformation from the waterfall based development towards a more agile approach, following small incremental and discontinuous transformation steps. Rather than only changing the lower level coordination of development teams, it was decided to change the organizational structure along the way. A matrix-like organizational structure was replaced with hierarchical one with cross-functional teams at its lower level trying to embrace agile software development: a structure not necessarily prescribed by agile but motivated by Ericsson's scale. The strictly hierarchical structure causes a great number of connections, clear responsibilities and therefore delegation and potential queuing delays. To address this Ericsson integrated parts of agile's methodologies into their existing organisational structure while adding variations of methodologies where needed. This includes a partially deploying methodologies, defining custom roles and responsibilities and adding an integration layer for the organisational structure.

3.2.2 Organizational Structure at Ericsson

The organisation under study is located on two sites: Lindholmen and Kista (Sweden) and is part of Ericsson AB. Its organisational structure at the time of the study is presented on the Figure 3.1.

In the epicentre of the development activities reside the XFTs — self-sufficient units which have all the necessary competencies for a feature delivery at their disposal. XFTs at Ericsson generally consist of 5 to 9 people. In order to handle the size and complexity of products the teams work with, they are appointed to a single Product Guardian (PG), who is not a part of a single XFT but works closely with several.
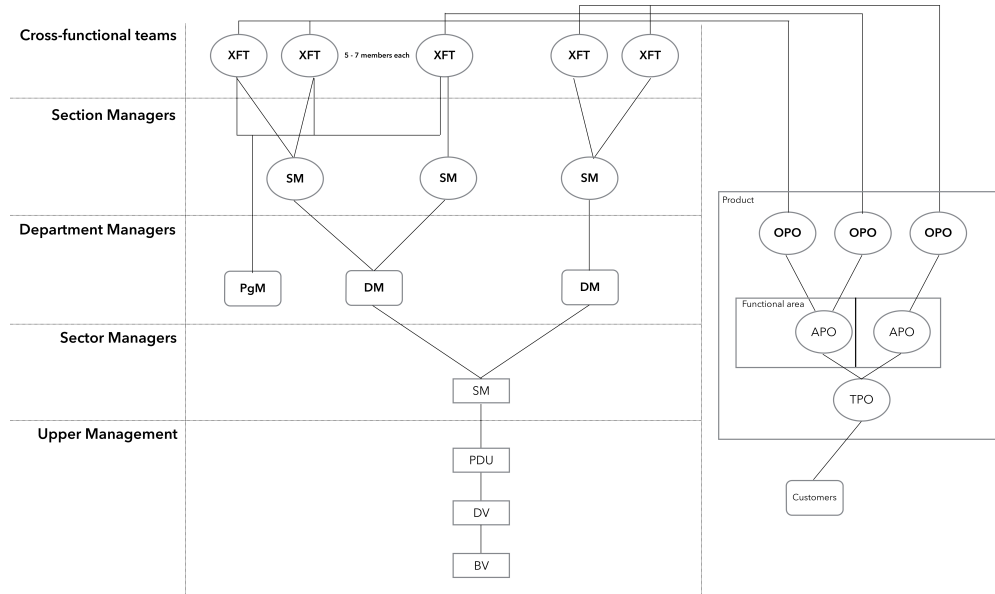
Figure 3.1: Organisational structure of PDU CAT

Each team furthermore belongs to a section, which is where they collaborate with a Team Coach (TC) (also acting as a Section Manager (SM)), who mostly looks over 2 XFTs. Sections themselves belong to departments, which in turn are a part of a sector, each of them having a respective manager. A structure above the sector in the hierarchy is called a Product Development Unit (PDU). Together, this part of the structure constitutes the line organisation.

The start of the transformation towards an agile development process caused the introduction of a new product owner community to the existing structure. Given the company's scale, the traditional role of a Product Owner (PO) had to be divided into the areas of responsibility. Thus, new roles of Total Product Owners (TPOs), Area Product Owners (APOs) and Operational Product Owner (OPO) were introduced with a TPO being in direct contact with the customer and APOs, who in turn work closely together with 1-5 OPOs each. OPOs in turn work with several XFTs at a time. The exact amount depends on the nature of the product and a way of working inside the section. In case of a feature assigned to an XFT being too large and complex,an Feature Project Manager (FPjM) acts as an intermediary between the Program Manager (PgM) and OPOs, where the former is responsible for maintaining the high-level backlogs teams eventually get the stories from.

Figure 3.2 demonstrates a strived for division of collaboration between the roles into several layers. An XFT is always in the closest and intermediate contact and cooperation with their PG, OPO and SM/TC. The next layer is comprised of those roles who have a frequent contact to the XFT and their environment while the degree of this contact is significantly lower than in the first layer. The further the layer or distance from the XFT

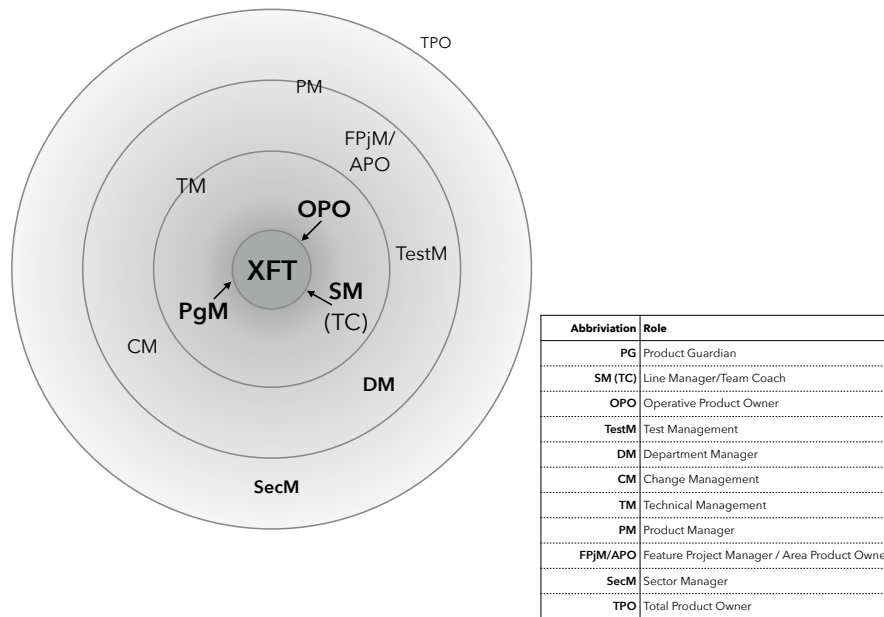| Abbriviation	Role
PG	Product Guardian
SM (TC)	Line Manager/Team Coach
OPO	Operative Product Owner
TestM	Test Management
DM	Department Manager
CM	Change Management
TM	Technical Management
PM	Product Manager
FPjM/APO	Feature Project Manager / Area Product Owner
SecM	Sector Manager
TPO	Total Product Owner

Figure 3.2: Layers of roles and their interaction.

is the least communication is implied.

3.2.3 Role Descriptions & Definitions

The more detailed description of the roles inside the organisation, including a short description the key tasks of each, can be found in the table below.

Description	*Key Tasks*
Agilean Coach	
Coaches the organisation in the new ways of working by covering problematic and uncertain areas not handled by the existing organisational roles. Mostly coaches the leadership team and management but also interacts with individual XFTs and other agilean roles when needed. After the settlement of new ways of working, the responsibilities are handed over to Section Managers.	Drive agile and lean improvements in the organization. Give feedback on ways to improve working. Drive workshops and retrospectives related to agile and lean. Coach teams to improve and become high-performing. Investigate, find and propose methods to improve teams and organization. Participate in meetings when applicable (for LT, XFT, Program, CoPs, etc.). Work as a bridge between organizations on items related to ways of working and agile and lean.

Team Coach	
With application of Scrum as an area of expertise, acts as an Agilean Coach on a team level for 1-2 XFTs by e.g. facilitating workshops and introducing methods.	Give feedback on ways to improve working. Drive workshops related to agile and lean questions. Coach teams to improve and become high-performing. Investigate, find and propose methods to improve teams and organization. Participate in meetings when applicable (for LT, XFT, Program, CoPs, etc). Handle impediments that the teams can not handle themselves.
Feature Project Manager	
End-to-end responsible for the features/other work items in case of them being too large and complex to be managed by a single OPO. Handles related coordination and progress reporting.	Support OPOs and teams with planning and coordination (e.g. between OPOs, teams, standards, projects, PDUs etc). Time plans and status updates. Report the status and escalate issues when needed. Follow up and reporting. Represent their part of a complex feature on a bigger scale.
Operative Product Owner (OPO)	
Acts as a customer on the site for 2-5 XFTs, shaping team's backlog. Follows the quality of the developed feature and makes sure its end value is understood by the XFT. Involved in technical development aspects, such as integration risks and technical dependencies.	Prioritize user stories across backlogs. Give feedback on end to end time plan. Handle teams' backlogs and know their status. Provide delivery time plan and input to check-lists. Facilitates cross XFTs learning by diversifying user stories or arranging meetings.

Product Guardian (PG)	
Secures product quality by ensuring unity of architecture and code structure within product/domain and alignment to software outside the domain. Knowledgeable within a specified domain of software and uses their skill to support XFTs and build up competence in the organization. Actively cooperates with OPOs on product improvement items to be put into XFT's backlogs.	Help in technical decisions related to a product/domain that goes in line with fulfilling the product vision and quality requirements. Have a vital few design rules for the product. Support the creation of definition of done for features affecting the product. Collect and prioritize product care and improvement items. Coach less experienced people when working with the product's code, documents and test.
XFT Scrum Master	
Ensures adherence of the XFT's process to Scrum. Filters interactions from outside to their XFTs based on their helpfulness. Acts according to a traditional theory concept, encouraging the team to improve its development process.	Communicate visions, goals and product backlog items to the XFT and assure efficient backlog management techniques. Coach the XFT into self-organization and cross-functionality. Lead and coach the organization in its Scrum adoption. Work with other Scrum Masters to increase the effectiveness of the application of Scrum in the organization.

Section Manager (SM)	
Combines legal personnel responsibility and support of the XFTs by removing impediments that the teams cannot handle themselves and helping out with competence planning.	Participate frequently in XFT's stand-ups, demos, backlog preparations. Give feedback to the XFT and Scrum Master after Scrum meetings. Involve Scrum Masters in discussions about team setups, recruitments and processes.
Program Manager	
Manages the program backlog, which is focused around a group of requirements from the product line.	Discuss requirements and their release with the APO. Facilitate program meetings with OPOs where they pull items from the backlog. Appoint a Feature Project Manager when main requirements are too much to handle for the OPOs. Identify impacted requirements areas and bring them to the sync meetings.

Table 3.1: Roles descriptions

4

Research Methodology

4.1 Research Purpose

The purpose of the research is to extend industry's knowledge of applying agile at scale with respect to information and communication flow and their effect on productivity characteristics related to the empowerment of XFTs. As mentioned by Dingsøyr and Moe [19], research in the area of large scale agile has not been extensive enough and "practice is ahead of research". Hence, results of the thesis complement the existing knowledge about difficulties accompanying agile integration in large scale enterprises.

4.2 Research Questions

At the onset of the study its scope has been shaped to investigate the issues related to information and communication flow within the organization that undermine the application of Scrum. The following research questions were defined to drive the research:

1. What are the information challenges associated with the adoption of large scale agile and how does their resolution benefit the application of agile?

2. What are the communication challenges associated with the adoption of large scale agile and how does their resolution benefit the application of agile?

3. Which productivity characteristics of an XFT become apparent as a result of an interplay of information and communication within a large scale agile organisation?

4.3 Case Study Research

The research investigates a phenomena highly intertwined with its context, thus it follows a case study research method that is the most suitable for such a purpose according to [51]. Yin [73, p. 9] prescribes the use of case studies when research attempts to answer "how" and "why" questions about a set of contemporary events while the researcher

has little or no control of the setting. Lethbridge et al. [40] emphasize consideration of the degree of contact with the studied subjects, type of the research questions and amount of data expected to be collected when selecting a type of study, claiming the appropriateness of a case studies when the focus is rather broad than specific and the amount of data to be produced and analysed is small. As these characteristics apply for this thesis it strengthens the ground for using a case study method. The findings are based on a single case mostly qualitative in its nature but is also underpinned with quantitative data. It investigates the existing setting, points out possible problematic areas and therefore is of exploratory nature [51] .

The object of the study is one of Ericsson's organisations, PDU CAT, and its application of agile methodologies. Units of analysis are comprised of a subset of the organization's employees, including two XFTs and representatives of related levels in organizational hierarchy and their activities within the organisation [51]. Both XFTs have 6 members (including a Scrum Master) and work closely with their OPOs while having a different degree of contact with their respective PgM. At the time of the study, both XFTs did not have a SM and his responsibilities were temporarily taken over by respective Department Managers (DMs). Only one team had a dedicated PG while the responsibilities of this role were spread out between different persons for the other team. Summarised, these roles are referred to as intermediate environment of an XFT further in the thesis.

The thesis follows the guidelines for conducting a case study suggested by Runeson and Höst [51]. First, the design of the study is outlined, including a plan and a set of research questions. Next, data collection protocol is established which is subsequently used for evidence collection. Gathered data is analysed and all the steps of the study are reported.

4.4 Data Collection

Data collection combines both quantitative and qualitative methods including semi-structured interviews, observations and surveys.

Two main data sets were collected using prevailingly first degree data collection techniques according to a taxonomy by Lethbridge et al. [40]. It shall be noted that the study does not implement a mixed research approach [65]: the qualitative part does not strictly build upon the quantitative perspective using a sequential or concurrent model as outlined by Ivankova et al. [31]. Both perspectives are aligned to the research questions, whereas the qualitative angle sheds light on reasons for communication which are hard to identify using purely qualitative methods.

4.4.1 Daily Surveys

First, the patterns of communication between the different entities in the organization were obtained by carrying out daily surveys. The surveys were designed to be cross-sectional with a focus on a single week during a sprint [48]. The data was collected from

2 XFTs and their intermediate environment whose roles are summarised in table 4.1. Roles and participants are complete in regards to the XFT's development environment working towards reaching the goal of individual sprints which makes data collection sufficient to describe the process and related research questions.

The surveys were distributed to the respondents in paper format and collected at the end of a working day. The survey queried respondents to mark their communication intensity in relation the usual amount with co-workers during the work day (see figure 4.1).

Figure 4.1: Communication natures in daily survey

A complete example of a survey can be found in the Appendix on Figure B.2. Direct administration to the respondent group allowed to control the completeness of each response and guaranteed a 100% response rate as every participant was in personal contact with the researchers. Travelling and absence from the office caused 3 empty responses, resulting in 97 out of 100 possible fill-outs.

Every respondent was introduced to the survey's goals before the first day's version was handed out. The explanation included the envisioned reason and outcome of the study, data collection procedure and the outline of the main concepts of the survey, while the respondents had the possibility to ask clarifying questions.

The initial classification of natures of communication as outlined on Figure 4.2 is based on the previous research conducted at Ericsson by [8, 60]. It has been further on reshaped in the course of several feedback loops to integrate insights provided by some of the participants of the study.

The survey was trialled on three volunteers of which one was the participant of the actual study to obtain general feedback on apprehension of the survey and its design.

4.4.2 Interviews

After processing the data obtained by the surveys, semi-structured face-to-face interviews ranging from 30 to 60 minutes were conducted over a three week period. The interview guide was designed to drive the conversations with respondents whose roles can be seen in Table 4.1. The process for this data collection method was defined in accordance with the guidelines mentioned by Runeson et al. [52] and Myers and Newman [44].

A date, time and location for each interview were discussed in advance to make sure their conduction is free of external pressures and the setting is suitable for a productive
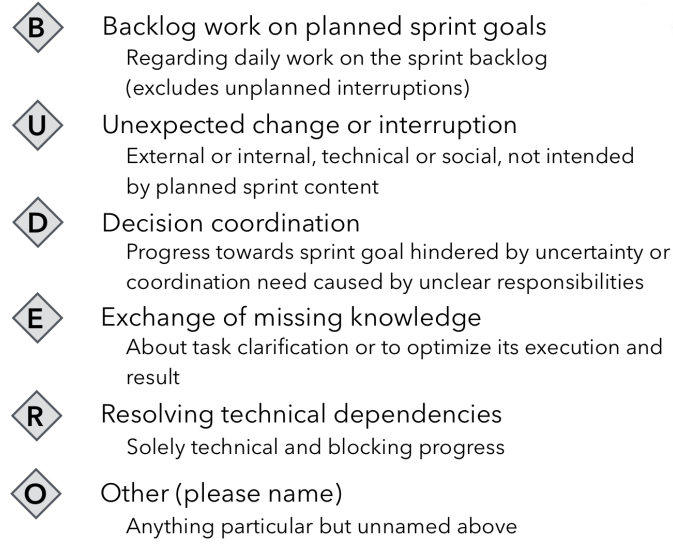
B Backlog work on planned sprint goals
Regarding daily work on the sprint backlog
(excludes unplanned interruptions)

U Unexpected change or interruption
External or internal, technical or social, not intended
by planned sprint content

D Decision coordination
Progress towards sprint goal hindered by uncertainty or
coordination need caused by unclear responsibilities

E Exchange of missing knowledge
About task clarification or to optimize its execution and
result

R Resolving technical dependencies
Solely technical and blocking progress

O Other (please name)
Anything particular but unnamed above

Figure 4.2: Communication natures in daily survey

conversation. Each session begun with an introduction to the research goals and an agenda for the upcoming interview. The interviewee was then asked the permission to record the interview and was guaranteed that their response will be made anonymous in the final publication of the study.

The questions were structured following the pyramid model, starting with more specific questions later on transitioning towards open-ended ones [52]. A set of questions about the employee's background information was asked aiming to break the ice and establish a friendly atmosphere. The main body of questions was unified by the same underlying theme derived from the research questions. A short extension of the general guide however was tailored in accordance with the respondent's role in the organization. The collection of all Interview Guides can be found in the Appendix.

To finish the interview, the researchers summarized the answers allowing the interviewee to correct or augment their response if needed. The participants were asked not to discuss the interview with their colleagues until the end of the interview period to avoid a learning effect.

4.4.3 Additional Data Collection Methods

In addition to interviews and surveys, the internal documentation was also used to study the research's context. The information extracted from such sources mostly concerned issues such as organizational structure and process descriptions. Moreover, the researchers had access to working area of both XFTs which allowed for observations and possibility to ask additional questions about the working environment. The participant observation [40] took place at the onset of the study to integrate with the teams and establish more firm personal contact.

XFT 1	
Role	*Participated in*
XFT Scrum Master	Survey & Interview
XFT Developer	Survey & Interview
XFT Developer	Survey & Interview
XFT PG	Survey & Interview
OPO	Survey & Interview
Department Manager (acting Section Manager)	Survey & Interview
Program Manager	Survey & Interview
XFT 2	
XFT Scrum Master	Survey & Interview
XFT Developer	Survey & Interview
XFT Developer	Survey & Interview
XFT PG	Survey
OPO	Survey & Interview
Department Manager (acting Section Manager)	Survey & Interview
Program Manager	Survey & Interview

Table 4.1: Study participants

4.5 Data Analysis

The data analysis for both the quantitative and qualitative part of the study were performed directly after the collection. At a later stage potential relationships and correlations between data sets were pointed out to ground a deeper understanding from both data collection methods.

4.5.1 Daily Surveys

The data obtained from the daily surveys was digitalized manually. To assure the correctness of the input data and minimise the possibility of human errors, both researchers processed the same response forms and cross-checked for inconsistencies after. Data was then stored in **.json*-files which were used as input for further calculations. Resulting data was finally transformed into **.csv*-files to generate communication heat maps with the help of the R software environment [1]. Any data processing needed to generate data

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[1]`www.r-project.org`

suitable for R was performed using a custom build software component. The software read all survey responses and allowed filtering by time, communication nature and employee's role. Filters were aimed to get a more detailed view towards specific subsets of the collected data. The output and functionality was tested and verified to ensure the output's correctness. Further data processing and visualisation was carried out using R packages upon daily collection of survey responses. The final visualisation images were produced after the survey week using the values accumulated throughout this period.

The visualisation of the data in forms of social network was performed using Gephi — an open source graph visualisation and manipulation software [2].

Visualising survey data using heat maps gives a picture of the communication intensities from the survey participants towards other roles within the organisation. Further filtering data by roles and especially communication natures allows for more detailed insights on the dynamics and perceptions of communication. The heat maps' purpose within the section Findings is to undermine insights from qualitative methods regarding topics of communication.

Social networks, on the other hand, manage to depict a big set of data thereby giving an overview of connections between various roles.

4.5.2 Interviews

The processing of the interviews data was performed using thematic analysis - a method targeted at discovering, analysing and reporting of patterns in data of qualitative nature [6]. The studied dataset consisted of the interview recordings that all together summed up to 13 data items.

The description of the method in Braun and Clarke [6] outlines 6 phases of the process:

Familiarising with data. Review of the transcriptions while keeping a focus on possibly recurring patterns.

Generating initial codes. Categorisation of the data set to initial codes.

Searching for themes. Initial combination of codes into themes.

Reviewing themes. Critical reflection on completeness and correctness of themes by again investigating the coded data.

Defining and naming themes. Further themes description and reflection on its contribution to the studied issues.

Producing the report. Selection of the most descriptive and compelling themes by aligning them to research questions.

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[2]`https://gephi.org/`

As a first step towards the familiarisation with the data each interview was transcribed in accordance with the intelligent verbatim format: filter words and repetitions were left out aiming to capture the information content and produce a more eloquent and concise report. Each transcript was then proof-read and summarised by both researchers. The summaries were not used within the thematic analysis and solely served the purpose of familiarising oneself with the contents of the interviews.

4.6 Threats to validity

This section discusses threats to validity of the research methodology and data collection of the study according to classification suggested by Runeson and Höst [51].

4.6.1 Construct Validity

Construct validity relates to connection between the operational methods and research theories investigated in the scope of the study [51].

To assure common understanding of the concepts used in the instruments, each survey participant went through the survey form together with the researchers, where the latter explained every section in detail and the former was able to ask clarifying questions. Interviewees were supplied with a study description involving goals and agendas via email before the interview and were briefly introduced this information again at the beginning of the interview session where they had the possibility to get thorough explanation on unclear parts. Evaluation apprehension threat, stemming from people being afraid of evaluation by their nature, was mitigated by guaranteeing anonymity to every study participant.

With benefits of data triangulation in mind, the mono-operation bias was addressed by collecting data of different nature from representatives of different teams and roles. However, having a rather small sample of subjects from a single company remains a limitation to this study.

4.6.2 Internal Validity

Threats to internal validity arise from the examination of casual relations between the studied concepts [51].

This study is focused around the information and communication flow within the organisation and their influence on the work-flow of XFTs. It is acknowledged that these factors are not the only ones affecting the productivity of the development teams but the scope of the study only investigates this perspective.

Using the daily surveys to determine communication patterns is highly dependent on respondents' answers and prone to the maturation threat. To alleviate the potential instrumentation flaws of the survey to an extent it was designed with the previous studies' results and feedback of trial participants as an input. The interview instrument went through a set of feedback loops of the study's supervisors to secure understandability and comprehensiveness.

The participating XFTs may not be representative of the patterns within the whole organization but it should be noted that the studied subjects were selected by an Agilean Coach who is knowledgeable about the performance and experiences inside the organisation.

4.6.3   External Validity

External validity is concerned with generalisability of the research findings [51].

This study was conducted in collaboration with a single organisation hence the setting might be biased by the culture and structure of this particular organization and consequently its interpretation of agile software development. The results therefore may not be generalizable to full extent by the nature of the qualitative study. The discovered problematic areas of large scale agile application are not necessarily valid in every context, however, a subset of the discovered challenges and proposed solutions may be transferred as an input to the investigation of another case.

4.6.4   Reliability

Reliability threats arise from the influence of the researchers on the data and its analysis [51].

To enable the possibility of conducting a similar study by another researcher the steps of the data collection were documented in detail and decisions for application of research methods argued for.

The study has been performed by two researchers thus lowering the possibility of a single researcher's bias. The instruments used in the study have also been discussed with both of the study supervisors.

5

Findings

At the time of the data collection the sprint backlogs of both XFTs differed significantly by the nature of the work packages. The first XFT described their set of user stories as rather usual while the second team was said to work on internal tasks focused around documentation. The participating XFTs diverge in the normal manner of contact with their PgMs but this is insignificant with respect to the studied issues.
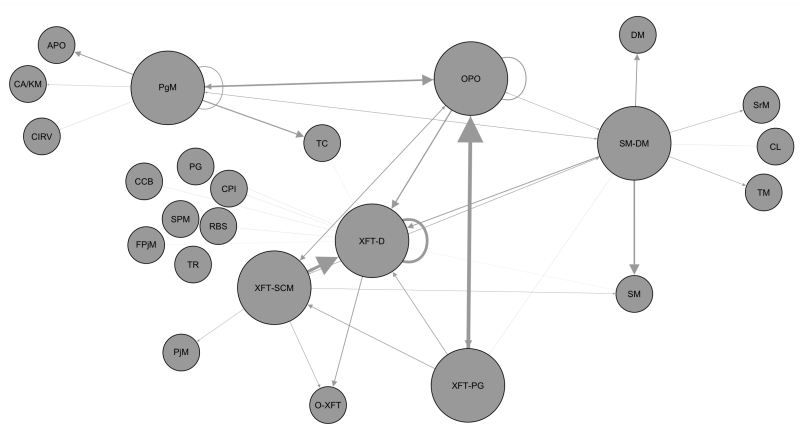

Figure 5.1: XFT-1: social network

The nodes of the network corresponding to the respondent group are indicated by the nodes of a bigger size. An XFTs in the scope of this study is taken up on a team level, thus the *XFT-D* node accumulates the responses of all XFT's developers. Both networks include nodes with the roles not previously mentioned in the thesis. Decoding of all abbreviations can be found in social network's legend.

The social networks characterisation of communication patterns of both teams is depicted in the Figures 5.1 and 5.2. Close collaboration between the members of the XFTs and their OPOs and PGs is attributable for both teams. At the same time the social networks illustrate the catching eye difference in the way the team members

communicate with the other parties. The number of direct contacts with the roles outside of the XFT's immediate environment for the developers of the first team is noticeably bigger than for the second team, where outside communication to a great extent seems to be flowing via the Scrum Master who acts as a communication hub.
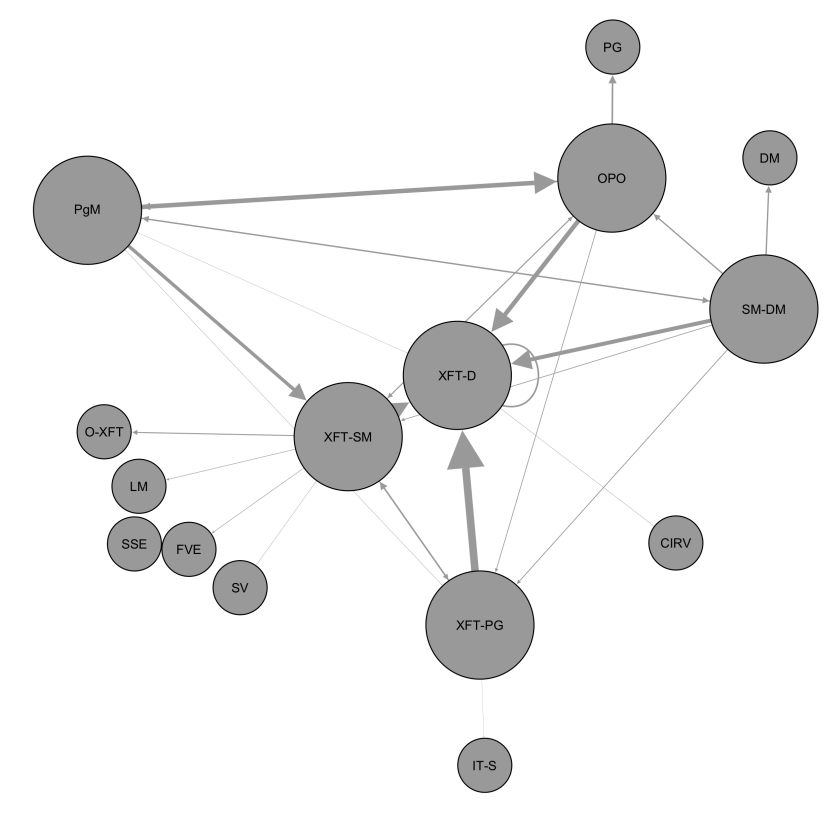

Figure 5.2: XFT-2: social network

Further investigation of the obtained data allowed for the study of the networks from the different viewpoints in a larger context. The analysis of the interviews revealed challenges of communication and information flow within a large scale agile organisation as well as benefits resulting from the overcoming of thereof. The suggested improvements in potentially problematic areas of the working environment might favour such transitions.

The findings of this thesis related to the *RQ1* and *RQ2* are divided as pertaining to either communication or information area with **communication** as a form of humans dynamically exchanging information through various channels and **information** as a single manifestation of a message's content giving a more static picture. Thus, the research makes a distinction mainly in the nature of two concepts. Communication is viewed as a dynamic process where overcoming a single challenge does not necessarily invalidate the existing problem and might lead to deterioration of other aspects of organisational communication. Information, on the other hand, viewed as rather static where challenges therefore are being almost directly mapped with the benefits and their

solving leading to improvements with little or no negative effect in other areas.

The findings in both areas are organised in three groups: challenges, benefits and improvements. The challenges describe the existing problematic aspects from the interviewees' points of view while benefits were mentioned as desired but are not a currently existing situation which would foster their work. The improvements are solely suggestions made by the participants which by no means are complete and capable of solving all of the existing issues.

A separate group of findings concerns the XFTs productivity characteristics which are affected by information and communication by implication. These cover different aspects of XFTs productivity that define their work flow.

5.1 Information

The findings of this section cover the first research question.
RQ1: *How does communication behaviour in a large scale agile organisation imply information sharing and gathering challenges?*

5.1.1 Challenges

Evaluating Information. From the interviewees' point of view of it is favourable to have access to descriptions of approaches different XFTs take in their development process. This can serve as a source of inspiration for own process improvements or solve problems that might have been encountered previously. However, the interviewees emphasize a need of reliance on the information that is commonly accessible by every party within the organisation and describe a difficulty in sorting out approved pieces of information.

> *[...] we really say that "We have decided that we will do this and this and that" — [...] that is not so easy to find, because you could find 10 "We have decided this and this and that" so which one is valid?*

Unknown Information Source/Receiver. Although acknowledged as a fundamental and integral activity of each organisational unit, information sharing remains an intricate problem. Due to a not always clear separation of responsibilities, information is often being broadcast to every party that may, according to the information source, be interested while those genuinely in need of the intelligence are potentially left unaware.

> *[...] it's not always so easy to know who should receive this information and you can not always broadcast everything that you do. [...] if they do, that gets too much [...].*

The XFTs, while diligently updating their Wiki pages available on the organisation's internal portal, mark that the information is not reaching its' seekers due to unstructured nature of the portal that makes the links hard to find:

> *Of course it's visible for more or less everyone, but I know for myself that if I enter another area, it's really tricky to find if I don't have any clues about where to start searching.*

Consequently, information gathering demands a significant effort. Whenever XFTs are being faced with an unknown domain in their work packages, they are lead to dead ends with a need for information hunting also not knowing where to begin the search:

> *[...] if it's a completely new thing then you kind of have to hunt for it, which kind of feels that you are on an island sitting alone basically.*

Unclear responsibility concerns negatively affect information gathering process as well, creating unnecessary long communication paths:

> *Many times I would like to just know "Who do I ask?". I mean I could ask one person just to get the name of the person who I really should ask to find out for a specific thing.*

These situations make XFTs reliant on their personal social networks that have been established while working at the organisation. Information in these networks is accidental rather than the information flow building up the evidence.

> *[...] I got the information that this team over there is working on something that is you do, because I've met that guy at the coffee machine and as I knew him from before I had a discussion. So it is depending more on your personal relationships with persons around in the organization than on actual information flow*

Overflow. A problem of an overwhelming amount of information constantly circulating within the organisation was noticed by almost every interviews' participant. For instance, the interviewees mentioned numerous emails reaching them on a daily basis from a vast variety of sources. The incomprehensible flow of incoming data is hard to handle without loosing the focus of your primary work and thus leads to either unnecessary long reading engagements or ignoring the potentially relevant information:

> *[...] if you get a lot of emails each day, a lot of them you can't read by physical limitations — you have to throw them away. Sometimes you miss stuff. It's a lot of stuff but sometimes you miss the important.*

Timing and Distortion. In the given environment which requires agreements from several parties to proceed on a certain task, it is not always possible to hold the common discussion at the same time. This creates the need for several coordination meetings sometimes parted by a number of days where information clutters and spreads thus disrupting the atmosphere around the XFTs:

[...] you have this distorted information and some team has heard something and some team has not. And then when it involves some kind of change then people don't really know what to trust.

5.1.2 Benefits

Unimpeded and fluent access to the information will smooth the working environment of the XFTs by reducing the time needed for the information search, promoting knowledge sharing and shifting the focus of the developers to their primary backlog work.

Established Information Paths. Supporting an infrastructure to maintain the structured information flow within the organisation will contribute to resolution of the information overflow and consequent problems. Establishing communication paths comes with a significant cost by the need to sort out all existing information sources and declare paths to access them while at the same time saves the information that potentially could be lost due to misguiding travel paths.

Knowledge Spreading. Having a clear structure of the information flow within the organisation will inevitably lead to information reaching its intended audience. By removing the unclarity within information sources and receivers knowledge will spread more fluently thus promoting the adoption of best practices between several teams and reducing the amount of double work.

Development Speed Increase. All of the information challenges are affecting XFTs. They have to set aside time they could have devoted to the backlog work and thus decrease their productivity. Eliminating at least one challenge can already free teams from unnecessary overheads that disrupt their working environment.

5.1.3 Improvements

Information Filtering. An ability to filter out the incoming information is desirable to overcome the information tsunami XFTs are faced with. While some interviewees suggest to mission an intermediate role for selecting information that is valuable for the teams, others propose the creation of seeking profiles for better customisation of heterogeneous needs of different roles with varying areas of concerns.

Information Persisting Manifest. The respondents seem generally concerned about the faultiness of the existing way of spreading information. The seeming anarchy caused by the lack of a commonly agreed and followed rules regarding information persistence leads to the knowledge being lost inside the teams and not being easily reachable by others. The interviewees expressed the willingness to adhere to such a manifest while marking the importance of knowledge sharing practices.

Accessible Intranet. The Intranet is capable of providing access to all of the shared information while at the same time it lacks a comprehensible structure. The interviewees note the discouragement of using it as a means for gathering information

as it simply does not have a common entry point. Reshaping it in a way allowing for information filtering will contribute to a more thorough use and a clarification of ways of information sharing.

5.2 Communication

The following group of findings addresses the second research question.
RQ2: *In which ways can communication challenges pertaining to the adoption of large scale agile influence communication flow within an organisation?*

5.2.1 Challenges

Bottlenecks. Having a growing organisation of a large scale inevitably comes at a cost of required extra coordination by several roles or persons exclusively holding responsibilities or information needed by a variety of units. Apart from bringing heavy load on the bottlenecks themselves it creates delays for dependant parties.

> *They have very-very many features to keep track of, but when something arise and get very hot, they are coming back, but if it's not that hot it takes long time, because they have such a full load on that.*

Different Perspectives. Due to differences in day-to-day concerns the interviewees are faced within their work, it is not uncommon that communicating instances diverge in their levels of attainment with various topics. This leads to misunderstandings that can turn into hindrances for either of involved parties. The arising problems include confusion about the tasks' goals:

> *the problem is that the [role] sees it very clear, the goal, but for me it's not clear. You say something like that, but the impact on my work — I have no idea.*

or enforced and time consuming communications not being beneficial for every participant:

> *You have a different point of view form a Project Manager. When he calls that meeting he has a status from all the teams, but that team does not care at all what this team does, so the benefit is only for the Project Manager, mostly.*

Islands. A concern cross-cutting through several interviews is the presence of communication islands. These are shaping around certain roles who tend to have the greatest deal of the daily encounters with a limited number of other roles. This results in knowledge concentration and its' following isolation inside these formed

groups. The interviewees mentioned this phenomena as both positive and negative aspect of the existing communication set-up thus supporting the challenging nature of balancing it out.

Small numbers of teams working on the same product have been mentioned by the interviewees as a beneficial factor for XFTs due to a close connections with other teams — they are contributing with a clear separation of work and provide availability of competences on other parts of the product the team is reliant on.

> We are 3 teams working with [product], it's very good functioning and we are all focused in one product. We are also situated in one area, so there are good communications between those 3 teams that is no issues at all.

On the other hand, such a separation from the rest of the organisation has the drawback of missing out on work and ways of working in other teams:

> But since we are sitting in that area we don't really have that much knowledge about other, how are other teams working [...].

Moreover, the XFTs have been mentioned as being communication islands of their own, to a big extent tending to keep communication channels within themselves and thereby solely relying on the competence of the team members and potentially narrowing the viewpoint:

> So now you tend to keep that discussion and decision within your team. So they should have a broader base of knowledge to base your decisions on.

5.1 illustrates a communication island around the Program Manager role from the XFT point of view, but it is considered to be rather beneficial as the team does not need to rely on the details of work the Program Manager performs. On the other hand, a Program Manager has a direct connection to the APO role, who is in closer contact with the customer than the XFTs, which is desired by the teams in the agile context.

Georgaphical Distribution. The scale of the organisation unavoidably requires coordination of multiple units that are often distributed across several geographical locations and could not be brought together as for strategic reasons. According to some of the interviewees, the environment in which such meetings are held is not well supported by the organisation and at times leads to the loss or misunderstanding of the issues that define upcoming decisions.

> So it's 30 people [...] and they are talking a lot, then we just sit there "Oh, what did he say now? Was it our problem or not?". [...] They have minutes of meetings and we try to follow them and so on. Sometimes it's difficult to follow the meeting when you are not in the place.

5.2.2 Benefits

An organisation transitioning towards agile environment should value open communication to promote smooth collaboration and cooperation between employees of various roles. Adjusting the approach towards organisational communication will yield certain benefits which when combined will help to establish that open-minded atmosphere agile emphasises on as a mean of reaching the ultimate goals.

Transparency. Not being in full control of their environment XFTs often delegate the removal of impediments or handling of inquiries. The interviewees repeatedly pointed out a wish for transparency in the progress on issue-solving. The responsible parties being frank about the steps that has been taken to resolve a problem is a stimulating gain for the teams as they are no longer left blinded with a hope of a quick response that sometimes has to travel through another organisation.

The need for transparency was also mentioned in the context of the delegated issues disappearing without being taken care of due to either lack of willingness or competence from those who are responsible. An open-minded environment allowing for traceability of the impediment handling is advantageous for a more efficient problem solving as well as for integration of the roles that are lacking competence which can be obtained by making the impediment visible and welcoming feedback on its solution.

Reduced Misunderstanding. Overcoming such communication challenges as perspective differences or geographical distribution will foster collaboration for communicating parties. Naturally, this is profitable for every participant as a better understanding of problems and providing detailed input or feedback increases comprehensibility at both ends of a communication channel.

Natural Communication. A rather asynchronous style of communication within the organisation is more desirable by some of the interviewees over having to attend the meetings called upon for synchronisation purposes. The demanded presence in such meetings, in which only a small part concerns the attendee, is viewed as disrupting and as a direct inconsistency with the agile principles. Indeed, numerous meetings during the day increase one's fatigue and moreover add new information for processing [41]. Nevertheless, Luong and Rogelberg [41] state that the amount of meetings does not correlate with one's productivity.

5.2.3 Improvements

Delegation Ability. Partly originating from troublesome information gathering and an oppressive amount of information necessary for the employees to be able to deal with the tasks, they report on being overwhelmed with the required communication channels. These channels need to be established prior to performing the task and may entail long waiting times for receiving feedback. Thus, to reduce

the frustration and demanding effort the study participants suggested having an intermediate role or specialised group of people who would take on handling issues:

> [...] you kind of put your errand there and just wait for the answer, you don't have to do that mailing and try to find the person [...]

Tight Integration. In an ideal agile world it is desirable to have an open communication environment in which competences of others can be easily obtained. In organisation of a large scale however this turns out to be rather troublesome. The interviewees note a loose connection between some units that are intended to have tight collaboration in Ericsson's interpretation of agile.

Thus, it has been numerously noted that the collaboration between XFTs and their SMs is rather weak and does not correspond to the intended level mentioned in Figure 3.2. This partially touches the previous improvement, as SMs are supposed to take on teams' impediments thus reducing their problem load.

> [...] it really should be a really close connection, but it isn't.

On a bigger scale, the acknowledged loose connection between the line organisation and the program (agile branch) is an issue in need of paramount attention given the essential role line organisation has in the new, after-transformational, way of working. Some of the interviewees think that the line is "not really deep into the organization", but suggest that this could be improved through education.

> I think they need more education maybe, I think so. Because I think they have a very important role, so I think it's good if they have more, I think they should be better at this agile work than we are in the teams or in the programs, because we are thinking a lot about these technical solutions so we don't really have so much time, so we just work as they say in a way. "OK, we have set up this way of working" and we just work, but I think they need to be more involved in this agile transformation.

To illustrate, it is mentioned that the XFTs, their OPOs and Section Managers have their communication scheme in a form of a triangle in which each two nodes communicate with each other separately but the three are never discussing issues together. This leads to issues never leaving the triangle as its resolution tends to loop around the nodes with them coming back to each other for suggestions.

> [...] to add a meeting, for the [role1] and the [role2] and the [role3], where we can say where we have impediments and just talk about the problems and say who can solve this, because otherwise we are just going around.

Equipment. Under the circumstances of impossibility of face to face communication in decision making meetings, a desire is put forward to have a setting which is as

close to real physical presence as possible. The interviewees think that with the technical environment capturing not only the voices of participants but allowing to have visual contact makes the meeting's participants feel more included in the discussion and thus promotes fruitful results.

> *[...] we should have like web cameras, so it's easier to follow.*

5.3 Productivity Characteristics

RQ3: In which ways can an organisation influence the XFT's work flow within large scale agile development?

Dependencies. It can be desirable to provide the development teams with independent work packages on which XFTs can focus during their sprints. Such an isolation of work is hard to achieve in an organisation where many teams are working on several products. As noted by the interviewees it is not uncommon to be interconnected in one way or another with other parts of the organisation. This starts with a need to coordinate with another unit in the organisation while working on the first step of a user story:

> *Many of our stories are actually that we should book a meeting, we should have that meeting in the week or something like that and we need to do some preparation sometimes [...]*

and being dependent on progress of others:

> *It could be some delivery that is delayed or something like that.*

and coming back to being unaware of other teams' work in the same code area:

> *[...] one team is doing work in the same area of the code and they don't know about someone else is doing a delivery and suddenly everything that you have made is not valid anymore because it doesn't align with what has just been delivered in.*

However, discovered dependencies are readily discussed and collaborated on between developers but tend to cause more intense communication between XFTs than usual as Figures 5.3 and 5.4 depict.

In addition to this, the social networks in the figures 5.1 and 5.2 demonstrate a quite significant amount of contacts for the XFT within for a week long period with entities outside their closest environment.

Unplanned Work. The commitment to a set of stories throughout the duration of a sprint considerably emphasized in Scrum is not always strictly followed by the studied organisation. XFTs experience influences from different parts of the organisation which do not necessarily contribute to the progress of development:
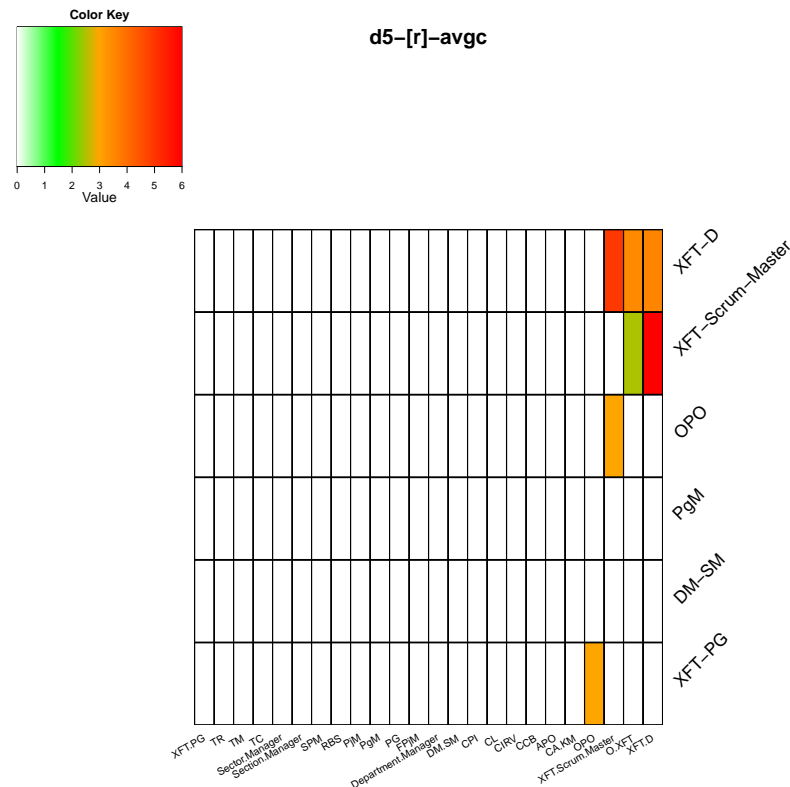
Figure 5.3: XFT-1: Heat map (resolving technical dependencies)

> *[...] they get some quite a few small extra tasks to [...]. I think it takes some time from the team.*

Aside from additional tasks, developers are often disturbed by the trouble reports which can be put forward by customers or fellow development teams. In case of a high severity a report may force XFTs to put the ongoing stories aside to fully concentrate on the report at hand:

> *[...] that started up as a small TR that someone started to work on and the suddenly it got really, red alert on it, so everything within Ericsson was almost stopped because this TR must be solved. And then of course, at least 2 of the teams were involved at the same time and it took 1 week to solve it.*

These items of unplanned work being pushed in to the backlog ultimately affect the teams' velocity by shifting the focus of developers:

> *[...] that person who looks into or answers that question or looks into*
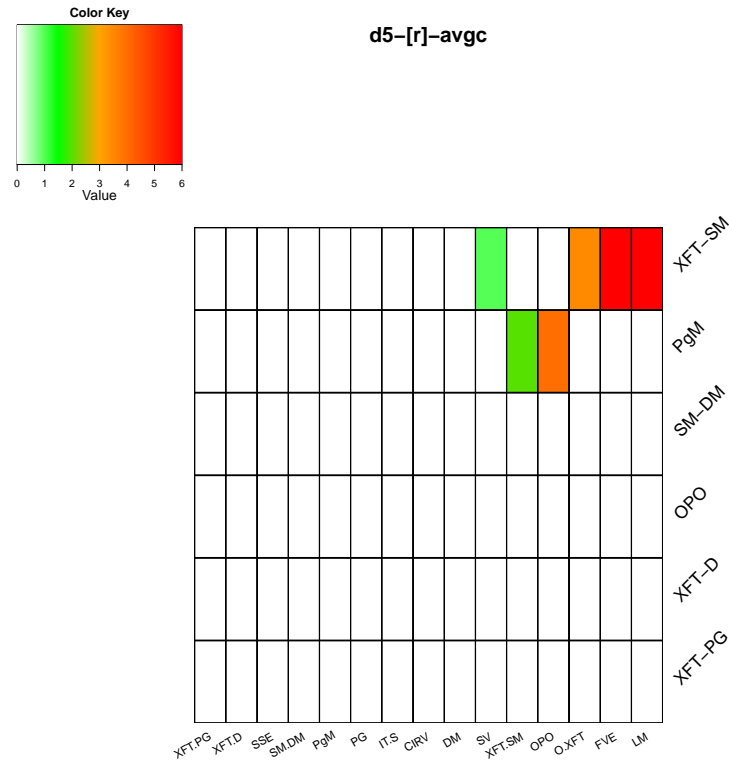
Figure 5.4: XFT-2: Heat map (resolving technical dependencies)

that problem might need to ask someone else in a team for help and then you have two people working on that. We had weeks where we had three problems and we were all working on that and work has stopped on the planned work.

Communication-wise, however, such encounters do not seem to cause more friction than the regular backlog work, as Figure 5.5 demonstrates.

Unknown Domain. The XFTs in the studied organisation are encouraged to take on tasks from different code areas. This sometimes causes teams to work in areas out of their expertise within an unknown domain. Familiarisation with the new area demands tremendous effort prior to actual development:

[...] we spend days just on getting to know their code and so on, because it's said that we should do all development, but... Yes, we could do it, but it takes several days more than if we just ask someone who knows this from the beginning.

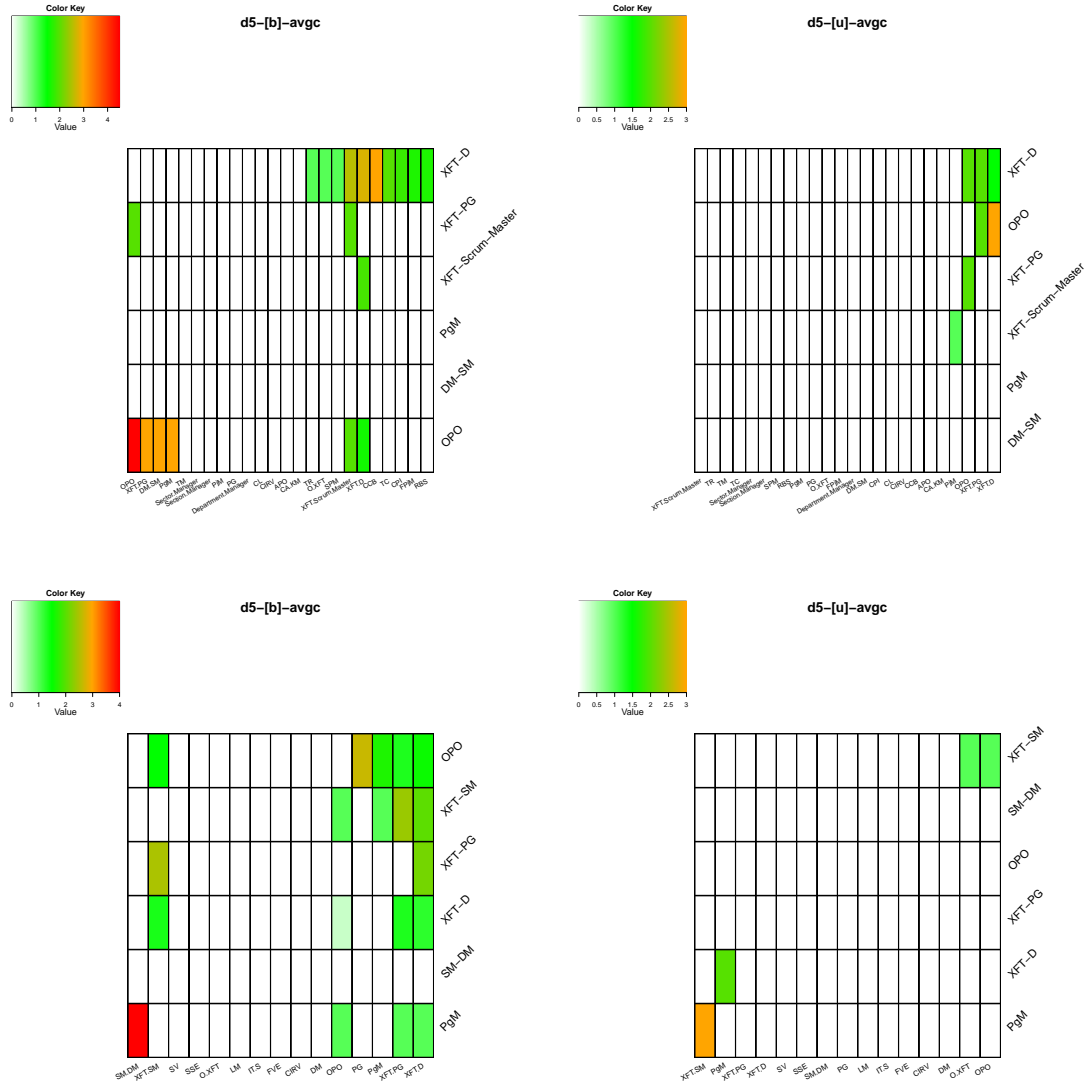In addition, it disrupts the sense of a single purpose inside the team.

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Figure 5.5: Differences in communication intensities on backlog (left) and unexpected change (right) heat maps for the XFT 1 (top) and XFT 2 (bottom)

> *We do not feel a sense of unity or single purpose within the team.*

Information Search. As mentioned in Section 5.1.1, finding the source of information inside the organisation is an arduous and not always obvious task which tends to consume more time than it should:

> *I can't run around chasing who is responsible for this and who is going to fix that, because then I decrease in speed.*

External Influences. Shielding XFTs from external influences and disruptions enables them to retain focus on backlog work and thereby positively affects the burndown. Interviewees however note outside factors crawling into their daily work and distracting them from backlog items. An example is an urgent re-prioritisation of tasks:

> *[...] it's normally due to urgent re-prioritisation of the work. Something has happened that is unexpected.*

or forced participation in events that might not affect XFTs directly:

> *[...] because they discuss things that are not relevant for my sprint or my team and then I think it is waste.*

or concern their future work:

> *[...] we have lots of other meetings that show up suddenly, some prestudy that starts and we really need to attend that one because we going to work with that in 2 months*

Technical Environment. One of the issues having its origins in the XFTs' empowerment is concerned with their technical environment. The interviewees repeatedly reported on being stalled by factors outside of their responsibility or competence.

> *So that has taken a lot of time and that, if you need a node and you are dependent on the nodes and you run a command and you need the traces, your work stops and that's what we have not gotten help with and we still do not know how to do that.*

Product Vision. The organisation's magnitude and its structure with several layers between developers and customers diminished the notion of customer collaboration. Thus, teams tend to have little participation in product discussions. At the same time, the wish of a long-term product vision being communicated to teams has been brought up. It could bring XFTs closer to customers and motivate their work which in turn could positively affect product quality. As of now, the vision is not being communicated to the teams to a desirable extent. Rooted in those with more customer contact having perspective rather different from the teams' it makes the communication not beneficial to either parties:

> *[...] for a [role] goal can be very clear, but for the XFT team we say ok, but we have no idea what that means for us.*

Moreover, those with a vision are faced with its agility and fragility and thus do not communicate it fully as it might change at any moment:

> *I think they like to know what we will go, the goals, but i this agile world,
> I think, it's sometimes it will just change again, even if we have this
> plan.*

However, in some of the respondent's opinion, the vision's carriers may sometimes
be not interested in passing it along:

> *If I should speak for myself, I don't think [...] is that interested in the
> [product], to have that vision for [product].*

In the first XFT's case the APO's role has the most customer contact among all
roles present in the network in the figure 5.1. It proves how problematic the establishment of tighter collaboration between the customer or their PO representative
and the team members can be. As of now the communication has to travel via two
intermediates: an OPO and a Program Manager.

6

Discussion

Thematically coding the interviews revealed several common perceptions of participants and allowed for structuring the research's findings as described in Section 5. Furthermore, it left room for relating them and interpreting their meaning on a larger scale. The following diagrams integrate all findings and generate a common view towards information and communication challenges, benefits and improvements. They lay the foundation for a set of trade-offs around XFT empowerment and their work flow and the overarching organisation. These trade-offs in turn can impact the productivity of XFTs positively or negatively.

6.1 Communication & Information

A more thorough analysis of the interviews' transcriptions revealed that XFTs elaborate on information and communication by mentioning associated challenges, benefits and possible improvements.
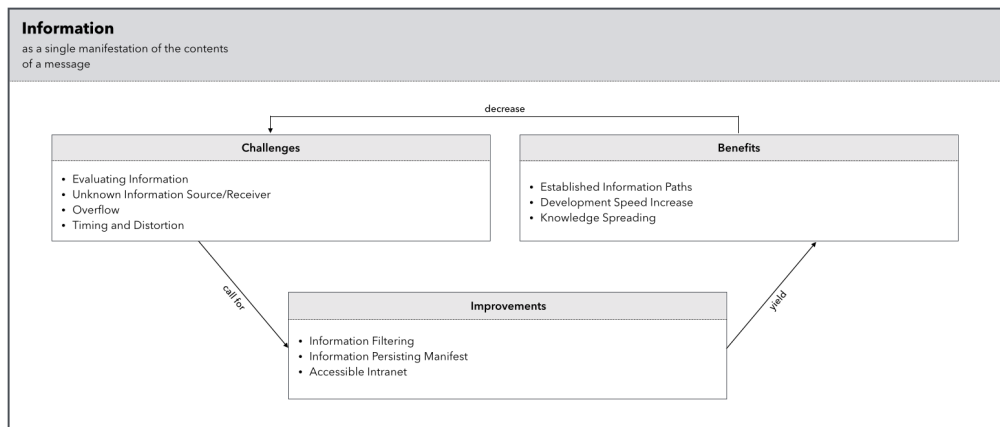
Figure 6.1: Information challenges, benefits and improvements

In addition, all three elements show an equal relation among one another within

the fields of information and communication. Targeted benefits can only be realised by addressing a known challenge with a tailored improvement. As outlined in figures 6.1 and 6.2 challenges can be overcome by applying an improvement which in turn *decreases* the challenge but might also strengthen another one as a negative side effect. Side effects are caused by the tendency of improvements to change the nature of communication and information. After all this might just affect other existing challenges or can even create new ones. In general, challenges *call for* improvements while the improvement itself *yields* certain benefits. It is important to note that one can not overcome a challenge without addressing it with a concrete improvement.
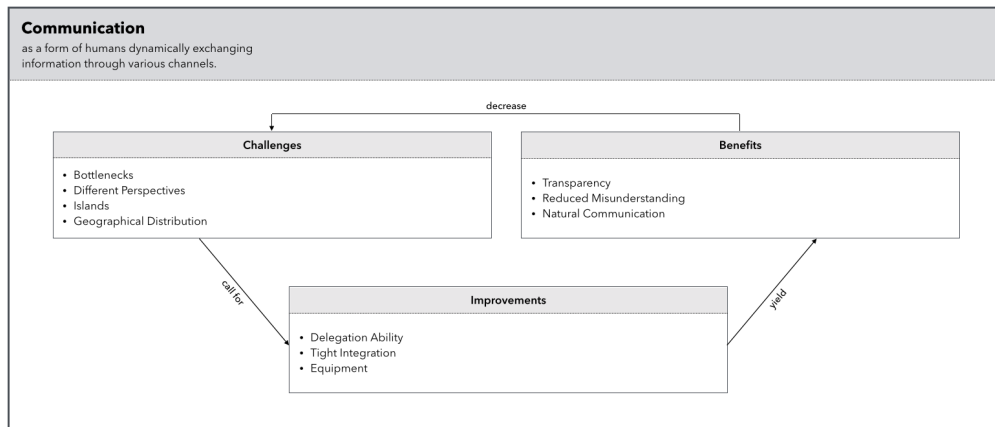
Figure 6.2: Communication challenges, benefits and improvements

Figure B.1 illustrates a presence of *mutual influence* between communication and information. Whenever the way in which communication is dynamically carried out is changed it can also feedback into information and affect its challenges and possible benefits. Pikkarainen et al. [47] for instance call the increasing amount of informal communication evolving into an inevitable challenge for large scale agile organisations. The studied organisation and its XFTs declare the rising *information overflow* as one of the main challenges which must be addressed with a variety of improvements such as an ability for *information filtering* and an *accessible intranet*. The found communication challenge of having *different perspectives* towards the level of details on a certain topic or compulsory collective meetings varying in benefit for its participants is partially caused by the new and often uneven distribution of responsibilities in the process of empowering the XFTs. This growing disconnection between units within the organisation and its relation to empowerment has also been pointed out previously [42, 66].

Furthermore, the *dynamic nature* of communication itself promotes this *two-sided* relationship in which information is defined as a *manifestation of the contents of a message.*
In the context of an organisation, properties of information feed into communication and vice versa. One side of this *mutual influence* manifests itself whenever information is exchanged when communicating. Communication success depends on the present

information challenges. Communication is likely to be efficient whenever sources are accessible without an overflow, correct information has been evaluated, the piece of information is not distorted and appropriate receivers are known. *Communication islands* for instance, according to Kettunen and Laanti [33], often arise from the accumulation of knowledge — an issue to which this study additionally observed that islands can develop unintentionally. The later elimination of an island by publicly offering the gathered knowledge often results in an excessive demand of knowledge sharing for its members having an distractive effect on their work focus.

Similarly, the other way around, the state of information with its associated challenges and benefits is also influenced by communication. Information challenges tend to arise and change from present communication procedures and adjustments of its context. A shift towards more geographical distribution, for instance, generates new communication challenges which yet again render new information demands and requirements as also stated by Kraut and Streeter [34] who also emphasizes the geographical distance as negatively influential to communication behaviour.

6.2 Trade-offs & Productivity Characteristics

Both distinct but interdependent fields of information and communication then influence a set of trade-offs through setting up the basis of organisation's position in relation to being rather *transparent* or focussing on *islands*.

Figure 6.3 illustrates different trade-offs which are greatly influenced by the described interplay of communication and information, its challenges and benefits. All three trade-offs contain the rather agile perceptions towards organisations, work flow and empowerment on their right extreme. Their left extreme outlines the more traditional perceptions towards software development processes.

Interviewees noted these previously mentioned concepts touching on communication and information mostly in the context of the present organisational structure as outlined in Figure 3.1. Additional to the static structure interviewees interact with organisational aspects such as processes definitions and prevailing roles definitions. In an agile organisation these elements are usually aligned with the organisation's intention towards being *transparent* or favouring *islands* (see Figure 6.3). Single decisions within a given organisational framework by changing processes or just carrying out work can then change the positioning on the organisational trade-off in one of its directions, while neither one of the two extremes are wished for under all circumstances. *Transparency* may seem to always be desirable to allow for a fluent information circulation but bears issues at large scale causing confusion by overflow paralysing decision making. Forming *islands* may appear negatively connotated as it disconnects individual units but is advantageous in efficiency for isolated and specialised tasks.

The trade-off on a level of an organisation envisioning the adoption of agile methodologies influences two subordinate trade-offs: one around the XFT empowerment and the second around their work flow. The XFT empowerment bears a necessary decision on how responsibilities should be delegated towards teams. On the one hand, an XFT's
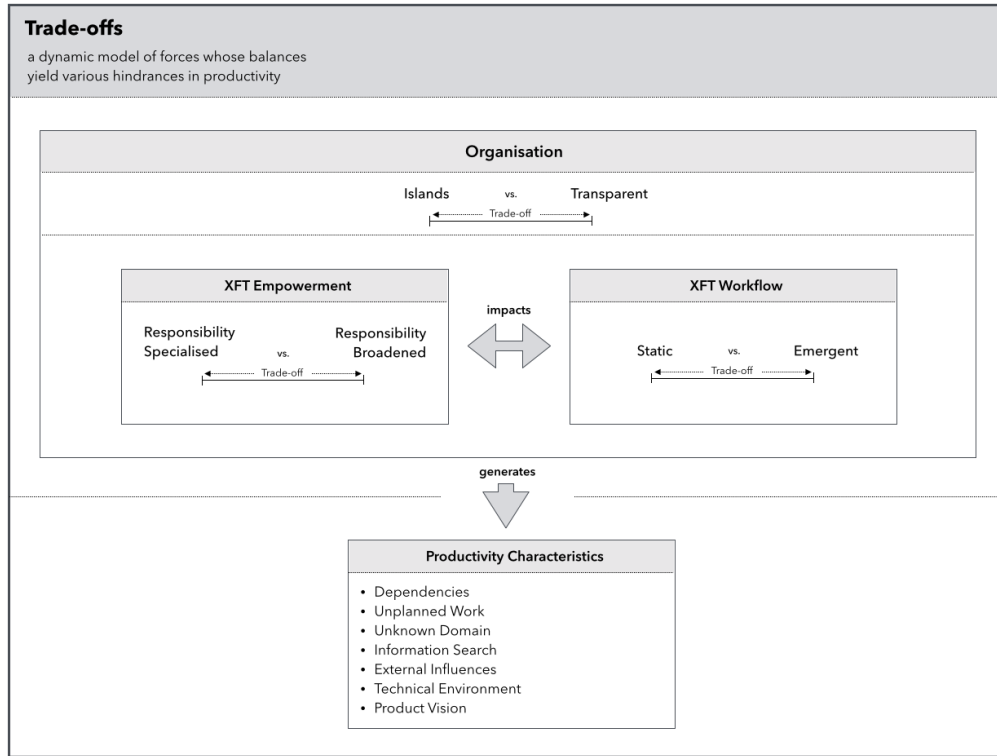
Figure 6.3: Trade-offs in empowerment, work flow and organisational influence

responsibilities can be *specialised* according to a product or its members' competences. On the other hand, various degrees of *broadened* responsibilities can be assigned. Completely *broadened* XFTs would therefore be able to take over almost any task and solve most impediments within their environment without much external guidance. The empowerment approach tends to have negative side effects on both extremes. Assigning too many responsibilities is a cause of XFTs being overwhelmed and loosing focus. On the contrary, highly *specialised* teams would strive in a well-defined field with a preferably narrow scope. Context changes or various external dependencies can break their focus and turn out costly for their efficiency.

Software development also entails a work flow in which a trade-off between an *emergent* and *static* nature should be made. An *emergent* work flow is composed of groups solving a task self-coordinated without dedicated supervision. Whereas groups working in a *static* fashion tend to require more oversight and are more suited for the assignment of predefined tasks. An *emergent* work flow reduces the need for pre-planning but tends to struggle with carrying out tasks of higher complexity with too many interdependencies. *Static* work flows, through their static structure, are more compatible with a vast amount of dependencies but are vulnerable by their need of coordination and supervision.

The three mentioned trade-offs around the *organisation*, *empowerment* and *work flow*

mutually influence one another. The alignment within one trade-off can ease reaching a certain position on another but might be hindered by the third. The possibility to freely adjust a trade-off might thereby not always be there unless others are changed previously. This strong attachment is also noticeable by certain incompatibilities between the trade-offs' positions. *Emergent* work flow, for instance, is difficult in an organisation favouring *islands* and a *specialised* strategy towards empowerment. *Broad* XFTs prefer some level of *transparency* with a rather *emergent* work flow to engage in solving changing tasks.

Finally, settling on all trade-offs defines a set of dependent *productivity characteristics*. The existence of these concrete characteristics and their severity is mostly influenced by the mentioned trade-offs and the organisation's nature. The often negative effect of *technical dependencies* and associated challenges potentially creating domino effect or even vicious circle have previously been pointed out by Sekitoleko et al. [60]. Concerns regarding planning and maintaining a shared *product vision* have also been previously pointed out [18]. Still, Deepika Badampudi [18] states that these are less rooted in the agile's need to flexibility but rather caused by unclear requirements, false customer collaboration and a lack of competence.

The key is to identify acceptable *productivity characteristics* while moving along information and communication challenges and the adjustment of all trade-offs until the intended characteristics carry into effect. The trade-offs are just means to an end and agility lies in the ability to adapt and chose the most suitable constellation under given circumstances and an intended outcome.

7

Conclusions

Agile methodologies have recently been applied within companies of bigger sizes than its methodologies were originally designed for. Resulting from this any case study in the area of large scale agile eventually contributes to the existing body of knowledge. This thesis, through two weekly rounds of daily surveys and following semi-structured interviews, focused on the belated integration difficulties related to information and communication flow within the organisation and their implicative affect on the working environment of the XFTs.

The information challenges, which are the subject of the RQ1, discovered by the study include information evaluation, problematic information sharing and gathering due to unknown sources and receivers, information overflow, and information distortion along with the timing issues of the information's travel. Through numerous improvements among which are information filtering, information persisting manifest and accessible Intranet, established information paths, development speed increase and knowledge spreading benefits can be obtained.

The aim of the RQ2 was to discover the challenges related to the communication within an organisation that has transferred to agile methodologies. The most dominant findings of the study on this topic include communication bottlenecks, communication islands, differences in perspectives of communicating parties and geographical distribution. These call for improvements in delegation abilities for the XFTs, tight integration between parts of the organisation and technical equipment support. Working on improvements yields benefits for the agile organisation, which include reduced misunderstandings, transparency and natural communication.

Finally, the study concludes, that seemingly secondary to software development, areas of communication and information flow within the organisation are the integral aspects to consider within the adoption and emergence of a new way of working. In an organisation faced with mentioned challenges, adjusting the level of organisational transparency and the related trade-offs of XFTs empowerment and work flow is a step to influence the productivity of development teams as subject to RQ3. It is characterised by various aspects, among which are dependencies, unplanned work, unknown domain, information search, external influences, technical environment and product vision.

7.1   Implications for Practitioners

Scaling agile within a large context entails various difficulties for practitioners. Even though agile's methodologies tend to have the general ability to scale or can be extended, emerging challenges of information and communication shall not be forgotten when trying to optimise an adoption of agile.

The outlined findings emphasize the importance of reflecting on trade-offs around the organisation, XFT empowerment and the XFT's work flow. A then deeper analysis of existing communication and information challenges yields benefits through specific improvements. This eventually leads to an understood environment with specific productivity characteristics which themselves can be influenced by adjusting the mentioned trade-offs and improving on information and communication's challenges.

It is important to note that qualitative investigations by capturing needed knowledge around the communication's and information's status quo are vital to lay a foundation for the such framework. The proposed analysis should be applied in practice, reflected upon and eventually extended. An utilisation would give insights on how productivity characteristics are affected by mitigated communication and information challenges within an environment defined by the mentioned trade-offs. Lastly, using heat maps and social networks for continuous real-time feedback within an organisation may reveal promising insights into an organisation's dynamics and associated issues.

The ability to incorporate qualities specific to any organisation's own nature allows the discussed framework to be applied outside the analysed case, ultimately contributing to a more successful application of agile without suggesting or prescribing concrete methods or practices.

7.2   Future Work

Despite having only one case, the study opens avenues for future research. As a consequence of research on agile software development from a perspective focusing on communication and information being sparse [47], this study intended to impart a structured understanding surrounding it. Just as Deepika Badampudi [18] unfolds potential productivity delays the study attempts to integrate independently discovered characteristics into a bigger picture of forces and balances.

This comprehension calls for *(i)* a more profound relation of communication and information challenges to be developed. On the given basis one could also more extensively *(ii)* determine causes of productivity characteristics to different trade-off positioning. Furthermore, *(iii)* conducting a survey for constructing heat maps and social networks with more XFTs holds potential to bring forth profound and more diverse findings.

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A

Interview Guides

General Guide: All Roles (except: SM/DM & PgM)

The guide was used for all interviees who were not an SM/DM or PgM and was extended by a specfic guide dependent on the interviewee's role.

Background Information

1. What is your role in the organization and with regards to the XFT [NAME]?

2. What are your key responsibilities?

3. Have you been working here before the transition towards agile?

   (a) What was your role during that time?

Agile Transformation & Ways of Working

1. How did company's transition towards agile change your responsibilities? t

   (a) What is the purpose of your role in the agile context?
   (b) How clear are the responsibilities within the agile context?
   (c) What are the aspects regarding the organisational structure which might stand in the way of working in an agile manner?

2. What are the aspects regarding the organisational structure which might stand in the way of working in an agile manner?

   (a) What are major mismatches between the XFT's way of working and its related organisational structure?
   (b) How compatible are various parts of the organization with agile and why?
   (c) What characteristics of ways of working makes them more or less compatible?

Information Flow & Organisational Structure

1. Which roles are part of your communication environment and what are your responsibilities towards them?

   (a) Name 3-5 roles you communicate most frequently and intense with?
   (b) What are the topics you communicate about with these roles?
   (c) Which events tend to cause high levels of communication between roles?

      i. Which communication patterns tend to impact your workflow negatively?
      ii. What are the main occasions for this?
      iii. How often do they occur?

   (d) Do you see any role as being too central and aggregate too many responsibilities?

      i. How can this cause communication bottlenecks and affect progress?

2. How well is information circulating within the organisation and around you?

   (a) Can you describe how the information sharing and receiving is performed?

      i. How do you decide on what information to share?
      ii. What kind of information do you share or receive from upwards?
      iii. What kind of information do you share or receive from downwards?
      iv. What kind of information do you share between co-workers of the same role?

   (b) In what direction is communication insufficient or inefficient?

      i. What is problematic with information transfer?
      ii. How could impactful improvements be made?

   (c) When information is needed, how do you find a relevant source?

      i. What can be an obstacle in this process?

   (d) What countermeasures could improve information sharing in general?

      i. How could information be made more accessible?

   (e) How well does the collaboration between teams work?

      i. What are the problems that affect a team negatively?

3. To what extent are you involved in decision coordination regarding backlog related issues?

   (a) How could involvement of different parties be changed?
   (b) Which problematic areas could be mitigated?
   (c) What type of decision making can impact the XFT's progress?

      i. What are reasons and impacts of blockages?

4. How sufficiently integrated do you think the agile branch is with the line management?

   (a) What information is shared and how often?

   (b) What are your expectations toward this collaboration?

      i. How well and fast is feedback considered?

   (c) How do you think interaction could be improved?

   (d) How do different interests from a DMs/SMs, POs and PgMs influence the work of XFTs?

      i. How clearly separated do their responsibilities appear to be?

      ii. How can it build tension towards the XFTs and what effects can this have?

      iii. How well is agile development aligned with long term planning?

      iv. What problems does this create in regards to decision making and coordination?

5. How tight is the collaboration and communication between XFTs and POs?

   (a) How could feedback and information sharing be improved?

   (b) How can the team in turn affect decisions made from their PO chain?

      i. To what extent are decisions made collaboratively?

      ii. How can feedback be given and how well is it considered?

   (c) What are the problematic areas within this chain of communication?

      i. What are the main issues regarding information reaching the XFTs?

      ii. How can it be improved?

Workflow & Interruptions

1. How can the normal workflow during a sprint be interrupted from its planned direction?

   (a) *(If not interrupted)* How do you manage external influences?

   (b) *(If interrupted)* Can you elaborate on different effects they have on your workflow?

      i. How frequent are they?

   (c) What are the external influences that might cause these interruptions, where are their roots within the organisation?

   (d) How are interruptions addressed?

   i. Which roles have more responsibilities than others in such a case?

 (e) When taking action, are there any blockages in the communication path which slow down resolution?

 (f) Can you give an example for an exceptionally *unproductive* sprint?

   i. What were the characteristics, communication patterns and causes?

 (g) Can you give an example for an exceptionally *productive* sprint?

   i. What were the characteristics, communication patterns and causes?

 (h) Can you give any concrete example of how the way of working or environment for the team could be improved?

2. How does the XFT's empowerment influence your work both positively and negatively?

 (a) How comfortable are you with the amount of responsibilities?

 (b) How do increasing responsibilities affect your communication?

 (c) How could responsibilities be shared better with different roles?

Extended Guide: XFT-Developer

Agile & The Organisational Structure

1. Your XFT has no team coach at the moment, how does it relate to your workflow?

 (a) How are responsibilities of a coach implemented in practice?

   i. How are the responsibilities of a team coach shared?

 (b) What parts of your regular workflow are affected by this absence?

 (c) What challenges does it create for the team?

Extended Guide: XFT-PG

Agile & The Organisational Structure

1. How does the PO (OPO, APO, TPO) chain affect the work of an XFT?

 (a) What are problematic areas relating to communication with POs?

   i. What are the main issues regarding information reaching the XFTs?

   ii. How can it be improved?

Extended Guide: XFT-SM

Agile & The Organisational Structure

1. To what extent are you involved in solving impediments the team is facing?

   (a) How well is your intended involvement defined?

   (b) Are you able to resolve most impactful impediments?

       i. What communication is involved in resolving them?

   (c) Which other roles should take greater action in solving them?

   (d) What consequences may unresolved impediments have on a team?

Extended Guide: OPO

Agile & The Organisational Structure

1. How does the PO (OPO, APO, TPO) chain affect the work of an XFT?

   (a) How big is the distance between OPO, to APO and TPO?

       i. How in turn can this affect decision coordination?

       ii. How can this affect XFTs?

   (b) How can the PO chain affect responsiveness in regards to adjusting to change?

       i. How could this be optimized?

Specific Guide: PgM & DM/SM

The specific guide was used for interviews with PgMs and DM/SMs and is a strict subset of the general guide.

Background Information

1. What is your role in the organization and with regards to the XFT [NAME]?

2. What are your key responsibilities?

3. Have you been working here before the transition towards agile?

   (a) What was your role during that time?

Agile Transformation & Ways of Working

1. How did company's transition towards agile change your responsibilities? t

    (a) What is the purpose of your role in the agile context?
    (b) How clear are the responsibilities within the agile context?

2. What are the aspects regarding the organisational structure which might stand in the way of working in an agile manner?

    (a) What are major mismatches between the XFT's way of working and its related organisational structure?
    (b) How compatible are various parts of the organization with agile and why?
    (c) What characteristics of ways of working makes them more or less compatible?

Information Flow & Organisational Structure

1. Which roles are part of your communication environment and what are your responsibilities towards them?

    (a) Which events tend to cause high levels of communication between roles?
        i. Which communication patterns tend to impact your workflow negatively?
        ii. What are the main occasions for this?
        iii. How often do they occur?
    (b) Do you see any role as being too central and aggregate too many responsibilities?
        i. How can this cause communication bottlenecks and affect progress?

2. How well is information circulating within the organisation and around you?

    (a) Can you describe how the information sharing and receiving is performed?
        i. How do you decide on what information to share?
        ii. What kind of information do you share or receive from upwards?
        iii. What kind of information do you share or receive from downwards?
        iv. What kind of information do you share between co-workers of the same role?
    (b) In what direction is communication insufficient or inefficient?
        i. What is problematic with information transfer?
        ii. How could impactful improvements be made?
    (c) When information is needed, how do you find a relevant source?
        i. What can be an obstacle in this process?

(d) What countermeasures could improve information sharing in general?

    i. How could information be made more accessible?

(e) How well does the collaboration between teams work?

    i. What are the problems that affect a team negatively?

3. How sufficiently integrated do you think the agile branch is with the line management?

    (a) What information is shared and how often?

    (b) What are your expectations toward this collaboration?

        i. How well and fast is feedback considered?

    (c) How do you think interaction could be improved?

    (d) How do different interests from a DMs/SMs, POs and PgMs influence the work of XFTs?

        i. How clearly separated do their responsibilities appear to be?

        ii. How can it build tension towards the XFTs and what effects can this have?

        iii. How well is agile development aligned with long term planning?

        iv. What problems does this create in regards to decision making and coordination?

4. To what extent are you involved in decision coordination regarding backlog related issues?

    (a) How could involvement of different parties be changed?

    (b) Which problematic areas could be mitigated?

    (c) What type of decision making can impact the XFT's progress?

        i. What are reasons and impacts of blockages?

Workflow & Interruptions

1. How does the XFT's empowerment influence your work both positively and negatively?

    (a) How comfortable are you with the amount of responsibilities?

    (b) How do increasing responsibilities affect your communication?

    (c) How could responsibilities be shared better with different roles?

B

Figures

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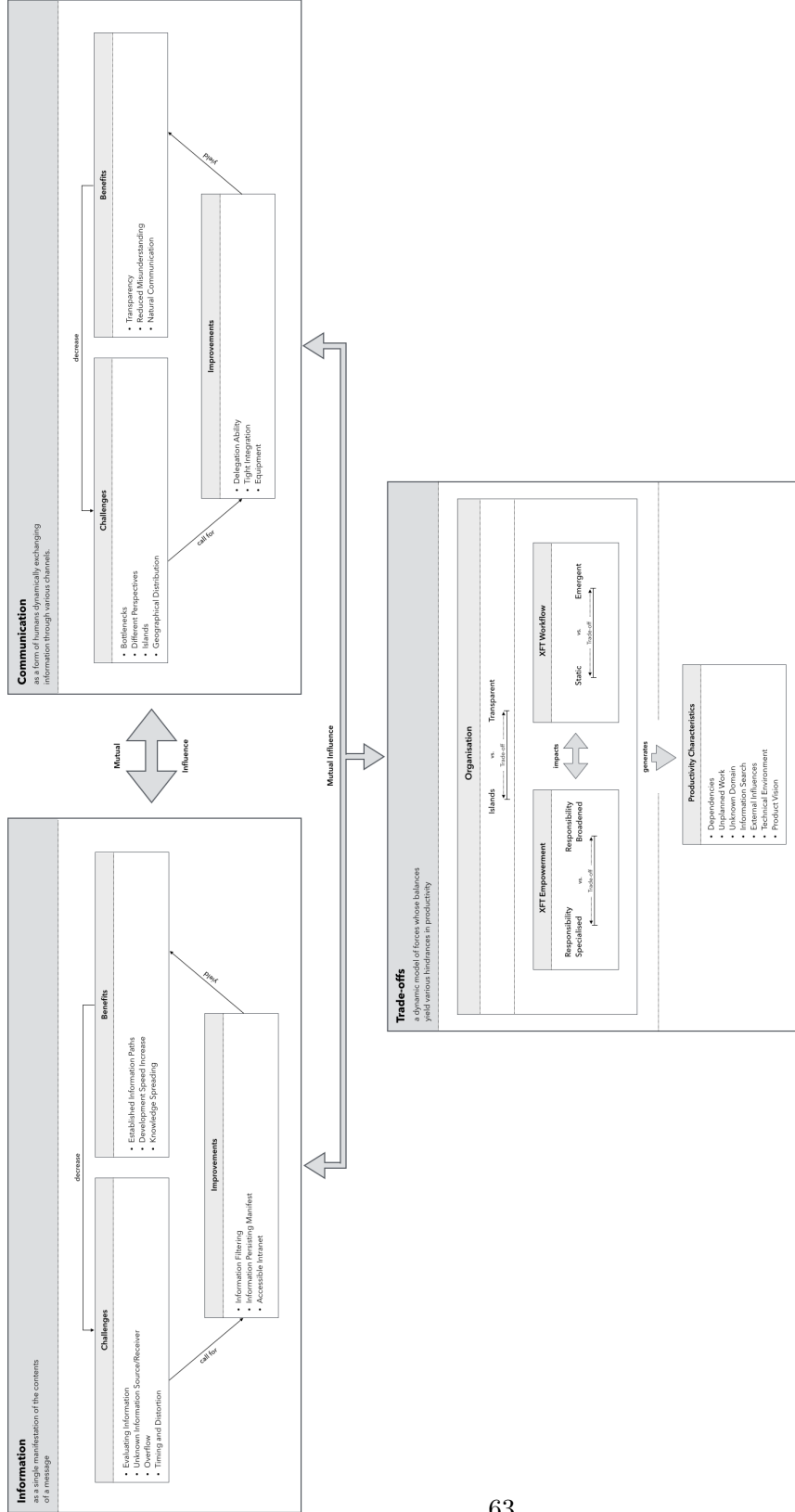
Figure B.1: Information, communication and trade-offs

Daily survey

···

Day 5 - X23

Introduction

Filling out this survey should not take longer than *five minutes*. Please take some time to consider the ideas and guidelines.

Your data will be coded thus your *response is anonymous*. Data gathered will be used to generate a *communication heatmap,* visualizing roles and their interaction by color coding their relative intensity of communicating.

The heatmaps will be *hanged out* on whiteboards around *on daily basis*. One heatmap will try to visualize the last days interaction and another one will show aggregated data gathered over time.

Explanations

This survey tries to investigate *communication and collaboration intensity*, their *initiation* and *nature or reason.*

Intensity: Relate such aspects of communication as duration, information density, significance to your job tasks to their usual levels when in contact with a given role. Communication implies any kind of daily **work related** collaboration or interaction.

Initiated: Whether or not the communication was **mostly initiated** by you.

Nature: The **main reason** or type of communication. If several communications of different nature – **pick the one** with the most influence of your work throughout the day.

Legend

◯ A *scale* from low to high - please mark only one box.

▢ A *checkbox* representing a yes-no answer ticked being yes.

Ⓑ Backlog work on planned sprint goals
  Regarding daily work on the sprint backlog (excludes unplanned interruptions)

Ⓤ Unexpected change or interruption
  External or internal, technical or social, not intended by planned sprint content

Ⓓ Decision coordination
  Progress towards sprint goal hindered by uncertainty or coordination need caused by unclear responsibilities

Ⓔ Exchange of missing knowledge
  About task clarification or to optimize its execution and result

Ⓡ Resolving technical dependencies
  Solely technical and blocking progress

Ⓞ Other (please name)
  Anything particular but unnamed above

} A radio group - please mark one.

MS2 (XFT)   Please *do not* fill the *rows* for co-workers with who you did not collaborate

Name	Communication intensity			Initiated by me	Dominant nature of communication	
	Minimal	*Usual*	*Extraordinary*	*Mark if yes!*	*Please mark only one!*	*Other (please name)*
John Doe	◯ ◯ ◯	◯ ◯	◯	▢	Ⓑ Ⓤ Ⓓ Ⓔ Ⓡ Ⓞ	....
Sven Svensson	◯ ◯ ◯	◯ ◯	◯	▢	Ⓑ Ⓤ Ⓓ Ⓔ Ⓡ Ⓞ	....
Max Mustermann	◯ ◯ ◯	◯ ◯	◯	▢	Ⓑ Ⓤ Ⓓ Ⓔ Ⓡ Ⓞ	....
Vasya Pupkin	◯ ◯ ◯	◯ ◯	◯	▢	Ⓑ Ⓤ Ⓓ Ⓔ Ⓡ Ⓞ	....
Michael Smith	◯ ◯ ◯	◯ ◯	◯	▢	Ⓑ Ⓤ Ⓓ Ⓔ Ⓡ Ⓞ	....
Jane Doe	◯ ◯ ◯	◯ ◯	◯	▢	Ⓑ Ⓤ Ⓓ Ⓔ Ⓡ Ⓞ	....
Pietje Puk	◯ ◯ ◯	◯ ◯	◯	▢	Ⓑ Ⓤ Ⓓ Ⓔ Ⓡ Ⓞ	....

OPOs   Please *do not* fill the *rows* for co-workers with who you did not collaborate

Name	Communication intensity			Initiated by me	Dominant nature of communication	
	Minimal	*Usual*	*Extraordinary*	*Mark if yes!*	*Please mark only one!*	*Other (please name)*
Richard Roe	◯ ◯ ◯	◯ ◯	◯	▢	Ⓑ Ⓤ Ⓓ Ⓔ Ⓡ Ⓞ	....

Section Managers   Please *do not* fill the *rows* for co-workers with who you did not collaborate

Name	Communication intensity			Initiated by me	Dominant nature of communication	
	Minimal	*Usual*	*Extraordinary*	*Mark if yes!*	*Please mark only one!*	*Other (please name)*
Juan Pérez	◯ ◯ ◯	◯ ◯	◯	▢	Ⓑ Ⓤ Ⓓ Ⓔ Ⓡ Ⓞ	....

Figure B.2: Example survey page 1

Department Managers   Please *do not* fill the *rows* for co-workers with who you did not collaborate

Name	Communication intensity			Initiated by me	Dominant nature of communication	
	Minimal	*Usual*	*Extraordinary*	*Mark if yes!*	*Please mark only one!*	*Other (please name)*
Ashok Kumar	○ ○ ○	○ ○ ○		☐	B U D E R O	....

Program Managers   Please *do not* fill the *rows* for co-workers with who you did not collaborate

Name	Communication intensity			Initiated by me	Dominant nature of communication	
	Minimal	*Usual*	*Extraordinary*	*Mark if yes!*	*Please mark only one!*	*Other (please name)*
Josefine Josefsson	○ ○ ○	○ ○ ○		☐	B U D E R O	....
Zhang Sang	○ ○ ○	○ ○ ○		☐	B U D E R O	....

Personal additions   Please *do not* fill the *rows* for co-workers with who you did not collaborate

Person & role	Communication intensity			Initiated by me	Dominant nature of communication	
	Minimal	*Usual*	*Extraordinary*	*Mark if yes!*	*Please mark only one!*	*Other (please name)*
Jean Dupont Designer	○ ○ ○	○ ○ ○		☐	B U D E R O	....
Mehmet Mehmetcik Section Manager	○ ○ ○	○ ○ ○		☐	B U D E R O	....
Pinco Pallino PG	○ ○ ○	○ ○ ○		☐	B U D E R O	....

Others   Please *do not* fill the *rows* for co-workers with who you did not collaborate

Person & role	Communication intensity			Initiated by me	Dominant nature of communication	
Name: Role:	*Minimal* ○ ○ ○	*Usual* ○ ○ ○	*Extraordinary*	*Mark if yes!* ☐	*Please mark only one!* B U D E R O	*Other (please name)* ....
Name: Role:	○ ○ ○	○ ○ ○		☐	B U D E R O	....
Name: Role:	○ ○ ○	○ ○ ○		☐	B U D E R O	....
Name: Role:	○ ○ ○	○ ○ ○		☐	B U D E R O	....
Name: Role:	○ ○ ○	○ ○ ○		☐	B U D E R O	....

Figure B.3: Example survey page 2

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