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# **The Human Centric Aspect of Agile Maturity**

Evaluating factors of the human centric aspect of agile maturity and identifying opportunities for improvement in teams of a software installation division

Master's thesis in Quality and Operations Management

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## Abstract

This master thesis was conducted at the Software Installation Division(SWID) division of Case Company(CC) to investigate how individual teams have fared in terms of the human centric aspect of agile maturity. Research within agile maturity lacks exploration on factors that influence the human centric aspect of agile maturity to build on. For this research, two research questions were framed to explore and analyze the factors that contributed to the human centric aspect of agile maturity. The research question also focused on identifying opportunities for enhancing the human centric aspect of agile maturity in teams of SWID. The research methods that were used for the research include a literature review, interviews, and a survey. A literature review helped to understand the concepts of agile and agile maturity. It also supported our study by helping to identify relevant data collection methods that could be used for research. The literature review also assisted to frame questionnaires for interviews and surveys. Interviews were conducted with scrum masters from eight teams. The self-completion survey built on insight from interviews was sent out to all the members of SWID.

The concept of agile maturity is intended to guide a team/organization to sustain and improve their way of working agile. For every team/organization that has undergone a recent agile transformation, agile maturity functions as a tool to track progress and identify opportunities for improvement of the agile practices. A number of factors contribute to agile maturity and in this thesis, we focused on one of the aspects namely the “Human centric”. Five factors that contributed to the human centric aspect of agile maturity were identified, namely communication, collaboration, self-organization, empowerment, and values. The value factor focuses on human values such as inclusivity and work satisfaction.

The identified factors were assessed in the eight teams of SWID. Subsequently, an analysis of improvement areas for the teams in terms of communication, collaboration, self-organization, empowerment, and values was conducted. The analysis has resulted in a series of recommendations which are highlighted in the last part of the report.

The authors of the thesis have put in equal efforts towards this research work.

Keywords: Agile Maturity, Agile, Human centric, Communication, Collaboration, Values, Team, Self-organization, Empowerment.



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# List of Abbreviations

CC Case Company

SWID Software Installation Division

F2F Face to Face

# Chapter 1

## Introduction

### 1.1 Background

Today the software development sector is rapidly burgeoning with increased competition, constant change in customer requirements and introduction of disruptive technologies (Cooper, 2016). To confront these challenges and level up, there is a surge in demand for a software development process that can aid speed, efficiency, and flexibility. Agile methodology is claimed to assist these attributes and is also described as one of the most popular methods for software development in today's era (Livermore, 2008).

Agile methodology has improved how the software is developed and has emerged as one of the evolutionary approaches which regularly produces high-quality working software (Hobbs & Petit, 2017). Agile software development is guided by four key values and twelve principles which were developed by seventeen software developers in 2001 to meet the rapidly changing customer demands and reduce time to market (Rigby, Sutherland, & Noble, 2018) including a strive for a sustainable way of working. Agile maturity can be defined as an assessment tool that measures the execution of agile practices, principles, and values. It can help in tracking the progress of an agile transformation in an organization and also diagnose improvement areas. Agile maturity in an organization can be analyzed based on different aspects. Aspects such as human centric, customer collaboration, and technical excellence are primarily employed in the analysis of agile maturity (Sidky, 2007). These aspects of agile maturity influence the progress of each other. The Human centric aspect is thus one of the key components of agile maturity. It is primarily focused on individuals, interactions between them, and the degree of importance given to them (Cockburn, 2001). Agile practitioners, agile principles, and values have highlighted the importance of the human centric aspect of agile maturity and consider it to be the cornerstone in the agile software development process. However, the literature have not explicitly highlighted the important factors that contribute to the human centric aspect of agile maturity.

In the contemporary world, the automobile industry has transformed from a traditional manufacturing industry to a sophisticated industry that blends software

and manufacturing for accelerating time to market and for introducing state-of-art products (Katumba & Knauss, 2014). Software plays a crucial role in enhancing automobiles, it can be particularly attributed to autonomous driving, infotainment systems and electrification. In order to improve the software development process and to stay competitive, automobile companies are putting their primary focus on being creative, flexible, and efficient (Katumba & Knauss, 2014). Agile way of working can augment organizations to accomplish these attributes (Hoda, Salleh, & Grundy, 2018). At CC, SWID where our case study is focused in this thesis, the implementation of agile started in the autumn of 2020 during an internal organizational restructuring. The SWID was separated from the division of manufacturing and logistics and was established as a separate division. At the time of our study, SWID encompasses eight smaller teams in it. The division is responsible for both the development and installation of vehicle software applications at end of the production line. All the teams have been working with agile methodology since its inception. However, the maturity of the teams with respect to agile is not of the same level for all the teams. Agile maturity can be assessed based on different aspects as mentioned in the previous paragraph. The Human centric aspect of agile maturity focuses on well being of individuals. An assessment and improvement of human centric aspect of agile maturity can reasonably improve the productivity and efficiency of the teams. It can also be used as a foundation to improve technical excellence and customer collaboration aspects as they're interlinked. Due to the scope of the thesis and the preference of the case company we have focused on delving into the human centric aspect of agile maturity. Our research on exploring, assessing, and suggesting improvements for the factors of the human centric aspect of agile maturity can help to contribute to the literature on examining factors of the human centric aspect and also help SWID teams to improve their human centric aspect of agile maturity.

## 1.2 Purpose

The purpose of this thesis is to throw light on the human centric aspect of agile maturity and explore the factors that contribute to it. This thesis also aims to measure how these factors have fared in each team at the SWID and identify potential opportunities for improvement.

## 1.3 Research Questions

Two research questions were framed to guide our thesis. Cockburn (2001) has stated that the human centric aspect of agile maturity is one of the most important cornerstones of agile software development. The first research question encompasses two parts. The first part of the research question concerns identifying the factors that contribute to the human centric aspect of agile maturity. The second part of the question aims at identifying how the teams of SWID have fared in terms of these factors.



**RQ1:**

- i. *What factors contribute to the human centric aspect of Agile maturity?*
- ii. *How have the contributing factors of the human centric aspect of agile maturity fared in the teams of SWID?*

The second research question is intended to focus on identifying opportunities for improvement of human centric aspect of agile maturity in teams. SWID is currently focused on enhancing the human centric aspect of agile maturity. The second research question focuses on suggesting potential solutions for enhancing human centric aspect of agile maturity in SWID.

**RQ2:**

*How can the human centric aspect of agile maturity be enhanced at SWID?*

## 1.4 Delimitation

The scope of the thesis work is focused on evaluating the human centric aspect of agile maturity in the SWID. The evaluation process does not involve the use of any prescribed tool. Evaluation is done using a literature survey, interviews, and survey responses. The work is limited to evaluating the human centric aspect of agile maturity and identifying opportunities for improving it in SWID. The recommendations from the thesis cannot guarantee an immediate improvement in the human centric aspect of agile maturity. The recommendations would hopefully provide gradual improvements over time. The research was done remotely due to COVID 19. Hence there is a limitation with respect to communication and observation

# Chapter 2

## Literature Background

This chapter presents an overview of agile, agility, agile maturity, and its human centric aspect. An overview of scrum is also presented in this chapter as it is the agile method adopted by the case company. The information is obtained based on the literature review.

### 2.1 Traditional Versus Agile Development

Software development gained traction in the 1970s (Braude & Bernstein, 2016). During the early days of the evolution of the software development industry, traditional plan-driven methods were predominantly put to use in the development process. Traditional plan-driven methods like the waterfall method or stage-gate method were used for the software development process (Al-Saqqa, Sawalha, & AbdelNabi, 2020). The development cycle of traditional methods progresses sequentially and closely follows the development cycle of Design, Build, Test, and Implement (Awad, 2005). The traditional development process is visualized in Fig 2.1. These traditional methods advocate a step-by-step process in which moving to the next phase is possible only when the previous phase has been completed. A set of objectives is defined for each phase of the development cycle, based on the accomplishment of these objectives a decision to progress to the next phase is taken. The set of objectives are well-defined and determined before the commencement of the development process. The objectives are in line with customer and technical requirements (McCormick, 2012). The customer requirements are well known and stable over time in traditional development methods. Since these traditional development methods follow sequentially, any error detected in the testing phase would mean that the previous phases of development must be redone. Even though the customer requirements are stable and well known in traditional development methods, sometimes customers would want to upgrade a requirement. In that case, new change requests from the customers are inevitable, it would also mean rework of previous phases. Rework of the previous phases would incur a lot of costs and would also consume a lot of time. To find a solution for this obstacle, more iterative approaches were suggested over the period, namely the agile approach of software development (Petersen, 2010).

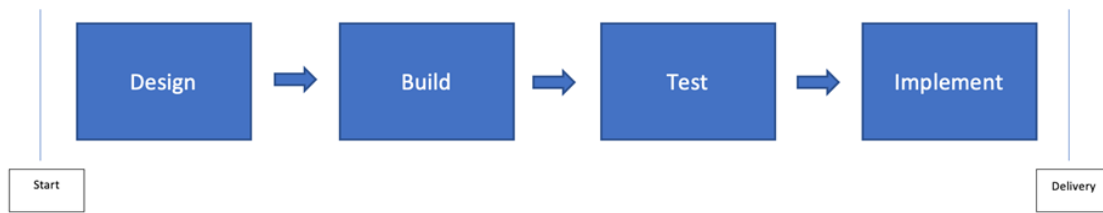


Figure 2.1: Traditional Development Process

The development cycle of an agile approach encompasses the same Design, Build, Test and Implement phases as in traditional methods. But these phases are accomplished parallelly in the agile approach as opposed to the sequential progression in traditional methods. In the agile approach, there are frequent design-build-test-implement iterations (McCormick, 2012). The agile development process is visualized in Fig 2.2. Each iteration of the agile process helps to provide incremental working software. These iterations enable a shorter development cycle and hence helps to cut down the time to market (Sliger, 2006). Frequent iterations and shorter development cycles of the agile approach can be attributed to the cross-functional teams, where people work with different phases of the development cycle together (Sliger, 2006). The customer requirements are not fixed in the agile approach, it changes from time to time. The shorter development cycles, iterations, and collaboration between team members enable accommodation of change requests and quick decision making in an agile approach (Cohen, Lindvall, & Costa, 2004). Agile methods and traditional methods have a stark difference from each other. Time and resources are fixed in agile methods, the scope is flexible. Whereas in traditional methods scope is fixed, time and resources are flexible (Hunt, 2006). To provide a better understanding of the agile approach, it is further explained in the following section.

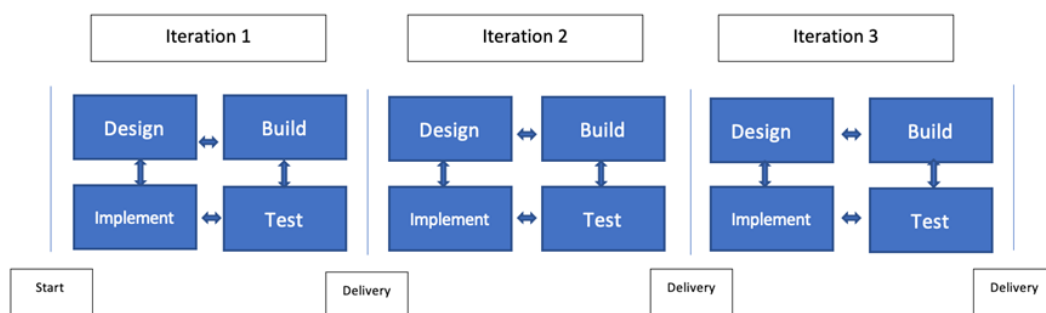


Figure 2.2: Agile/Iterative Development Process

## 2.2 The Agile Approach

The core of the agile approach can be defined as a combination of two parts. Agile manifesto constitutes one part of the core of agile approach (Dingsoyr, Nerur,

Balijepally, & Moe, 2012). The Agile manifesto states values and principles that can guide an organization into an agile way of working. The constituents of the agile manifesto are explained in the upcoming Chapter 2.3. The other part that constitutes the core of agile is the concept of agility (Conboy & Fitzgerald, 2004). Agility composes a set of attributes that agile development systematically follows in its approach. The concept of agility is explained in-depth in Chapter 2.4. The agile approach can be largely influenced by the organizational structure of the firm. The agile approach recommends the idea of decentralized decision making (Cao, Mohan, Xu, & Ramesh, 2009). This idea could be supported by frequent exchange of information between team members, collaborations within and across teams, and by providing a degree of freedom to members to make decisions. Decentralized decision-making can also support imperative concepts of the agile approach like self-organization. Self-organization helps the members of the team to designate tasks among themselves and set timelines for the completion of these tasks without any intervention from management. Self-organization helps team members to understand their responsibilities and also about what the team expects from them (Hoda & Murugesan, 2016). Considering the above discussion, it can be assumed that a flat organization structure would be more suitable for adopting an agile approach rather than a hierarchical and central decision-making structure (Boehm & Turner, 2003). The agile approach has been incorporated by several different methods such as Test-Driven Development (TDD) method, Feature Driven Development (FDD) method, Extreme Programming (XP) method, Scrum method, and Dynamic System Development Model (DSDM). These methods differ from each other by selecting an appropriate set of practices and terminology (Elbanna & Sarker, 2015). Each method has its own life cycle, principles, and roles. Even though they vary in their approach, they find a common ground in following core values of agile i.e contributing to a project in iterations and incremental processes (Al-Saqqa et al., 2020). The case company uses the Scrum method for software development and the constituents of scrum is explained in Chapter 2.5

## 2.3 The Agile Manifesto

The Agile manifesto also known as Manifesto for Agile Software Development encompasses values and principles which can act as a guide for an organization willing to adopt an agile approach. Fowler, Highsmith, et al. (2001) states the four values that lay the foundation for agile are (See Table 2.1):

<i>Individuals and interactions over processes and tools</i>
<i>Working software over comprehensive documentation</i>
<i>Customer collaboration over contract negotiation</i>
<i>Responding to change over following a plan</i>

Table 2.1: The four core values of Manifesto for Agile Software Development (Fowler et al., 2001)

The interpretation from the first core value is that *communication and interactions* between human software developers is more important than formal process, tools and methods. The focus of this value is to prioritize humans, collaboration, and communication between them in an organization (Rodríguez et al., 2019). One may interpret that the second value statement as the prioritization of efforts put into actual programming and to minimize time spent on documentation to the minimum requisites. The Third core value suggests to enhance *customer collaboration* by involving them in all phases of the project, gathering input, obtaining feedback, and having frequent communication with them rather than just negotiating contracts to obtain financial and administrative benefits (Rodríguez et al., 2019). The Fourth core value of agile development suggests focusing on *responding to a change* by being flexible and accommodative. The project plan must continuously evolve according to customer feedback and demand. The project should not necessarily follow a predetermined trajectory (Rodríguez et al., 2019).

In addition to these four core values, the agile manifesto also lists out twelve principles (Hunt, 2006). The twelve principles were derived from the four core values of agile development. The listed principles can be considered as guidelines to agile methodology and can also be used as checklists to verify if the organization is following an agile way of working. The twelve principles are (See Table 2.2):

<p>“Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.”</p> <p>“Welcome changing requirements, even late in development. Agile processes harness change for the customer’s competitive advantage.”</p> <p>“Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.”</p> <p>“Business people and developers must work together daily throughout the project.”</p> <p>“Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.”</p> <p>“The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.”</p> <p>“Working software is the primary measure of progress.”</p> <p>“Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.”</p> <p>“Continuous attention to technical excellence and good design enhances agility.”</p> <p>“Simplicity—the art of maximizing the amount of work not done—is essential.”</p> <p>“The best architectures, requirements, and designs emerge from self-organizing teams.”</p> <p>“At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behaviour accordingly.”</p>
---

Table 2.2: The twelve principles of manifesto for agile software development (Beck et al., 2001)

The twelve principles stated in the agile manifesto highlights important attributes that can support an agile way of working (Sidky, 2007).

## 2.4 Agility

Agility is the ability to adapt and respond rapidly to an uncertain environment and unpredictable customer requirements (Conboy & Fitzgerald, 2004). Agility encompasses the value of flexibility and speed in it (Conboy, 2009). Flexibility is the potential to embrace change effectively. Speed is the rate at which a response is handed out to a change proposal (Gren, Torkar, & Feldt, 2017). The term agility is directly linked to nimbleness, suppleness, quickness, dexterity, liveliness, or alertness (Erickson, Lyytinen, & Siau, 2005). Al-Saqqa et al (2020, p. 250) states that “The amount of agility the firm has will determine the degree of competitively it owns”. The degree of agility can also be closely associated with the characteristics of an organization and it is not constant through all phases of a project. Flexibility can be considered as one of the critical characteristics of Agility. Flexibility helps to accommodate change requests in a project (Ruparelia, 2010). In agile utmost importance is given to customer satisfaction and requirements. In most cases, the developers oblige to make changes as per customer requirements. The changes accommodated due to the characteristic of flexibility can impact the effort, and time (Stålhane, Katta, & Myklebust, 2014). The flexibility characteristic of agility may seem attractive, but it carries its own drawbacks.

## 2.5 Scrum

Scrum is one of the most used agile methods in the software development industry (Al-Saqqa et al., 2020). Scrum is considered to be a framework rather than a set of rules and practices. Scrum was first proposed by Jeff Sutherland and Ken Schwaber in the year 1995 and they again revised the scrum framework in 2010. The founders of scrum published a Scrum guide detailing the activities, roles, and rules of the scrum framework. Scrum is an iterative framework where development is carried out in short sprints. Each sprint can last for 1-4 weeks (Maximini, 2018). In each sprint, the product plan is outlined, developed, and tested. Iterative and incremental development of scrum helps to obtain feedbacks faster and helps in identifying errors at an earlier stage (Schwaber & Sutherland, 2016). The scrum framework encompasses *development team, product owner, and scrum master*.

### 2.5.1 Development Team

A development team is a self-organizing team in which roles and responsibilities are dynamic and change over time (Hoda, Noble, & Marshall, 2011). The roles and responsibilities of the members in development team are considered to be informal (Hoda et al., 2011) . The team consists of cross-functional members who collaborate with each other to work towards sprint goal (Mundra, Misra, & Dhawale, 2013). The team has the freedom to decide the way in which tasks are accomplished. The

development team can have 5-9 members according to the scrum guide (Williams, 2010).

## **2.5.2 Product Owner**

The Product Owner (PO) acts as a messenger and communicates with the development team and stakeholders of the project. The PO collects requirements from the customer and is responsible for providing the development team with user stories/ features (Sverrisdottir, Ingason, & Jonasson, 2014). A feature is a part of product, usually a service that meets the needs of a stakeholder (Knaster, 2021). Short descriptions of a small amount of required functionality written in the user's language are known as stories. Agile Teams develop small, vertical slices of system functionality that can be finished in a single sprint (Knaster, 2021). The PO also has the responsibility of prioritizing the product backlog for each sprint. The PO prioritizes the product backlog based on customer requirements. The PO also makes sure that the development team clearly understands the requirements for each sprint (Williams, 2010).

## **2.5.3 Scrum Master**

The scrum master acts as a coach for the development team. The scrum master does not have authority over the development team, instead, he makes sure the team has resources and capacity for reaching the goal in a sustainable way (Al-Saqqa et al., 2020). The scrum master also ensures that the development team follows agile practices and rules. The Scrum master holds a meeting with the development team daily for 15 minutes to track progress and remove obstacles faced by the team if any (Spiegler, Heinecke, & Wagner, 2019). This is also referred to as daily scrum and is brought up in the subsection Sprint (2.5.6) . The Scrum Master can also be a developer in the development team and can have dual roles (Al-Saqqa et al., 2020).

## **2.5.4 Product Backlog**

The product backlog is updated by the product owner. The product backlog contains all the features and requirements of the product that was conveyed by the customer. Based on the priority of the customer requirement, the features are sorted in ascending order. The highest priority feature would be at the top of the backlog (Maximini, 2018). The product backlog is updated constantly until the product is completed and handed over to the customer (Janus, 2012). Product backlogs are usually not self-explanatory (Maximini, 2018). Continuous collaboration between the product owner and the development team is needed to ensure that the product backlog is properly understood.

## **2.5.5 Sprint Backlog**

The sprint backlog consists of selected items from the product backlog (Cervone, 2011). The features/user stories for the upcoming sprint are selected from product backlog (Maximini, 2018). The development team creates a sprint backlog during

sprint meetings. The development team is responsible for the sprint backlog and members outside the development team do not influence it. The sprint backlog can be considered to facilitate the breakdown of extensive requirements into smaller tasks (Schwaber & Sutherland, 2016).

### **2.5.6 Sprint**

Sprint is one of the important events in the Scrum framework. The duration of the sprint is 1-4 weeks (Maximini, 2018) . The actual development work of a product is kick-started during the sprint event (Maximini, 2018). Sprint encompasses activities like sprint planning, development work, and daily scrum. Sprint planning is a activity in which the team along with the Scrum master decides on the goal of the sprint and on how to accomplish the goal (Al-Saqqa et al., 2020). Development work is another activity within the sprint. In this activity, members of the development team decide on which feature they want to work with and how they want to work with it. The work of a development team is visualized using a scrum board that contains categories “To Do” “In Progress” and “Done”. Visualization is done to ensure that the development team is working towards their sprint goal (Zhang & Patel, 2010). The daily scrum is another activity in the sprint. It is usually a 15-minute daily meeting in which the scrum master and development team members participate. During this meeting, the progress of the emerging work is tracked. The current progress, progress to be made, and impediments in sprint goals are discussed in this phase (Schwaber & Sutherland, 2016). At end of the sprint, a sprint review meeting takes place. The product owner, the scrum master, the development team, and the stakeholders take part in the sprint review meetings. In sprint review meetings, the output of the sprint is inspected and analyzed. The participants of the sprint review meeting collaborate to determine the next steps and identify the need for changes (Maximini, 2018).

### **2.5.7 Sprint Retrospective**

A sprint retrospective takes place after the sprint review. In a sprint retrospective, the development team introspects their performance and identifies opportunities for improvement(Wawryk & Ng, 2019). They introspect their ways of working, including tools, processes, and people. The introspection helps them to identify strengths, weaknesses, and threats. Sprint retrospective also helps the team to identify how their strengths can be used to add value to upcoming sprints (Schwaber & Sutherland, 2016).

## **2.6 Large-Scale Agile**

Agile methods are considered to be best suited for organizations with small and co-located teams. It can be attributed to the fact that small teams enable ease of access to users and business experts (Cockburn, 2001). The success of small teams in agile has inspired its use in large-scale software development. Organizations are inclined to large-scale agile ramp up after witnessing the success of small teams in terms of



productivity, time to market, flexibility, and quality of software development (Rigby et al., 2018). Large-scale agile adoption is confronted with many challenges notably inter-team coordination and knowledge sharing (Dingsøy, Rolland, Moe, & Seim, 2017). Rolland, Dingsøy, Fitzgerald, and Stol (2016) state that as the number of agile teams in organization increases, the ability to coordinate with other teams decreases as the teams are focused on self-management. The authors also state that lack of inter-team coordination could in turn hamper the progress of a large project. Rolland et al. (2016) also state that knowledge sharing is affected in large-scale agile implementation. The authors add that increase in number of members in a project stifles the opportunity to share knowledge.

Dingsøy et al. (2017) proposes a step-wise ramp up which focuses on implementing agile in small teams and inducting agile values and practices into non-agile teams. Dingsøy et al. (2017) suggests that agile scale-up should move from the team level to the inter-team level and then to higher levels to overcome potential large-scale agile challenges. Rigby et al. (2018) suggests creating a classification of teams and then sequence the agile transition in these teams to mitigate challenges posed by large-scale agile. Several frameworks have also been proposed by agile practitioners to help organizations in large-scale agile development. Large Scale Scrum (LeSS), Scaled Agile Framework (SAFe), the Nexus framework and Disciplined Agile Delivery are some popular frameworks put into use by organizations for large scale agile development (Bick, Spohrer, Hoda, Scheerer, & Heinzl, 2017). Our case company uses SAFe for scaling agile and more detailed information on SAFe is found in Appendix A.

## 2.7 Agile Maturity

Agile maturity is an ambiguous concept and cannot be confined to a single definition (Gren et al., 2017). The ambiguity around agile maturity makes measuring maturity tedious. Agile maturity can be closely related to behavior that conforms to an agile way of working (Gren et al., 2017). Apprehensions were raised by organizations on how to track their progress/regress in terms of agile. Comprehensive assistance to organizations in understanding the concept of agile and a roadmap to scale the agile way of working was supported by the concept of agile maturity (Ozcan-Top & Demirörs, 2013). Agile maturity can guide transformation, improve and assess agility (Yürüm, Demirörs, & Rabhi, 2018). In literature, there are several maturity models that can be used to assess agile maturity. Maturity models are the instruments used to rate capabilities and based on this rating, initiatives can be implemented to improve the maturity of an element, a person, an object or a social system (Fontana, Fontana, da Rosa Garbuio, Reinehr, & Malucelli, 2014). Maturity models provide a direction at every step of development. The maturity model associates agile values and principles to different maturity levels to make it understandable. These values and principles help in iterative improvements and help to achieve agility (Sidky, 2007). A number of agile maturity models have been published by different consultants. These maturity models differentiate from each other by the number of levels and factors/themes they measure. Most of these ma-

turity models have not been validated in scientific research (Gren, Torkar, & Feldt, 2015). Agile practitioners also state that they couldn't draw conclusions on the benefits of using prescriptive maturity models (Fontana et al., 2014). Agile maturity can be assessed based on different aspects, such as technical excellence, customer collaboration, and the human centric aspect (Sidky, 2007). In this thesis, we are focusing on the human centric aspect of agile maturity. The area of focus was predominantly selected to study the human centric aspect. In the following Chapter 2.8, we elaborate on the underlying factors of the human centric aspect and their influence on agile maturity.

## 2.8 The Human Centric Aspect of Agile Maturity

Agile maturity can be assessed based on distinctive aspects like human centric, customer collaboration, and technical excellence as described in the previous section. These aspects were condensed based on careful evaluation of agile principles that were listed in the agile manifesto (Sidky, 2007). Each aspect possesses a unique characteristic that differentiates them from each other. The customer collaboration aspect focuses on the relationship and communication between the customer, developers and other stakeholders (Beck et al., 2001). Technical excellence focuses on the skills and knowledge that the developers impart to ensure the highest quality of the software is produced (Highsmith & Highsmith, 2002). Likewise, the human centric aspect focuses on the individuals and interactions between them (Sidky, 2007). The Agile manifesto consists of a set of values and principles that guides the agile way of working. The degree of adherence to these principles and values can predominantly influence the agile maturity of team/organization (Patel & Ramachandran, 2009). Values and Principles of the agile approach to software development emphasized that communication, collaboration, and empowerment are of utmost importance in the manifesto for agile software development (Beck et al., 2001). To exemplify, some of values and principles (See chapter 2.3) that reiterates the importance of these factors in the agile manifesto are presented: "Individuals and interactions over processes and tools", "The most efficient and effective method of conveying information to and within a development team is face-to-face conversation" and "Build projects around motivated individuals. Give them the environment and support they need and trust them to get the job done". Berczuk (2007) cites that communication is key in agile maturity as it helps in "frequent, good quality feedback to facilitate the ability to change direction as business needs change". Communication helps to bring people closer and aids to ease information and knowledge transfer between them which can, in turn, assist to respond to changes in a quick manner (Berczuk, 2007). Tessem (2014) states that empowerment is another key component of agile maturity. The author explains that the characteristic of empowerment provides individuals with a degree of freedom to make decisions, express disagreement, and pitch in new opinions. These attributes of empowerment can help to bring out innovative ideas, encourage individuals, and improve productivity levels.

Agility could be closely related to the characteristics of flexibility and speed. Flexibility and speed in turn rely on the collaboration factor (Berczuk, 2007). Collabora-

tion helps to bring individuals from different teams and competencies together, this enhances the ability to receive frequent feedback and arrive at a collective solution to complex problems. It therein helps to build trust among people and individual's knowledge. These traits of collaboration can enhance agility and therefore influence agile maturity (Williams, 2010). Communication, empowerment, and collaboration have a substantial influence on agile maturity and have a common focal point. They all focus on people and the interaction between them.

# Chapter 3

## Case Description

CC is one of the leading automobile manufacturers in Sweden, the company initially started manufacturing automobiles in the twentieth century. CC has always ensured the utmost safety in the cars produced by them. Apart from a primary focus on safety, CC is currently working on building cars that are fully autonomous, sustainable, and electric. Software plays a very crucial role in electrification and building an autonomous car (Vollertsen, 2020). SWID of CC focuses on software deployment, development, maintenance, and upgrade. SWID in order to improve their efficiency and productivity adopts an agile way of working. The most important focus area of SWID is leadership, people, and culture. SWID believes that agile leadership and empowered teams can positively contribute to the growth of organization and division. SWID also believes that increased agile maturity can help to the iterative improvement of the quality of output.

### 3.1 The Software Installation Division

SWID established itself as a separate division on Oct 1, 2020. SWID closely works with building software, integrating it with hardware, maintenance, and upgrading software for CC. CC as an organization are working towards one of its goals of enabling software as a business opportunity and improving the car experience every day. SWID works towards contributing to this goal. The primary focus area of SWID is to advance the installation of software through WIFI, cable, and over-the-air. SWID believes that enhancing the software installation procedure would help them accelerate time-to-market. SWID further branches into eight teams and each team works with a separate application. But team 5 is an exception as it is further subdivided into team 6 and team 7 and each smaller team works with different features on the same application. That is, in total eight teams are subjected to the present study.

## **3.2 Agile Transformation**

The Agile Transformation in CC began during the year 2017. The company focused on organization-wide agile transformation and all divisions were part of it. SWID was not formed when the Agile transition was initiated at CC. They were a part of a different division when the transformation took place. SWID was started in 2020 and they have adopted an agile way of working from the start. The teams in SWID closely work with agile frameworks like SAFe, Scrum and methods like kanban.

## **3.3 Stakeholders**

SWID is associated with several stakeholders. SWID stated that they have a positive rapport with their stakeholders and also that there is a frequent flow of information between them. Stakeholders range from internal departments to external consumers. The internal stakeholders of SWID are CC's R&D department and manufacturing plant. Here stakeholders and SWID together build new software, level up existing ones, and integrate hardware with software. External stakeholders of SWID are CC workshops and end customers. External stakeholder engagement predominantly focuses on servicing the software, deploying new software, and updating existing software. SWID tends to put its primary focus on the requirements of stakeholders. SWID uses stakeholder feedback from each phase to progress further. SWID tends to maintain a cordial relationship with its stakeholders.

# Chapter 4

## Methods

In this section, research process concerning this master thesis is presented. It includes outlines of the research strategy, the research design, data collection, the quality of conducted research and ethical considerations.

### 4.1 Research Strategy

A deliberate research strategy helps to frame the step by step action plan that can guide thoughts and efforts towards systematic research practice, and therefore enable qualitative results and reporting (Bell, Bryman, & Harley, 2019). This research follows a research strategy that uses a mix of qualitative and quantitative research methods to obtain in-depth knowledge and information from the case company. A research strategy can be classified into inductive, deductive, or abductive based on the link between theory and empirical research. An inductive approach helps to build theory using empirical findings whereas a deductive approach supports the exploration of theory and then uses empirical data to test the basis of that theory. For this thesis, we look to inspect existing theory and also to develop it based on empirical research. This implies that a mix of the deductive and inductive approaches is used. This combination is called the abductive approach, Figure 4.1 adapted from Dubois and Gadde (2002) depicts the constant redirection and matching between theory and empirical research.

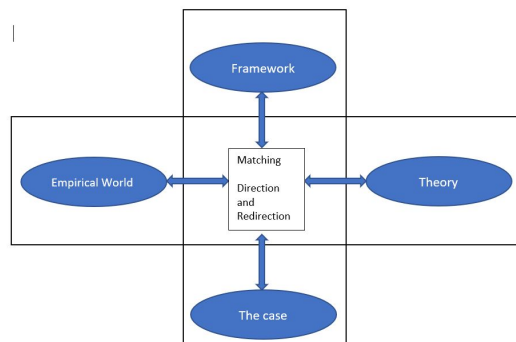


Figure 4.1: Abductive approach adapted from Dubois and Gadde (2002)

## 4.2 Research Design

A research design explains the framework of research methods that are employed for the data collection process (Bell et al., 2019). The design for this master thesis is based on a case study research approach, and focuses on data collection from a group of teams to obtain detailed information and knowledge. One of the research questions in this study is focused on determining the rating of human centric factors of agile maturity in teams of SWID. The analysis was performed on a team level and was not focused on the organization level.

### 4.2.1 Pre-study

The pre-study was conducted within two parts: Organizational Agile Framework and Literature study. These two parts were studied in parallel.

The authors searched the organization's internal database using keywords *Agile*, *Scrum*, *SAFe* and these results helped to understand the functionality of the organization SAFe Framework (See Appendix A) which is the case company's adapted form of SAFe framework. The search results from internal database also helped us understand Agile Release Train(ART), information flow and software development.

The literature study was conducted on Agile software development, Agile maturity, Agile transformation, Agile scaling, and Agile in the automotive industry to develop knowledge on existing theory. Articles were searched using a set of keywords in the following search engines: Chalmers Library, Harvard Business Review and Science Direct. The academic thesis supervisor also recommended articles in the area of agile that could be fruitful for research. The resources used for this study combines articles and websites that outlines Agile methodology, principles, values, and practices. The literature study was conducted in three parts.

The first part was focused on gaining knowledge about agile software development. Articles were searched using a set of keywords: *agility*, *agile software development*, *automotive agile*, *core*, and *review of agile*.

The second part was focused on understanding agile practices, agile maturity, and agile teams. Articles were searched using keywords: *agile practices*, *self-organizing teams*, *agile maturity*. This part of the study helped us understand the concept of agile maturity and aided in the process of framing interview questions for the scrum masters of SWID.

The last part was focused on obtaining knowledge on the human centric aspect of agile maturity. Keywords such as *agile human centric*, *collaborative development*, and *agile empowerment* were used to search for related articles. The articles from this part of the literature review helped in providing information on the human centric aspect of agile maturity and also in identifying important factors that contributed to it. It also helped us to develop questions for the survey.

## 4.2.2 Interviews

Interviews were primarily conducted to explore the factors that contribute to the human centric aspect of agile maturity. Interviews also aimed at analyzing challenges, communication, and the planning process within teams of SWID. Interviewees were selected based on the convenience sampling technique, which is a type of non-probability sampling that helps the researchers to take samples from a group of individuals who are available for interviews and are also willing to participate in the interviews (Taherdoost, 2016). Seven interviews were conducted. The seven people were available for interview and the interviewees were chosen based on discussion with the CC supervisor of the present thesis. Seven interviews were deemed as an appropriate number to obtain relevant information in the project’s time frame. All interviewees were scrum masters and most were also working as developers (See table 4.1). All the interviews were conducted through the online channel Microsoft Teams due to Covid-19. As stated by Bell et al (2019), semi-structured interviews are guided by prepared questions which also enables to ask follow-up questions for capturing relevant information. Semi-structured interviews were considered to be appropriate for our research as they can help us capture precise thoughts and reflections of informants about what factors they think influenced the human centric aspect of agile maturity. Semi-structured interviews lasted up to a duration of approximately 45 minutes per interview. A set of 19 questions were asked to the interviewees (See Appendix B). The semi-structured approach enabled us to get comparative data and capture unique descriptive data as stated by Waller, Farquharson, and Dempsey (2015).

Person 1(P1) was a both Scrum master and Developer at Team 1(T1)
Person 2(P2) was a Scrum master at Team 2(T2)
Person 3(P3) was a Scrum master and Developer at Team 3(T3)
Person 4(P4) was a both Scrum master and Developer at Team 4(T4)
Person 5(P5) was a both Scrum master and Developer at Team 5(T5)
Person 6(P6) was a both Scrum master and Developer at Team 6(T6)
Person 7(P7) was a both Scrum master and Developer at Team 7(T7)

Table 4.1: List of Interviewees

Interviews were recorded and transcribed. The transcribed interviews were analyzed using a structured approach called *thematic analysis*. It is a systematic approach to capture the underlying meaning from qualitative data (Terry, Hayfield, Clarke, & Braun, 2017). For this study, we analyzed the interview data using Braun and Clarke (2006) six steps for conducting thematic analysis. The steps suggested by Braun and Clarke (2005):

1. Familiarising with data
2. Generating initial codes
3. Search for themes



4. Reviewing themes
5. Defining and naming themes
6. Producing the report .

The Table 4.2 explains how the thematic analysis was conducted. It helped us to identify the important factors that contribute to the human centric aspect of agile maturity. Both the ones that were already derived from the literature, as well as the conception of two additional ones.

<b>Interview Statement</b>	<b>Refined meaning</b>	<b>Theming &amp; Reviewing</b>	<b>Defining &amp; Naming</b>
"Team does not communicate with me as often as they do with the PO".	Restricted communication within team	Communication between members of team	Communication
"Some developers want to work individually and they don't want to collaborate with others".	Lack of collaboration with team members	Collaboration within team	Collaboration
"It is difficult for the team to understand responsibilities and organize work among themselves as they are used to the traditional way of working".	Reliance on management to assign work	Lack of self-organization of team members	Self-organization
" Our team should be more accommodative of cultural differences"	Lack of inclusivity of different cultures in team	Inclusivity within team	Values

Table 4.2: Example of Thematic Analysis

### 4.2.3 Survey

Surveys are considered to be a viable quantitative approach for obtaining quantifiable data. Web-based surveys are considered to be cheap, efficient, and also helps to obtain responses in a short time (Bell et al., 2019). Web-based surveys can use a wider variety of embellishments in terms of appearance (Bell et al., 2019). The web-based survey helped reach a wider audience and also helped to mitigate the issue of accessibility to respondents that was caused by the pandemic situation. Based on literature review, interviews, and meetings with supervisors we decided to use web-based self-completion surveys for collecting data regarding the factors that contributed to the human centric aspect of agile maturity. For this research, we used a self-completion web survey that was facilitated through Microsoft Forms. The employees of CC were bound to respond to surveys only from intranet applications due to confidentiality. Hence, we used Microsoft Forms from the CC intranet to conduct this survey. The self-completion survey consisted of questions for five factors, the questions that belong to each factor were framed based on literature review, internal documents, and consultation with academic and CC supervisors. A total of 23 self-completion questions were framed, the factor to which each question belonged to is highlighted in Table 4.3 and questionnaire in Appendix C. We also had one open question in the survey for respondents to provide feedback and suggestions. The survey had five options for each question, the options and the scale for each option are displayed in Appendix D1. Question 23 of the survey had different scale for each option than that was used for other questions, further explanation is provided in Appendix D1. The survey was sent to all the team members of the SWID. It was sent out to a total of 70 respondents, all of them were members of the development team. We received 30 responses in total for the self-completion

Indicator	Questions
Communication	Q1,Q2,Q3,Q4,Q5,Q6
Collaboration	Q7,Q8,Q9,Q10,Q11,Q12
Self-Organization	Q13,Q14,Q15
Empowerment	Q16,Q17,Q18,Q19,Q20
Values	Q21,Q22,Q23

Table 4.3: Survey Questionnaires Categorization for Human Centric Aspects of Agile Maturity

survey. From Team 1 we received six responses and from Team 2 we received three responses. Five responses were registered by each of Team 3 and Team 4. Team 5 registered two responses for the self-completion survey. Team 6, Team 7, and Team 8 registered three responses each for the survey. Each team of SWID had an average of seven members in it. The statistical data of respondents from each team is presented in Appendix D1. The response rate for the survey is close to 42 percent. The respondents were anonymous hence their roles in teams were not divulged. We assume that the respondents for the survey would have been from different roles like developer, scrum master, and product owners from each team. A total of 40 respondents did not respond to our survey, multiple reminders were sent to them before ending the survey. Lack of interest in the survey, length of the survey, and lack of time for responding to the survey are assumed to be some of the reasons for not getting a response from the 40 members. The responses from the survey were then analyzed and the nominal range for each factor for each team was calculated based on the method presented in Appendix E. To reduce the bias, we have used cheap talk scripts in their questionnaires. The cheap talk script elicits respondents with a short description and explicitly stresses the potential problem of hypothetical bias before the respondent answers the questions (Van Loo, Caputo, Nayga Jr, Meullenet, & Ricke, 2011).

### 4.3 Quality Of Research

For this thesis, we use a combination of both qualitative and quantitative research. According to Bell et al. (2019), one of the primary criteria for evaluating qualitative research is trustworthiness. To achieve that, four quality criteria are considered to be important and these are: *Credibility, Transferability, Dependability, and Confirmability* (Bell et al., 2019). Credibility was potentially ensured by using literary resources from Chalmers Library, Google Scholar, and Science Direct. Credibility was also ensured by using interview guides and conducting a pilot study on interview questions. The interviews were transcribed and sent to the respective interviewees for review and approval which also ensured the credibility of our research. Seven interviews were conducted with scrum masters of different teams in SWID. The scrum master acts as a coach to the development team and potentially has frequent interactions with members of the development team. Considering this, their role was potentially best suited to answer our questions on the human centric aspect of

agile maturity. Confirmability was potentially ensured by having regular meetings with the academic supervisor and CC supervisor for this thesis. The data results were also personally approved by interviewees after reviewing of transcription which also ensured confirmability in our research. Personal preferences and bias were better mitigated in interview questions and answers. This was done using cheap talk scripts before the interview. This likely ensured that confirmability criteria are met in our research. However, it was difficult to ensure the dependability and transferability criteria are met in our research. Since this study was performed at a single organization and all the findings from this study might only be applicable to that particular organization. However, some of our findings partially aligned with agile maturity theories, so it can be argued that some of our findings may be generalizable in other contexts as well. Therefore the quality criteria of dependability and transferability are assumed to be partially met for this research.

Quality criteria for quantitative research are *Reliability, Replication, Validity* (Bell et al., 2019). In quantitative research, reliability implies the degree to which data from surveys are consistent every time it is measured. For this research, we focused on the entire population of the eight teams at SWID. We sent out our self-completion survey to all the 70 members who belonged to different teams of SWID. We received over 30 responses to our survey from members of all the teams. The distribution of responses received was quite even for Team 2, Team 5, Team 6, Team 7, and Team 8. Team 1, Team 3, and Team 4 had a higher response rate than the rest. The statistical data of responses from each team is presented in Appendix D1. The overall response rate was 42 percent from a sample of 70 members. Delice (2010) states that the number of responses registered for a survey should be more than or equal to thirty to ensure reliability of the research. The number of responses received for the survey ensures that the reliability criteria are possibly met for this research. The Replicability criteria of quality seek to identify if the methods, tools, and techniques are explained and articulated precisely for another researcher to use them in their research. In section 4.4, we have explained in detail the research methods used for this thesis, and in the appendix, we have also presented our interview questionnaires (See Appendix B), survey questionnaires (See Appendix C), and the method used to compute our results (See Appendix E). This ensures that replicability criteria are possibly fulfilled in this research.

Validity of the study is influenced by how accurate each step of the research is outlined and performed with respect to its intended purpose. The quantitative method used in this research for obtaining data is self-completion survey questionnaires. The questionnaires were focused on assessing the range of human centric factors of agile maturity in teams of SWID. The questionnaires were designed by considering literature review, thematic analysis of interviews, and discussion with an academic supervisor and CC supervisor. The five factors that the survey tries to assess are obtained based on literature review and thematic analysis of interview transcripts. The questions for each factor of human centric aspect of agile maturity were focused on laying the foundation for a comprehensive analysis of the factor. The questionnaire were reviewed by both the academic supervisor and CC supervi-

sor before it was sent out to the respondents. To avoid bias in the survey we also used cheap talk scripts at the beginning of the survey. Each respondent may have their own interpretation of the questionnaires. We presumably tried to ensure that each question conveyed the meaning it was intended to. This was possibly ensured through a pilot study of the survey questionnaire with a CC employee. The respondents also were provided with contact information of thesis authors, so they could contact us in case they do not understand a question. With all these steps, validity criteria for the self-completion questionnaire were likely met in our research.

## 4.4 Limitations

Respondents of interviews and surveys could have invoked a certain degree of bias in their answers. The authors of this thesis have tried to avoid bias by using cheap talk scripts before interviews and surveys. The respondents were also informed that they would be anonymous and that their identities would not be revealed. This was done to avoid bias. Despite our efforts, there could be negligible bias in the responses from interviews and surveys. In order to protect sensitive information, the names of people we interviewed, the teams they belonged to, and their response to each question are not published in this report. We also assume that we could have got more accurate empirical data if had used the Swedish language instead of the English language that was put into use in this research. One of the sizable limitations of this research was not able to ensure that dependability and transferability criteria of quality were fully met. This can be attributed to the fact that the research was carried out in a single organization and the findings could not be applicable to other organizations. The pandemic restricted our communication with CC employees, since the majority of the communication was through e-mails. The pandemic also restricted observation of CC employees which could have increased the quality of the research.

## 4.5 Ethical Consideration

During our interviews, we have adhered to the four ethical pillars stated by Diener and Crandall (1978), which emphasizes protecting participants from harm, not invading their privacy, acquiring informed consent, and avoiding deception. Consent of interviewees was obtained for recording and transcribing the interview. The participants wanted to be anonymous, hence we obliged to it and kept their names anonymous. We also obliged to participants that data sourced through interviews would only be used for the thesis report and that it will be effaced immediately after the results are concluded. We were also very clear that the data was only going to be used for the purpose of this thesis.

# Chapter 5

## Findings

The qualitative part of three factors that contribute to the human centric aspect of agile maturity is presented in Section 2.8. We propose two additional factors that contribute to human centric aspect of agile maturity based on thematic analysis of interviews in Section 4.2 .

### 5.1 The Human Centric Aspect of Agile Maturity

From the literature review, it could be noted that communication, collaboration, and empowerment were significant factors that contributed to the human centric aspect (presented in section 2.8). For this research, we interviewed scrum masters and developers of SWID who hailed from eight different teams. The interview composed several questions and some of them were aimed at unearthing difficulties and challenges of working with an agile approach, and also factors that teams considered to be important. From the thematic analysis of the interviews, it could be observed that along with communication and collaboration, the respondents also highlighted the importance of two other factors which are self-organization and values. Values here correspond to humanistic values which encompass inclusivity, work satisfaction and human well being. Respondents expressed that self-organization and values were also an integral part of the human centric aspect of agile maturity and that they are very important factors in an agile approach. Self-organization and values were not named explicitly in literature reviewed, as contributing factors of the human centric aspect. The importance of self-organization was highlighted in the literature, but its contribution to the human centric aspect is potentially under explored. From thematic analysis, we better found indications that self-organization and value factors too significantly contributed to the human centric aspect of agile maturity. By leveraging findings from literature and thematic analysis of interviews (See table 4.2) it was identified that communication, collaboration, empowerment, self-organization, and values were significant factors that contributed to the human centric aspect of agile maturity. Thus the survey was based on these five factors. In section 5.3 we analyze how these factors have fared in teams of SWID, but first the two additional factors identified during interviews analysis are related to previous scholarly work in subsection 5.2 .

## 5.2 Anchoring additional factors in literature

### 5.2.1 Self-Organization

Self-organization is one of the anchors of agile software practices. One of twelve principles listed by Beck et al. (2001) in agile manifesto informs that self-organizing teams helps to bring out the best solution, design, and architecture for agile software development. One of the characteristics of self-organizing teams that have often been discussed in organizational theories is the minimum critical specification, which emphasizes that teams should identify their responsibilities and set timelines for completing prescribed tasks themselves without the involvement of management (Hoda & Murugesan, 2016). Requisite variety characteristic of self-organization emphasizes that application of diverse skills by a team can help to cater to the changing business requirements (Hoda & Murugesan, 2016). Self-organization promotes knowledge sharing in teams, it supports the development of a team-based competence rather than individual competence. This can help work progress despite the absence of specific individuals. Learning to learn characteristic helps teams to follow double-loop learning by which they not only learn to develop new skills but also new ways to accomplish the tasks (Nerur & Balijepally, 2007). Teams implementing these characteristics can potentially become self-organized and can influence the productivity of teams (Nerur & Balijepally, 2007). The self-organization function of agile teams has potentially contributed towards an increase in productivity and efficiency of teams (Hoda et al., 2011). The self-organization factor is one of the cornerstones of the agile approach that helps to accommodate changes and bolster the team to respond to changes in a quick manner (Conboy, 2009). Self-organization is talked about widely in agile literature but its association to the human centric aspect of agile maturity has not been explicitly highlighted. Based on the thematic analysis of the interview, we consider self-organization as a significant factor contributing to the human centric aspect of agile maturity.

### 5.2.2 Values

Values here correspond to humanistic values which encompass inclusivity, work satisfaction and human well being. Values are essential to the agile team; it helps to avoid bias and evokes the idea of inclusivity (Shrivastava et al., 2010). Value factor tries to explore the inclusivity, work satisfaction, and capacity utilization of team members in an agile approach. Moss (2019) states that burnout can negatively affect employee well-being. Burnout can be mitigated through proper capacity planning which can in turn reduce over-utilization of the employees (Sharma, 2018). Capacity planning attribute of the value factor extensively focuses on the well-being of individuals by trying to cut down over utilization. Values are fundamental for humans; it helps them to contribute towards the growth of organization (Lehtonen, 2009). In literature there is a limited exploration of the value factor with respect to agile maturity. Thematic analysis of interviews pointed out that the value factor plays an integral role in shaping human centric aspect of agile maturity. Interviewees felt that over utilization has affected their work satisfaction levels and wanted to focus on improving capacity planning in their teams. Interviewees also highlighted that

inclusivity is necessary for teams to accommodate different cultures and different opinions. Inclusivity helps to improve creativity, innovation, problem-solving ability and employee morale in an organization (Tarvin, 2021). When an organization pays adequate attention to the well-being of its members, it would be automatically reflected in the organization's productivity and effectiveness (Robertson & Cooper, 2010). The value factor is central to the human centric aspect as it dedicates a great deal of focus on employee well-being. We consider that the value factor can be one of the contributing factors to the human centric aspect of agile maturity.

### 5.3 Five Factors Influencing the Human Centric Aspect

Five factors predominantly seem to influence the human centric aspect of agile maturity in this case. The five factors are presented in Figure 5.1. We subsequently present qualitative survey results (See Appendix D for statistical data) of each factor and each team. The recommendations for improving the five factors in teams of SWID is discussed in Chapter 6.

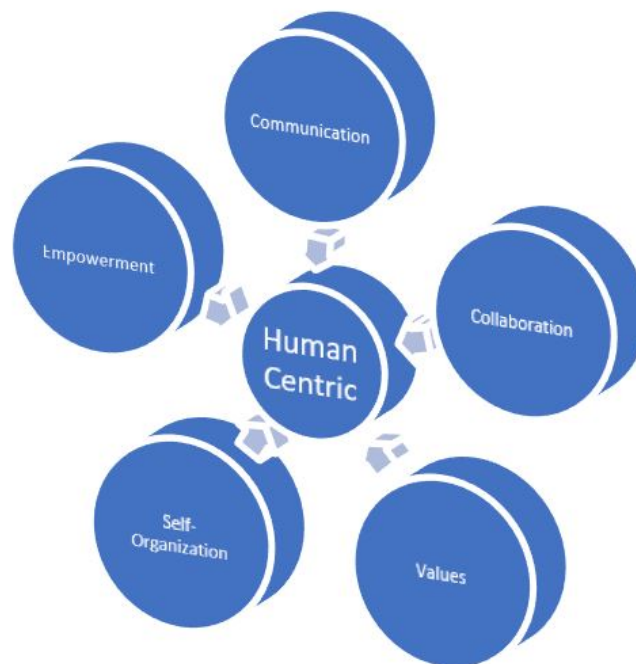


Figure 5.1: Factors Influencing The Human Centric Aspect

#### 5.3.1 Communication

We have framed six questions in our survey to assess the attribute of communication in teams. The questions aim at analyzing the frequency of communication, mode of communication, ease, and also whether the team environment promotes knowledge

sharing and reflects on the received feedback. Based on the response to our survey, we evaluate the communication factor for each team and assess their current situation. The assessments are summarized in Table 5.1

### **Team 1**

From Team 1, over half of the respondents agreed that they interact with their team members regularly whereas the other half responded with tend to agree for the same. Half of the participants responded that they constructively used feedbacks from retrospectives for improvements. The majority of the respondents also agreed that their team environment promoted knowledge sharing while the rest responded with the tend to agree option. It was also interesting to observe that the majority of the team members had frequent F2F communications with their teammates while the rest responded with neither agree nor disagree for the same. The majority of respondents have also mentioned that they do not hold back from contacting their peers in case of uncertainty. The majority of the team members strongly agreed with the fact that product information was communicated to the entire team while others responded with tend to agree for the same. These responses from Team 1 have indicated that the communication factor of the team falls under the *Largely Achieved* interval.

### **Team 2**

From the responses of team 2, it could be visualized that majority of respondents communicated with their team members frequently. However, to the question of team reflecting over feedback from retrospective more than half of them rated it with the tend to agree and the rest with the neither agree nor disagree option. Also, the majority of them strongly agreed that their team environment promotes knowledge sharing while few respondents rated it with tend to agree option. When it comes to regular F2F communication with their peers some of them responded with the tend to agree option whereas others were neutral. Whereas, for asking opinions of their peers in event of uncertainty the majority voted for it with the strongly agree option. But, regarding the information of product being shared with the team, it was interesting to see more than half responding with tend to agree for it while others with neither agree nor disagree. These responses from Team 2 have indicated that the communication factor of the team falls under the *Largely Acheived* interval.

### **Team 3**

The respondents from team 3 strongly agreed that they communicate with members of their team on a regular basis. But when asked if their team constructively uses the feedback from retrospectives the response was that some of them tend to agree while others were neutral. However, for the question which asked if their team environment promoted knowledge sharing one-third of the respondents responded with strongly agree while the others responded with tend to agree for the same. When it comes to F2F conversation with their peers, the majority rated it with the strongly agree option. Noteworthy observation is that all of them responded with strongly agree to the question that asked if they seek an opinion from peers in case of uncer-



tainty. On being asked whether the information of the product was communicated to the entire team the majority of them tend to agree to it. These responses from Team 3 have indicated that the communication factor of the team falls under the *Largely Acheived* interval.

#### **Team 4**

The majority of members of team 4 strongly agree that they communicate with team members on a regular basis. But, when asked whether they constructively use feedback from the retrospective the majority of them were split between strongly agree and tend to agree while the other few remained neutral. However, when asked if their team environment promotes knowledge sharing, the majority strongly agree to it. With regards to F2F communication responses were mixed, but no one disagreed to its regular occurrence. The majority of respondents have also mentioned that they do not hold back from contacting their peers in case of uncertainty. When asked about whether the information of the product was communicated to the entire team, most of them tended to agree with it. These responses from Team 4 have indicated that the communication factor of the team falls under the *Largely Acheived* interval.

#### **Team 5**

Based on responses from team 5, we observed that they interact with members of their team regularly. But when asked about the usage of feedback from retrospective over half responded with tend to agree for it and also the proportion remained the same when asked to rate knowledge sharing in the teams. The interesting observation is that F2F communication was rated strongly agree by one half while the other half slightly disagreed for the same. The majority of respondents have strongly agreed that they do not hold back from contacting their peers in case of uncertainty. Regarding the communication of product information throughout the team, many responded with strongly agree to it. These responses from Team 5 have indicated that the communication factor of the team falls under the *Largely Acheived* interval.

#### **Team 6**

The responses from team 6 were very interesting to study because the majority of them strongly agreed that they have frequent interaction between team members and optimally used feedback of retrospective, and also that they do not hesitate to seek opinions of their peers in case of uncertainty. The respondents of the team also strongly agree with the fact that information about the product is communicated to the entire team. But when asked about F2F communication half of the respondents strongly agreed that they have frequent F2F communication and the other remained neutral. These responses from Team 6 have indicated that the communication factor of the team falls under the *Potentially Fulfilled* interval.

#### **Team 7**

From the responses of team 7, we observed that they have fared very well in terms of frequent interaction with their team members. But for the optimal usage of feedback from retrospectives, many responded with tend to agree with it. However, most of

them agreed that their team environment promoted knowledge sharing. When asked if they have regular F2F conversations, the majority of team members responded with tend to agree with it. The interesting observation is that majority of them do not hold back from seeking the opinions of their peers in case of uncertainty. Also, regarding the flow of product information, the majority of them strongly agree that it was conveyed to the entire team. These responses from Team 7 have indicated that the communication factor of the team falls under the *Largely Acheived* interval.

### Team 8

Most of the respondents from team 8, responded that they regularly interact with their team members. The majority of respondents strongly agreed that the team constructively uses feedback from retrospectives to reflect on strengths and weaknesses. However, they also strongly agreed that their team environment promoted knowledge sharing. But, when asked if they have regular F2F communication with team members more than half responded with strongly agree and tend to agree while the rest remained neutral. Also, many strongly agreed that they do not hesitate to ask their fellow team members for opinions in an event of uncertainty. For the last question majority of them strongly agreed that the team communicated the information about the product to every member. These responses from Team 5 have indicated that the communication factor of the team falls under the *Potentially Fulfilled* interval.

Indicator	Team	0 %-35% (Not Achieved)	35%-65% (Partially Achieved)	65 %-85% (Largely Achieved)	85%-100% (Potentially Fulfilled)
Communication	Team 1			X	
	Team 2			X	
	Team 3			X	
	Team 4			X	
	Team 5			X	
	Team 6				X
	Team 7			X	
	Team 8				X

Table 5.1: Nominal Interval Range for Communication

## 5.3.2 Collaboration

In our surveys, we included five questions to analyze the collaboration factor among members of the teams. The questions related to collaboration aim at evaluating trust, teamwork, networking, and cross-functional working. The responses for the collaboration factor are assessed for each team.

### Team 1

Respondents from team 1 strongly agreed that they trust team members to get work done without interference. Respondents also strongly agreed that their team has members from different competencies. However, over half of them were split

between strongly agree and tend to agree when asked if their team members apply diverse skills to achieve a common goal while others remained neutral for the same. The majority of them responded with strongly agree and tend to agree when asked if they would leverage connections outside the team to get work done. An interesting observation from the responses is that the entire team strongly agreed that they seek opinions from peers for critical decisions. Respondents also strongly agreed that their team members work across products to achieve effective collaboration. These responses from Team 1 have indicated that the collaboration factor of the team falls under the *Largely Achieved* interval.

### **Team 2**

From team 2, over half of the respondents strongly agreed that they trust their team members to accomplish a task and other few respondents rated it to be neutral and some even slightly disagreed with it. The team members tend to agree that their team is composed of members from different competencies while some remained neutral about it. However, when asked if the team applies diverse skills to achieve a common goal over half of them disagreed with it. But when asked if they leverage connections between teams to get work done more than half agreed to it. It was interesting to see that majority of the respondents strongly agreed that they seek the opinions of peers for taking critical decisions. When asked if their team members work across products, the majority of them disagreed with it. These responses from Team 2 have indicated that the collaboration factor of the team falls under the *Partially Fulfilled* interval.

### **Team 3**

The members of the team strongly agreed that they trust their team members to accomplish the prescribed tasks. From responses, it could be seen that the team has people from different competencies and also that their team leverages diverse skills to achieve a common goal. This can be attributed to the strongly agreed response by members for both the questions. When asked about whether they leverage connections across teams to get work done many responded with tend to agree for the same. It was interesting to see that team seeks the individual opinions for making critical decisions with many strongly agreeing to it. Also, over half agreed that their team members work across products while the rest remained neutral for the same. These responses from Team 3 have indicated that the collaboration factor of the team falls under the *Largely Achieved* interval.

### **Team 4**

When team 4 was asked about trust between team members to complete prescribed tasks, over half agreed that they have strong trust between peers while the rest remained neutral about it. Also, the team responded with tend to agree when asked if the team is composed of people from different competencies. It was interesting to see that they apply diverse skills to achieve a common goal and also leverage connections across teams to get work done. This can be attributed to a strongly agree response from the majority of respondents of the team for both the questions. When asked if their team seeks individual opinion for making critical decisions, the

majority of them strongly agreed with it. Whereas, for the question that aimed at understanding if team members worked across products many responded with tend to agree for it. These responses from Team 4 have indicated that the collaboration factor of the team falls under the *Largely Acheived* interval.

### **Team 5**

In team 5, many completely agreed that they trust their team members to accomplish the prescribed task, but few responded with tend to agree with it. All the respondents agreed that their team is composed of members from different competencies. When asked about whether the team applies diverse skills to achieve a common goal many responded with tend to agree for it. However, it was interesting to see that the majority of them strongly agree that they leverage connections between teams to get work done. But, when asked if the team considers an individual's opinion for taking critical decisions many responded with tend to agree for it. Regarding team members working across products over half responded with strongly agree and tend to agree while others remained neutral. These responses from Team 5 have indicated that the collaboration factor of the team falls under the *Largely Acheived* interval.

### **Team 6**

It was very interesting to see team 6 results, the team members strongly agreed that they trust their peers to accomplish prescribed tasks without intervention and also that their team consists of members from different competencies. Further, they also strongly agreed that their team applies diverse skills to achieve a common goal. The team members also strongly agreed that they leverage connections between teams to get work done and that the team asks individual's opinion for taking critical decisions. The respondents also strongly agreed that their team members work across products to contribute positively to the organization. These responses from Team 6 have indicated that the collaboration factor of the team falls under the *Potentially Fulfilled* interval.

### **Team 7**

From analyzing team 7 results, it could be seen that the majority of members strongly agree that they trust their peers to accomplish prescribed tasks and some also responded with tend to agree for the same. The majority of them strongly agreed that they have a team that is composed of people from different competencies. But when asked if their team applies diverse skills to achieve a common goal many responded with tend to agree for the same. Further, when asked about leveraging connections between teams to get work done less than half strongly agreed to it whereas over half of them responded with tend to agree towards it. The majority of respondents also tend to agree that their team seeks their inputs for critical decisions. The majority of respondents tend to agree that their team members work across products. These responses from Team 7 have indicated that the collaboration factor of the team falls under the *Potentially Fulfilled* interval.

### Team 8

From team 8 responses, it could be seen that the majority of them strongly agree that they trust their members to complete prescribed tasks without intervention. Also, the majority of them strongly agreed that their team composes of people from different competencies. Further, over half strongly agreed that their team applies diverse skills to achieve a common goal while some responded with tend to agree for the same. The members strongly agreed that they leverage connections between teams to get work done. When asked if their team members seek their inputs for critical decisions majority remained neutral for the same. Also, the majority responded to be neutral when asked if team members work across products. These responses from Team 8 have indicated that the collaboration factor of the team falls under the *Largely Achieved* interval.

Indicator	Team	0 %-35% (Not Achieved)	35%-65% (Partially Fulfilled)	65 %-85% (Largely Achieved)	85%-100% (Potentially Fulfilled)
Collaboration	Team 1			X	
	Team 2		X		
	Team 3			X	
	Team 4			X	
	Team 5			X	
	Team 6				X
	Team 7				X
	Team 8			X	

Table 5.2: Nominal Interval Range for Collaboration

### 5.3.3 Self-organization

To assess the self-organization ability of teams, we have framed three questions in the survey. The questions aim at evaluating the identification of responsibilities, alignment in the team, and interference of management. The survey responses for the self-organization factor for each team are assessed.

#### Team 1

From team 1 responses, it could be seen that the majority of them strongly agree that they clearly understand what the team expects from them while few respondents tend to agree with it. Also, it was interesting to see that all team members strongly agreed that their team is self-organized. Further, many also strongly agreed that they prefer to work in teams where the task is divided among themselves. These responses from Team 1 have indicated that the self-organization factor of the team falls under the *Potentially fulfilled* interval.

#### Team 2

From team 2 responses, it could be seen that many remained neutral when asked if they clearly understand what the team expects from them. When asked if their team

was self-organized, the majority replied with tend to disagree with it. However, over half responded with strongly agree and tend to agree that they work in teams where they can divide work among themselves while less than half remained neutral for the same. These responses from Team 2 have indicated that the self-organization factor of the team falls under the *Partially Achieved* interval.

### **Team 3**

Over half of the members of team 3 strongly agreed that they clearly understand what the team expects from them and also strongly agreed that their team is self-organized. Further, the majority of the respondents strongly agreed that they like to work in teams where the work can be divided among themselves. These responses from Team 3 have indicated that the self-organization factor of the team falls under the *Potentially Fulfilled* interval.

### **Team 4**

The responses from team 4, showed that the majority of them strongly agree that they understand what the team expects from them while less than half remained neutral for the same. Also, the majority of them tend to agree that their team is self-organized. The majority of them also strongly agreed that they like to work in teams where tasks can be divided among themselves while only a few responded with tend to agree for the same. These responses from Team 4 have indicated that the self-organization factor of the team falls under the *Largely Achieved* interval.

### **Team 5**

From responses recorded by team 5, it could be seen that the majority tend to agree that they understand what their team expects from them while less than half responded with strongly agree for the same. However, it was interesting to see that majority of them strongly agree that their team is self-organized while one of them responded with tend to agree for the same. Further, over half strongly agreed that it is important to work in teams where tasks can be divided among themselves while some responded with tend to agree for the same. These responses from Team 5 have indicated that the self-organization factor of the team falls under the *Potentially Fulfilled* interval

### **Team 6**

It was interesting to see the responses of team 6, the majority of them strongly agreed that they understand what the team expects from them and also that their team is self-organized. However, when asked about whether they like to work in teams where the work can be divided among themselves, half of them responded with strongly agree while others responded with tend to agree for the same. These responses from Team 6 have indicated that the self-organization factor of the team falls under the *Potentially Fulfilled* interval

### **Team 7**

The members from team 7 strongly agreed that they understand what the team expects from them. The members also strongly agreed that their team is self-organized.

Over half of them strongly agreed that they like to work in teams where they can divide work among themselves whereas less than half responded with tend to agree for the same. These responses from Team 7 have indicated that the self-organization factor of the team falls under the *Potentially Fulfilled* interval

### Team 8

The response from team 8 shows that the majority of them strongly agree that they understand what the team expects from them. But, when asked whether their team is self-organized over half of them responded with strongly agree and tend to agree while others remained neutral. However, it was interesting to see that majority of them strongly agreeing that they would like to work in a team that would divide tasks among themselves while the rest replied with tend to agree for the same. These responses from Team 8 have indicated that the self-organization factor of the team falls under the *Largely Achieved* interval

Indicator	Team	0 %-35% (Not Achieved)	35%-65% (Partially Achieved)	65 %-85% (Largely Achieved)	85%-100% (Potentially Fulfilled)
Self-Organization	Team 1				X
	Team 2		X		
	Team 3				X
	Team 4			X	
	Team 5				X
	Team 6				X
	Team 7				X
	Team 8			X	

Table 5.3: Nominal Interval Range for Self-organization

### 5.3.4 Empowerment

In this survey, we assess the empowerment factor in teams through a set of five questions. The questions focus on analyzing the ability to develop new skills, access to resources, encouragement in the team, and freedom to disagree. The responses from individual teams on empowerment are assessed.

#### Team 1

Responses from team 1 show that over half of the respondents strongly agree that they work constantly to develop new skills to contribute to the organization while few respondents tend to agree with it. Also, over half responded with strongly agree and tend to agree that their team has resources and skills to respond to changing demands while others remained neutral for the same. The majority of them strongly agreed that they could express disagreement with the management's decision without any consequences while few remained neutral about it. When asked if their team encourages creativity, the majority of them responded with strongly agree and tend to agree for it. Further, it was interesting to see the majority of them respond with strongly agree and tend to agree that they are being rewarded for their efforts

by the team while some also responded with tend to disagree for the same. These responses from Team 1 have indicated that the empowerment factor of the team falls under the *Potentially Fulfilled* interval.

### **Team 2**

With the responses from the team, we found that the majority of them tend to agree that they continuously work on developing new skills that can in turn contribute positively to the organization. When asked if the team is equipped with skills and resources to respond to changes, one-third of them remained neutral while two-third were split between tend to disagree and strongly disagree options. The majority of the team members responded with strongly agree and tend to agree that they can express disagreement with management without facing any consequence while one respondent tend to disagree with it. Further, two-third of respondents were split between strongly agree and tend to agree that their team motivates them to be creative while others remained neutral. However, all of the respondents remained neutral when asked if they were being rewarded for their efforts by the team. These responses from Team 2 have indicated that the empowerment factor of the team falls under the *Partially Achieved* interval

### **Team 3**

From team 3, it was interesting to see all of the respondents strongly agreeing that they continuously work on developing new skills that positively contribute to organizational growth. However, when asked if they have been equipped with the necessary skills and resources for responding to changes two-third of respondents were split between strongly agree and tend to agree while the rest remained neutral. Further, team members said they can disagree with management without fearing consequences with respondents being split between strongly agree and tend to agree options. It was interesting to see that all of the respondents strongly agreeing that their team encourages creativity and does not dictate terms to members. Also, the respondents were split between strongly agree and tend to agree when asked if they were duly rewarded for their efforts by the team. These responses from Team 3 have indicated that the empowerment factor of the team falls under the *Largely Achieved* interval.

### **Team 4**

Two-third of the respondents from team 4 strongly agreed that they work on developing new skills that can contribute to organizational growth while one-third responded with tend to disagree for the same. Also, two-third of the respondents were equally split between strongly agree and tend to agree when asked if they were equipped with resources and skills for responding to changes and one third responded with tend to disagree for the same. However, when asked if they can disagree with management without fearing consequence all the respondents were split between strongly agree and tend to agree for the same. Further, over half strongly agreed that their team encourages them to be creative and does not dictate terms while others remained neutral. It was interesting to see that majority of them



strongly agreeing that they are duly rewarded for their efforts by the team while few remained neutral for the same. These responses from Team 4 have indicated that the empowerment factor of the team falls under the *Largely Achieved* interval

### **Team 5**

Responses recorded by team 5 showed that one-fifth of the respondents strongly agree that their team continuously works on developing new skills that can contribute to organizational growth while other respondents tend to agree. The majority of the respondents also strongly agreed that their team is equipped with resources and skills to respond to changes while others responded with tend to agree for the same. The majority of them strongly agreed that they can disagree with management without fearing consequences while few responded tend to agree for the same. Further, when asked if their team encourages them to be creative, the majority of them responded with strongly agree while others responded with tend to agree for the same. It was interesting to see that majority of the respondents tend to agree that they are being duly rewarded for their efforts by the team while others responded with strongly agree for the same. These responses from Team 5 have indicated that the empowerment factor of the team falls under the *Potentially Fulfilled* interval.

### **Team 6**

From the responses of team 6, it could be seen that respondents were split between strongly agree and tend to agree when asked if they work on developing new skills that can contribute to the growth of the organization. The respondents were also split between strongly agree and tend to agree when asked if they were equipped with resources and skills to respond to changes. Further, the majority of respondents tend to agree that they can disagree with management without fearing consequences. Also, the respondents were split between strongly agree and tend to agree for questions that asked if their team encourages them to be creative and whether if they are being duly rewarded by the team for their efforts. These responses from Team 6 have indicated that the empowerment factor of the team falls under the *Potentially Fulfilled* interval.

### **Team 7**

In the responses from team 7, it could be seen more than half of them strongly agree that they work on developing new skills that can contribute to organizational growth while others responded with tend to agree for the same. The respondents were split between strongly agree and tend to agree when asked if they were equipped with resources and skills to respond to changes. Further, the team completely agreed that it was possible to disagree with management without fearing consequences. Also, it was interesting to see that the respondents strongly agree that their team encourages creativity. However, when asked if they were duly rewarded by the team less than half responded with strongly agree and the others responded with tend to agree for the same. These responses from Team 7 have indicated that the empowerment factor of the team falls under the *Potentially Fulfilled* interval.

### Team 8

From team 8 responses, we observed that all the respondents strongly agree that they work towards developing new skills that contribute to the growth of the organization. The majority of them strongly agree that they are equipped with resources and skills to respond to changes while others remained neutral about it. The majority of them also strongly agree that they can disagree with management without fearing consequences while the rest remained neutral. Further, most of the respondents strongly agreed that their team encourages them to be creative while few of them responded with tend to agree for the same. It was interesting to see that majority of them strongly agree that are being duly rewarded for their efforts by the team while others responded with tend to agree. These responses from Team 8 have indicated that the empowerment factor of the team falls under the *Largely Achieved* interval.

Indicator	Team	0 %-35% (Not Achieved)	35%-65% (Partially Achieved)	65 %-85% (Largely Achieved)	85%-100% (Potentially Fulfilled)
Empowerment	Team 1				X
	Team 2		X		
	Team 3			X	
	Team 4			X	
	Team 5				X
	Team 6				X
	Team 7				X
	Team 8				X

Table 5.4: Nominal Interval Range for Empowerment

### 5.3.5 Values

In this survey, we have framed three questions to examine the inclusivity of different perspectives and cultures. We also aim to examine the work satisfaction and capacity utilization of individuals. The response from individuals for the Value factor for each team is assessed.

#### Team 1

From team 1, the majority of members strongly agree that their team accommodates values from different cultures and perspectives while others responded with tend to disagree for the same. However, it was interesting to see that majority of them are completely satisfied with the work they do for the team and one of the respondents remained neutral. But, when asked if they are over-utilized by the team over half of the respondents remained neutral while the other few responded with tend to agree, tend to disagree, and strongly disagree for the same. These responses from Team 1 have indicated that the value factor of the team falls under the *Largely Achieved* interval.

## **Team 2**

From team 2, over half agreed that their team accommodates values from different cultures and perspectives while one-third remained neutral for the same. The majority of the respondents also tend to agree that they were satisfied by the work they do for the team. However, the majority of them remained neutral when asked if they were over-utilized by their team while some respondents tend to agree with it. These responses from Team 2 have indicated that the value factor of the team falls under the *Partially Achieved* interval.

## **Team 3**

The responses from team 3 show that the majority of them strongly agree that their team accommodates the values brought in by different cultures and perspectives. The majority of them also strongly agreed that they were satisfied by the work they do for the team. However, when asked if they are over-utilized by the team many showed disagreement towards it which is an interesting aspect to observe. These responses from Team 3 have indicated that the value factor of the team falls under the *Largely Achieved* interval.

## **Team 4**

From team 4, over half strongly agreed that their team was accommodative of value brought in by different cultures and perspectives while some remained neutral. But, when asked if they are satisfied with the work they do, some responded with tend to agree while some remained neutral and the rest responded with tend to disagree with it. However, one-third of respondents strongly feel that they're over-utilized by the team while some remained neutral towards it. These responses from Team 4 have indicated that the value factor of the team falls under the *Partially Achieved* interval.

## **Team 5**

With the responses from team 5, many strongly agreed that their team is accommodative of values brought in by different cultures and perspectives while some remained neutral about it. But, when asked if they are satisfied by the work they do for the team, the majority of them responded with tend to agree and the rest responded with strongly agree for the same. However, when asked if they are over-utilized by the team there was a different pattern. We would see that agreement, disagreement, and being neutral were all of the same proportion. These responses from Team 5 have indicated that the value factor of the team falls under the *Largely Achieved* interval.

## **Team 6**

Team 6, when asked if their team is accommodative of values brought in by different cultures and perspectives, half of them strongly agreed to it while the other half only partially agreed towards it. Meanwhile, all the respondents strongly agreed that they are satisfied by the work they do for the team. However, when asked if they are over-utilized by the team half of them remained neutral while the other expressed disagreement towards it. These responses from Team 3 have indicated

that the value factor of the team falls under the *Largely Achieved* interval.

**Team 7**

In team 7, the majority of the respondents strongly agreed that their team is accommodative of values brought in by different cultures and perspectives while a few of them remained neutral for the same. But when asked if they are satisfied with the work they do for their team the respondents were split between strongly agree and tend to agree for it. Also, over half remained neutral when asked if they were over-utilized by the team members while the other half expressed disagreement towards it. These responses from Team 7 have indicated that the value factor of the team falls under the *Largely Achieved* interval.

**Team 8**

The majority of the respondents of team 8 strongly agreed that team was accommodative of values brought in by different cultures and perspectives. All the respondents strongly agreed that they are satisfied with the work they do for the team. But when asked if they are over-utilized by the team a few of them responded with tend to agree for it while others respondents tend to disagree with it. These responses from Team 8 have indicated that the value factor of the team falls under the *Largely Achieved* interval.

Indicator	Team	0 %-35% (Not Achieved)	35%-65% (Partially Achieved)	65 %-85% (Largely Achieved)	85%-100% (Potentially Fulfilled)
Values	Team 1			X	
	Team 2		X		
	Team 3			X	
	Team 4		X		
	Team 5			X	
	Team 6			X	
	Team 7			X	
	Team 8			X	

Table 5.5: Nominal Interval Range for Values

# Chapter 6

## Discussion

In this chapter, we return to the literature background and relate it to the findings presented in Chapter 5 and sketch potential solutions for improvement for each team and each factor.

### 6.1 Communication

From the analysis of the survey responses recorded by eight teams for the six questions of communication factor, it could be seen *Team 1, Team 2, Team 3, Team 4, Team 5 and Team 7* have placed its communication factor under the largely achieved interval which emphasizes that there is a shortcoming from being in the potentially fulfilled interval. The survey responses to each question of the communication factor have helped to identify potential causes for the above-mentioned teams to have fallen behind with respect to the communication factor. To each of these causes, potential solutions are sketched based on the literature review.

In a sprint retrospective, the team meets to introspect their performance and identify opportunities for improvement (Wawryk & Ng, 2019). From survey responses for Q2, we interpret that lack of proper utilization of the concept of retrospective to reflect on strengths, opportunities, and weakness may have caused a shortcoming for *Team 1, Team 3, and Team 4* with respect to the communication factor. A potential solution for overcoming this problem is that the team should ensure the retrospective meetings are focused on introspecting the opportunities, strengths, and weaknesses of the team. The team should also ensure that retrospective meetings promote an environment where members can voice out their opinions. Retrospective meetings can help to improve the interaction between members and empower them to voice out their opinions in a transparent and communicative environment (Parabol, 2021). With teams ensuring optimal use of the retrospective meetings, they can potentially enhance the communication factor.

Kuusinen et al. (2017, p. 3) quote that “Knowledge sharing is the process of transferring information, skills or understanding between people and organizations”. From survey responses for Q3, we interpret that inadequate knowledge sharing may have also caused a shortcoming of the communication factor in Team 4. A potential solu-

tion to overcome this problem is that the Scrum Masters should encourage members to share knowledge with other members of the team through Stand-up meetings or dashboards in the “Teams” web application. Knowledge sharing can help to improve the skill set and interactions between members of the team. This can in turn help Team 4 to enhance its communication factor.

F2F communication is considered to be an effective communication mode in the agile approach as it helps to capture instant feedback from stakeholders through facial expressions (Bhalerao & Ingle, 2010). F2F communication also helps to mitigate uncertainty in the information being communicated (Conboy, 2009). From survey responses for Q4, we interpret that inadequate F2F conversation between members of the team may have caused a shortcoming for *Team 2, Team 4, Team 5, and Team 7* with respect to communication factor. A potential solution is to promote F2F communication among all the stakeholders of the team. This can help members to have frequent interactions and to be updated on the impediments and on the status of the project. If a physical F2F conversation is not possible owing to the pandemic, a conversation can be initiated via web applications like Teams with cameras on. This can potentially help *Team 2, Team 4, Team 5, and Team 7* to further enhance their communication factor.

According to Boersma, Loke, Petkova, Sander, and Brombacher (2004), uniform access of information throughout the team helps to promote interaction, productivity, and creativity. From survey responses for Q6, we interpret that inadequate access to information among members of the team may have also caused a shortcoming for Team 1 in terms of the communication factor. A potential solution to overcome this is to ensure that all the members of the team have symmetrical access to product-related information. Symmetrical access to information would help to enhance interactions and creativity in teams. This can be a potential solution to address the shortcoming for Team 1 in terms of communication factor.

## 6.2 Collaboration

From the analysis of the survey responses recorded by eight teams for the six questions of collaboration, it could be seen it could be noted that *Team 1, Team 2, Team 3, Team 4, Team 6 and Team 8* have placed collaboration factor under largely achieved interval which emphasizes that there is a shortcoming from being in the potentially fulfilled interval. The survey responses to each question of the collaboration factor have helped to identify potential causes for the above-mentioned teams to have fallen behind with respect to the collaboration factor. To each of these causes, potential solutions are sketched based on the literature review.

Bond-Barnard, Fletcher, and Steyn (2018) states that the degree of collaboration between members in a team is directly influenced by the level of trust between them. From survey responses for Q7, we interpret that lack of trust between members of the team may have also caused a shortcoming of collaboration attribute in *Team 2*. A potential solution to improve trust between members is by promoting teamwork. When members get to work on accomplishing a prescribed task, the level of trust between them is enhanced by frequent communication and knowledge sharing

(Dorairaj & Noble, 2013). Trust between members should be improved in order for *Team 2* to enhance their collaboration factor.

Agile teams encompass members from different functions. Members from different functions collaborate to contribute to the team goal (Koehnemann, 2021). From survey responses for Q9, we interpret that lack of collaboration between members from different functions could have created a shortcoming of collaboration factor in *Team 1* and *Team 4*. Beck et al. (2001) state in the agile manifesto that people should collaborate with each other on a daily basis to ensure focus on a common goal and also that requirements are clearly understood. According to comments received for open question (Q24) of the survey, we interpret that poor collaboration between members of the team may have also caused a shortcoming of collaboration factor in *Team 1*. A potential solution to overcome these shortcomings is that the Scrum Masters should encourage team members to work collaboratively putting behind individualism. Scrum Masters should motivate members to work on group tasks that can promote the idea of teamwork to find an optimal solution for the problem. By promoting teamwork, the collaboration factor can be potentially enhanced in *Team 1 and Team 4*.

Working across teams can help to develop new skills and also enhance collaboration between members of different teams (Kashyap, 2019). From survey responses for Q12, we interpret that a lower degree of working across teams may have caused shortcoming of collaboration factor in *Team 2, Team 3, Team 6, and Team 8*. A potential solution to overcome the shortcoming is that the Scrum Masters should motivate members to work across teams. Working across teams will help members to develop new knowledge and they can also leverage their existing knowledge towards the improvement of other teams. Working across teams would enhance the collaboration between members of the team and also improve the productivity and efficiency of teams (Kropp, Meier, & Biddle, 2016). Motivating members to work across teams can be a potential solution to address the shortcoming for *Team 2, Team 3, Team 6, and Team 8* in terms of the collaboration factor.

### 6.3 Self-organization

From the analysis of the survey responses recorded by eight teams for the three questions of self-organization factor, it could be seen that *Team 2, Team 4, and Team 8* have rated their team's self-organization factor as largely achieved which indicates a shortcoming from being in the potentially fulfilled interval. The survey responses to each question of the self-organization factor have helped to identify the potential cause for *Team 2, Team 4, and Team 8* to have fallen behind with respect to the self-organization factor. To overcome this shortcoming, a potential solution is sketched based on the literature review.

The minimum critical specification, which is one of the characteristics of self-organization emphasizes that team members should identify their responsibilities and set time-lines for completing tasks themselves without depending on management (Hoda & Murugesan, 2016). Self-organization helps to bring decision-making to the level of teams and also helps teams to respond quickly to changing environments. This can

be attributed to the understanding of responsibilities and expectations of teams by individual members (Kakar, 2017). From survey responses for Q13 and Q14, we interpret that lack of ability to divide work among themselves and understand expectations of the team may have caused shortcoming of the self-organization factor for *Team 2*, *Team 4*, and *Team 8*. Scrum Masters should highlight the importance of self-organization in the team. Scrum Master should provide a clear picture of what the team expects from individuals and hand them the freedom to choose tasks. This could help clarify team expectations and empowers individuals to organize work among themselves. Self-organizing teams also help to bring out the best solution, design, and architecture for agile software development (Beck et al., 2001). By ensuring team members understand the importance and focus of self-organization, the shortcoming in *Team 2*, *Team 4*, and *Team 8* with respect to the self-organization factor can potentially be addressed.

## 6.4 Empowerment

From the analysis of the survey responses recorded by eight teams for the five questions of empowerment factor, it could be seen that *Team 2* has rated the empowerment factor as partially achieved and *Team 1*, *Team 3*, *Team 4*, and *Team 8* have rated the empowerment factor as largely achieved which indicates a shortcoming from being in the potentially fulfilled interval. The survey responses to each question of the empowerment factor have helped to identify potential causes for the above-mentioned teams to have fallen behind with respect to the empowerment factor. To each of these causes, potential solutions are sketched based on the literature review.

Tessem (2014) states that providing adequate resources and skills to individuals of the team helps to enhance the characteristic of empowerment in teams. From survey responses for Q17, we interpret that lack of resources and skills in the team to respond to changes may have caused shortcoming of empowerment factor in *Team 1*, *Team 2*, *Team 3*, *Team 4*, and *Team 8*. A potential solution to overcome this shortcoming is for the SWID Managers/Scrum Masters to ensure that adequate training programs are conducted to enhance the skill sets of team members. They should also ensure that required resources are provided to teams for responding to changes. By improving the skill set of individuals and by providing adequate resources, employees of the team may feel empowered (Malik, Sarwar, & Orr, 2021). This may help to address the shortcoming of the empowerment factor in *Team 1*, *Team 2*, *Team 3*, *Team 4*, and *Team 8*.

Freedom to express disagreement and voice out opinions is an embedded characteristic of empowerment (Tessem, 2014). Freedom to express thoughts can help to bring out innovative and creative ideas from individuals (Tessem, 2014). From survey responses for Q18, we interpret that a lower degree of freedom to express disagreement with management decisions may have also caused a shortcoming of the empowerment factor in *Team 2* and *Team 8*. Disagreement is a healthy expression that indicates that teams are not autocratic (Gallo, 2018). Disagreement helps individuals to pitch in alternative solutions which can be more innovative



than that which was proposed earlier (Gallo, 2018). Hence, the managers of SWID should ensure that enough freedom is provided to individuals of the team to disagree with management without fearing consequences. This can potentially enhance the empowerment factor in *Team 2 and Team 8*.

Folkman (2020) states that rewards and recognition can help to improve empowerment in teams. From survey responses for Q20, we interpret that lack of due recognition of individual's effort in the team may have also caused shortcoming of empowerment factor in *Team 4*. The managers of SWID/ Scrum Masters should ensure that employees' efforts are duly recognized. It can be done through tangible/intangible means like appreciation, incentives, promotion, or awards. Recognition of work can motivate individuals to contribute better towards the fulfillment of team goals (Tessem, 2014). By ensuring due recognition of efforts of individuals, the empowerment factor may be enhanced in *Team 4*.

## 6.5 Values

From the analysis of the survey responses recorded by eight teams for the three questions of Values factor, it could be seen that *Team 2 and Team 4* have rated the value factor as partially achieved and *Team 1, Team 3, Team 5, Team 6, Team 7 and Team 8* have rated value factor as largely achieved indicating that there is a shortcoming. The value factor focuses on the well-being of individuals and human values such as inclusivity and work satisfaction. The survey responses to each question of the value factor have helped to identify potential causes for the above-mentioned teams to have fallen behind with respect to the value factor. To each of these causes, potential solutions are sketched based on the literature review.

Values are very essential to teams; it helps to avoid bias and evokes the idea of inclusivity (Shrivastava et al., 2010). From survey responses for Q21, we interpret that a lower degree of inclusivity in teams may have caused a shortcoming of value factor in *Team 1*. Scrum Masters should ensure that teams are accommodative of different cultures and different perspectives. This would in turn improve collaboration and communication among members. Knowledge sharing too will be enhanced. Teams can look to hire skilled individuals from diverse backgrounds for enhancing the inclusivity attribute. By improving the degree of inclusivity, *Team 1* can potentially address the shortcoming with respect to the Value factor.

Tripp, Riemenschneider, and Thatcher (2016, p. 1) quote "Agile software-development advocates claim that an important value proposition of agile methods is that they make people more motivated and satisfied with their jobs". From survey responses for Q22, we interpret that lack of work satisfaction may have also caused a shortcoming of the Value factor in *Team 4*. Work satisfaction is of primary importance for individuals to be productive (Tripp et al., 2016). Work satisfaction can be negatively affected by conventional/repetitive work. Managers of SWID/ Scrum Masters of teams can improve work satisfaction levels in teams by providing individuals with challenging tasks, opportunities to learn new skills, by ensuring appropriate reward/recognition, and also by building a team atmosphere that motivates individuals. By enhancing work satisfaction levels of individuals, the shortcoming of the

Value factor in Team 4 may be potentially addressed.

Moss (2019) states that burnout can negatively affect employee well-being. Proper capacity planning can help to mitigate burnout by reducing over-utilization and also help to improve productivity of team (Sharma, 2018). From survey responses for Q23, we interpret that lack of capacity planning may have caused a shortcoming of the Value factor in *Team 1, Team 2, Team 3, Team 4, Team 5, Team 6, Team 7, and Team 8*. Improper capacity planning can lead to the over-utilization of team members and cause burnout of employees. Therefore, it is important for SWID managers/Scrum Masters of teams to maintain their integrity and autonomy and not to commit more than they can sustainably handle in each sprint. They should also focus on determining the accurate capacity needed for working with specific tasks and designate the required capacity with buffer. By ensuring proper capacity planning, the above-mentioned teams can potentially address shortcomings with respect to the Value factor.

# Chapter 7

## Conclusion

Our research was aimed at exploring the human centric aspect of agile maturity. The literature review and empirical data obtained from interviews and surveys helped us to specify the five underlying factors that contributed to the human centric aspect of agile maturity. The five factors are communication, collaboration, empowerment, self-organization, and values. The value factor focuses on human values such as inclusivity and work satisfaction. These five factors can potentially enhance the human centric aspect of agile maturity. From literature review and data from interviews, we identified the potential contribution of these five factors in agile teams. Communication can potentially help in the seamless transfer of information and knowledge. Collaboration may help in quick decision-making and arriving at optimal solutions to a complex problem. Empowerment could potentially help to enhance creativity, express opinions and disagreements in the team. Self-Organization can potentially help individuals realize the freedom of dividing tasks and making decisions. Values may help to improve work satisfaction, capacity planning, and inclusivity in teams. All these five factors in tandem contribute to the human centric aspect of agile maturity. Improving the human centric aspect of agile maturity in teams can potentially help to improve productivity, efficiency, creativity, and effectiveness of teams. The human centric aspect may also influence other agile maturity parameters like customer collaboration and technical excellence. It is crucial for an agile teams to put utmost focus on the human centric aspect. For this thesis, we also focused on examining how these five factors of the human centric aspect of agile maturity have fared in the teams of SWID. Upon analysis, we found that there was an opportunity for improvement for all the teams in terms of these five factors. Based on responses from the survey, we identified particular factors for each team that could be improved. Potential solutions to enhance these factors in teams were suggested, the suggestions were discussed explicitly in Chapter 6.

Agile methodology has considerably played an integral role in improving the software development process. The agile approach has also potentially contributed towards sustainable development. It is reasonable to consider that the values, principles, and practices of the agile approach focus on enhancing human values and well-being, this in turn supports the social aspect of sustainable development. Agile product development has also potentially helped to develop state-of-the-art technologies that

contribute to the development of autonomous cars and electrification. Autonomous cars and electrification are considered to enable new forms of mobility that holds potential for a more environmentally sustainable development. Apart from reducing the time to market and producing incremental products at regular intervals, the agile approach has also considerably contributed to social and environmental sustainable development.

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# Appendix A

## Scaled Agile Framework

The Scrum became famous among development teams but it does not emphasize much about how large projects can scale or how program level or portfolio level management handle their requirements together with agile (Brenner & Wunder, 2015). To mitigate this, Dean Leffingwell coined the “Scaled Agile Framework (SAFe)” which describes principles, practices, competencies for achieving business agility using combination lean and agile product development (Knaster, 2021). The first version 1.0, was published in 2011 and constantly evolved till current latest version 5.0, which was published in 2021 (Knaster, 2021). With implementation of SAFe organization can benefit in many ways. Based on numerous customer stories by (Knaster, 2021) it's demonstrated that SAFe will increase productivity by 20 to 50 percent, increase in product quality by 25 to 75 percent, improved time to market by 30 to 75 percent and, increase in job satisfaction and employee engagement from 10 to 50 percent (Knaster, 2021). At present, there are four types of SAFe; Essential SAFe, Large solution SAFe, Portfolio SAFe, and Full SAFe (Knaster, 2021). The difference between these is that what levels are included, whether it is Team level, Program level, Large Solution level and/or Portfolio level. However, type of SAFe an organization should implement depends on its size where Essential SAFe can be applied to small cross-discipline teams, where Large Solution SAFe can be applied to large organizations. In this first level, the agile teams employ with single or mix of agile methods like Scrum, Kanban and XP to maximize innovation, value delivery, and sustainability (Knaster, 2021). The SAFe agile team is a cross-functional group consisting of five to eleven Developers, Testers, who work with a common goal for reducing time-to-market and commitment to deliver the increment of value in Iterations (Sprints). These Iterations allow them to shorten the feedback cycles and to accommodate constantly changing business needs. Agile teams consist of two important roles: product owner and scrum master. Where, Product owner prioritizes the team backlog based on stakeholders' needs, while Scrum master helps by infusing, agreeing to Agile process, removing impediments and fostering an environment for high performance, continuous flow and improvements (Knaster, 2021).

## A.1 Program Level

This level can also be referred as Program Increment(PI) and similar to our Team level but scaled up. In this level, multiple teams work to deliver fully working software. Each PI consists of four development iterations and one innovation iteration followed by one planning iteration which typically corresponds to eight to twelve weeks (Knaster, 2021). The analogy behind this is called Agile Release Train(ART) where multiple teams along with other stakeholders constantly deliver value. On this level Product Management(PM) will define the outcome of each PI based on the program backlog, which is also called features. However, representatives from each team within ART meet twice a week to review progress towards PI objectives and to discuss dependencies among teams. This event is called Scrum of Scrum(SoS) which is facilitated by Release Train Engineer(RTE) who is also a scrum master for one team will act as Chief Scrum Master for this event(Knaster, 2021).

Similarly to team level where each sprint starts with planning event, likewise each PI starts with a planning meeting where all teams, PM and RTE meet to agree on what features can be delivered at end of the delivered and to highlight their dependencies with other agile teams (Knaster, 2021). For example, team X may require team Y to complete specific feature, in order for team X to start with one of their features, and therefore team Y prioritizes that feature in first sprint to make way for team Y to work with their backlog. However, at end of each sprint agile teams continuously integrate their work and demo it during sprint review and also all teams will demonstrate their work as single system during system demo which marks the end of PI(Knaster, 2021).

## A.2 Large Solution Level

In previous level, which is program level, multiple agile teams are described as ART whereas this level which is Large Solution/Enterprise level consists of Multiple ART. Here, Solution Train Engineer(STE) under solution management acts as servant leader to facilitate between ART to resolve the difficulties that single ART face. On this level, backlog is called capability, consists of several features. Further, there is also Solution architect who oversees each agile team defines technical and architectural vision for solutions under development(Knaster, 2021).

## A.3 Portfolio Level

The last level is called portfolio level and this level aligns strategy with execution and organizes solution development around the flow of value through one or more value streams (Knaster, 2021). On this level there are additional competencies i.e., Lean Portfolio Management(LPM) -this group helps to align strategy and execution by providing budgets, resources and governance. Continuous Learning Culture-this competency motivates individuals and enterprise as whole to continually increase knowledge, performance and, innovation. Organizational Agility-this competency describes how lean thinking people and agile teams optimize their processes and quickly adapt

to capitalize on new opportunities. At this level, backlogs are called epics. These Epics captures and reflect on new business capabilities that are addressed by ARTs product management during each PI planning coordinated by Epic Owners. Also, Kanban system at this level makes work visible and uses Work-in-process dashboards to assure that demand is matched to actual capacity of ARTs (Knaster, 2021).

The backlogs at each level are connected to the next level, demonstrating the relationship between multiple SAFe tiers. Portfolio level (Epics) is the highest level in SAFe, followed by Large solution level (Capability), Program level (features), and Team level (Stories) (Knaster, 2021).

## **A.4 Foundation of SAFe**

The foundation layer of SAFe holds various aspects that supports development are Lean Agile Leaders, Communication of Practice, Core Values, Lean-Agile Mindset, Lean-Agile Principles, Implementation pipeline.

## **A.5 Lean-Agile Leadership**

The Top management (leaders) in organizations that are adopting a new change are responsible for instilling the new change into the organizational culture and ensuring its execution. SAFe is no exception to this rule. The Lean-Agile approach assumes that the initial leaders be familiar with both Lean and Agile principles and practices. Then, as a result, leaders can create an environment that encourages organizations to adopt improved working practices. Individual teams can be coached, empowered, and engaged to attain their full potential using Lean and Agile principles (Knaster, 2021) .

## **A.6 Core Values**

In SAFe, there are four basic values: alignment, built-in quality, transparency, and program execution, and each of these values must be met. The first core value, alignment, is that all employees, regardless of role or position, are united by a single vision and objective. Built-in quality refers to procedures that ensure that each action and component meets the established quality standards. The goal of transparency is to foster trust by creating an environment in which everyone feels free to disclose information without fear of repercussions. The fourth and final value is program execution, which refers to ensuring that all employees accept and believe in the change (Knaster, 2021).

## **A.7 Lean-Agile Mindset**

In order to truly think and operate in a lean-agile manner, SAFe must have the suitable mind-set regarding its beliefs and actions. This starts with the leaders, who

must first learn and then teach the SAFe ideas and practices. This mindset blends lean product development concepts with agile approaches(Knaster, 2021).

## **A.8 Lean-Agile(SAFe) Principles**

SAFe consists of nine fundamental principles(P) which insists the roles and practices of SAFe. These are presented below.(Knaster, 2021)

P1: Take an economic view.

P2: Apply system thinking.

P3:Assume variability; preserve options.

P4:Build incrementally fast, integrated learning cycles.

P5:Base milestones on objective evaluation of working systems.

P6:Visualize and limit WIP, reduce batch sizes, and manage queue lengths.

P7: Apply cadence, synchronize with cross-domain planning.

P8:Unlock the intrinsic motivation of knowledge workers.

P9:Decentralize decision-making.

## **A.9 SAFe Implementation Pipeline**

- Step 1: Reaching the Tipping Point.
- Step 2: Train Lean-Agile Change Agents.
- Step 3: Train Executives, Managers, and Leaders.
- Step 4: Create a Lean-Agile Centre of Excellence (LACE).
- Step 5: Identify Value Streams and ARTs.
- Step 6: Create the Implementation Plan.
- Step 7: Prepare for ART Launch.
- Step 8: Train Teams and Launch ARTs.
- Step 9: Coach ART Execution.
- Step 10: Launch More ARTs and Value Streams.
- Step 11: Extend to the Portfolio.
- Step 12: Sustain and Improve

# Appendix B

## Interview Guide

### Warm Up Questions

Question 1: What is your role in the company?

Question 2: Which team do you work in?

Question 3: How long have you worked for CC ?

Question 4: How long have you worked within agile?

Question 5: What does it means for you to work with agile?

### Interview Questions

Question 1: When did your team start working with Agile methodology?

Question 2: Do you work with only agile methodology or is there a hybrid process in place?

Question 3: What is the strength of your agile team?

Question 4: Does your team enable cross-functional working?

Question 5: Do you follow all principles listed in the agile manifesto?

Question 6: Is your scrum team involved in all the discussions from project initiation to completion?

Question 7: Is roles & responsibilities clearly explained to your scrum team?

Question 8 : How would you define communication within your team?

Question 9: How many features does your team currently work on?

Question 10: How do you prioritize sprint backlog?

Question 11: Who sets the target for each iteration in your team?

Follow up: Do you use any metrics to evaluate agile implementation in your team?

Question 13: Are there any difficulties in working with agile? If so, could you elaborate on it?

Question 14: Can you highlight any particular challenges your team faces with respect to agile?

Question 15: Do you think the agile way of working can be enhanced further in your team?

Follow up question :If so how? (opportunities).

Question 16: How do you gather requirements?

Do you hold a meeting with the team after each iteration to reflect on it?

Question 17: In terms of productivity and efficiency do you think agile has provided better results than the traditional way of working?

Question 18: Has agile improved the level of work satisfaction in your team?

Question 19: Do you consider your team to have set benchmark for the agile way of working in VSI division?

Follow up question: If not, which team would you consider to have set benchmark?

In what do you think your team has to improve to set a benchmark?

# Appendix C

## Survey Questionnaires

The questionnaires for survey are listed below. The questionnaires were prepared from literature review (Sidky, 2007) , internal documents and empirical data retrieved from thematic analysis of interviews .

### **Communication**

- Q1 .You communicate with members of your team on a regular basis.
- Q2.Your team uses feedback from retrospective to reflect on strengths and weakness.
- Q3.Your team environment promotes knowledge sharing (through stand up meeting, white boards.etc).
- Q4.You have regular face-to-face interactions with members of your team .
- Q5.In event of uncertainty, you do not hesitate to ask your team members for opinion.
- Q6.Information of product is communicated to whole team.

### **Collaboration**

- Q7.You and your team members trust each other to accomplish prescribed tasks without any interference.
- Q8.Your team is composed of members with different competencies (test, development. etc.).
- Q9.You and your team apply diverse skills and thoughts to achieve a common goal .
- Q10.You leverage connections inside and outside your team to get work done.
- Q11.Your team members seek your input for critical decisions .
- Q12.Your team members work across products to contribute positively to it.

### **Self-Organization**

- Q13.You clearly understand about what your team expects from you (responsibility).
- Q14.You consider your team to be self-organized (team identifies their responsibilities and timelines and do not depend on manager to assign work) .
- Q15.You agree that it is very important for the employees to work in teams where they can divide the team tasks among themselves.

### **Empowerment**

- Q16.You continuously work on developing new skills that can positively contribute to your organization and team .



Q17. Your team has equipped you with resources and skills to understand and react to changing demands of stakeholders .

Q18. It is acceptable for you to express disagreement with your team/manager(s) without fearing for consequences .

Q19. Your team encourages you to be creative and does not dictate terms on what to do exactly.

Q20. You are duly recognized/rewarded for your efforts by the team .

**Values**

Q22. Your team accommodates values brought in by different perspective and cultures.

Q22. You are satisfied by the work you do for your team .

Q23. You are over utilized by your team (over worked) .

**Open-ended**

Q24. Comments/Suggestions for further improving Human Centric aspect in your team.

# Appendix D

## Survey Graphs

### Team 1



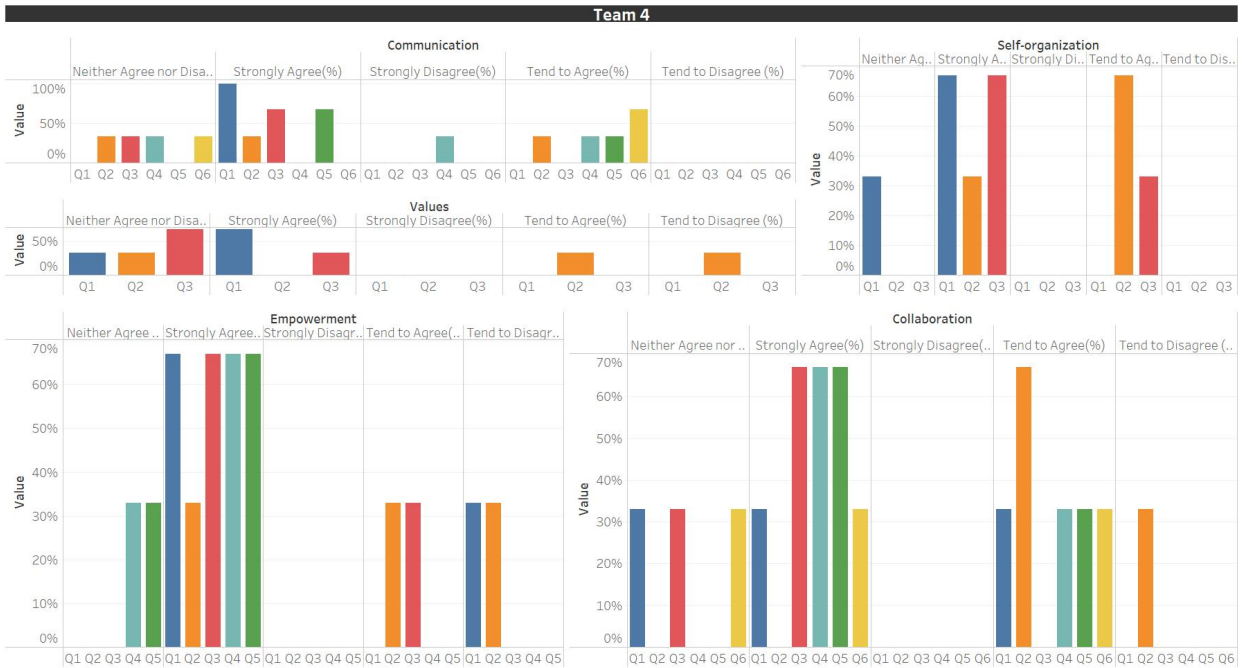
### Team 2



**Team 3**



**Team 4**



## Team 5



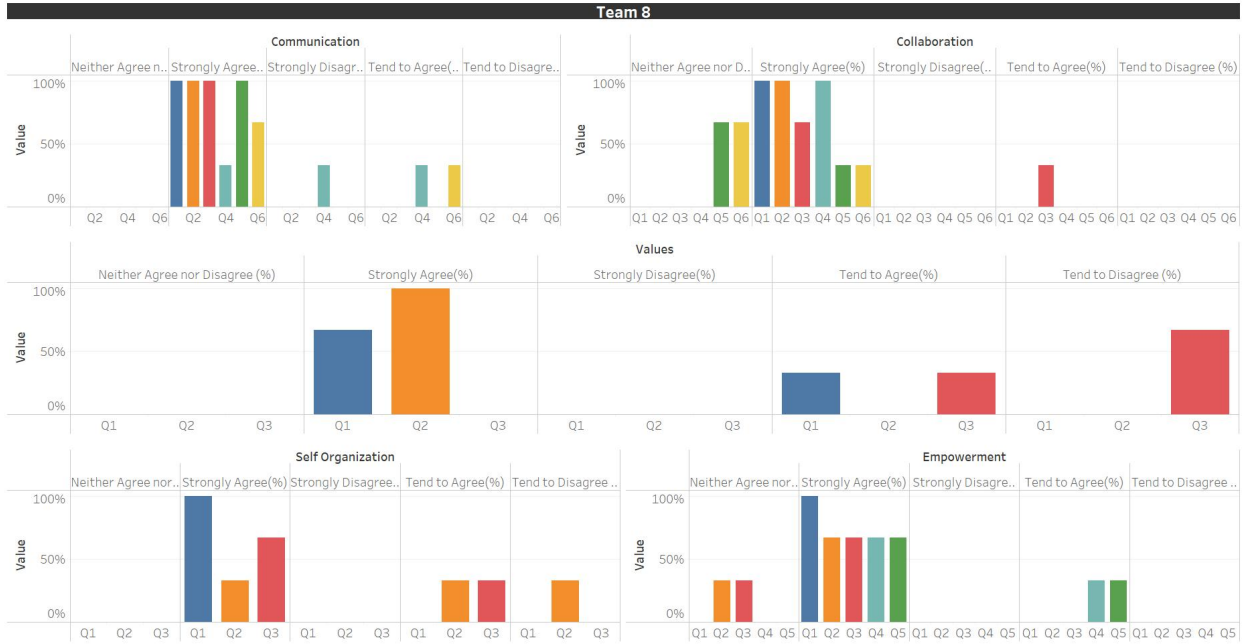
## Team 6



## Team 7



## Team 8



## D.1 Survey Responses

The options and scale for each option for questions  $Q1$  to  $Q22$  are presented in Table D.1.  $Q23$  encompasses a negative trait which distinguishes it from other questions. Hence to possibly ensure the validity of the survey and to perform better analysis, we have used a different scale for each option to calculate interval range of  $Q23$ . The options and related scale is presented in Table D.2 .

Survey Options	Scale
Strongly Disagree	0 %-20%
Tend to Disagree	20%-40%
Neither Agree nor Disagree	40% -60%
Tend to Agree	60%-80%
Strongly Agree	80%-100%

Table D.1: Survey Options

Survey Options	Scale
Strongly Disagree	80%-100%
Tend to Disagree	60%-80%
Neither Agree nor Disagree	40% -60%
Tend to Agree	20%-40%
Strongly Agree	0 %-20%

Table D.2: Survey Options

## Communication

Communication						
<b>Team 1</b>						
Rating Scale	<b>Q1</b>	<b>Q2</b>	<b>Q3</b>	<b>Q4</b>	<b>Q5</b>	<b>Q6</b>
Strongly Agree	5	4	4	1	4	3
Tend to Agree	1	1	2	2	2	3
Neither Agree nor Disagree	0	1	0	3	0	0
Tend to Disagree	0	0	0	0	0	0
Strongly Disagree	0	0	0	0	0	0
<b>Total</b>	<b>6</b>	<b>6</b>	<b>6</b>	<b>6</b>	<b>6</b>	<b>6</b>
<b>Team 2</b>						
Rating Scale	<b>Q1</b>	<b>Q2</b>	<b>Q3</b>	<b>Q4</b>	<b>Q5</b>	<b>Q6</b>
Strongly Agree	3	0	1	1	2	0
Tend to Agree	0	2	2	1	0	2
Neither Agree nor Disagree	0	1	0	1	0	1
Tend to Disagree	0	0	0	0	1	0
Strongly Disagree	0	0	0	0	0	0
<b>Total</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>Team 3</b>						
Rating Scale	<b>Q1</b>	<b>Q2</b>	<b>Q3</b>	<b>Q4</b>	<b>Q5</b>	<b>Q6</b>
Strongly Agree	3	1	1	2	3	1
Tend to Agree	0	1	2	1	0	2
Neither Agree nor Disagree	0	1	0	0	0	0
Tend to Disagree	0	0	0	0	0	0
Strongly Disagree	0	0	0	0	0	0
<b>Total</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>Team 4</b>						
Rating Scale	<b>Q1</b>	<b>Q2</b>	<b>Q3</b>	<b>Q4</b>	<b>Q5</b>	<b>Q6</b>
Strongly Agree	3	1	2	0	2	0
Tend to Agree	0	1	0	1	1	2
Neither Agree nor Disagree	0	1	1	1	0	1
Tend to Disagree	0	0	0	0	0	0
Strongly Disagree	0	0	0	1	0	0
<b>Total</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>Team 5</b>						
Rating Scale	<b>Q1</b>	<b>Q2</b>	<b>Q3</b>	<b>Q4</b>	<b>Q5</b>	<b>Q6</b>
Strongly Agree	5	2	2	0	4	4
Tend to Agree	0	3	3	2	1	1
Neither Agree nor Disagree	0	0	0	1	0	0
Tend to Disagree	0	0	0	2	0	0
Strongly Disagree	0	0	0	0	0	0
<b>Total</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>5</b>
<b>Team 6</b>						
Rating Scale	<b>Q1</b>	<b>Q2</b>	<b>Q3</b>	<b>Q4</b>	<b>Q5</b>	<b>Q6</b>

Table D.3 continued from previous page

Strongly Agree	2	2	2	1	2	2
Tend to Agree	0	0	0	0	0	0
Neither Agree nor Disagree	0	0	0	1	0	0
Tend to Disagree	0	0	0	0	0	0
Strongly Disagree	0	0	0	0	0	0
Total	2	2	2	2	2	2
<b>Team 7</b>						
Rating Scale	<b>Q1</b>	<b>Q2</b>	<b>Q3</b>	<b>Q4</b>	<b>Q5</b>	<b>Q6</b>
Strongly Agree	5	2	3	1	4	3
Tend to Agree	0	3	1	2	1	2
Neither Agree nor Disagree	0	0	1	1	0	0
Tend to Disagree	0	0	0	1	0	0
Strongly Disagree	0	0	0	0	0	0
Total	5	5	5	5	5	5
<b>Team 8</b>						
Rating Scale	<b>Q1</b>	<b>Q2</b>	<b>Q3</b>	<b>Q4</b>	<b>Q5</b>	<b>Q6</b>
Strongly Agree	3	3	3	1	3	2
Tend to Agree	0	0	0	1	0	1
Neither Agree nor Disagree	0	0	0	0	0	0
Tend to Disagree	0	0	0	0	0	0
Strongly Disagree	0	0	0	1	0	0
Total	3	3	3	3	3	3

Table D.3: Survey Response of Communication

## Collaboration

<b>Collaboration</b>						
<b>Team 1</b>						
Rating Scale	<b>Q7</b>	<b>Q8</b>	<b>Q9</b>	<b>Q10</b>	<b>Q11</b>	<b>Q12</b>
Strongly Agree	4	6	3	4	4	3
Tend to Agree	2	0	2	2	2	1
Neither Agree nor Disagree	0	0	1	0	0	2
Tend to Disagree	0	0	0	0	0	0
Strongly Disagree	0	0	0	0	0	0
Total	6	6	6	6	6	6
<b>Team 2</b>						
Rating Scale	<b>Q7</b>	<b>Q8</b>	<b>Q9</b>	<b>Q10</b>	<b>Q11</b>	<b>Q12</b>
Strongly Agree	0	0	0	1	0	0
Tend to Agree	0	2	1	1	3	1
Neither Agree nor Disagree	2	1	1	1	0	1
Tend to Disagree	1	0	1	0	0	1
Strongly Disagree	0	0	0	0	0	0
Total	3	3	3	3	3	3



Table D.4 continued from previous page

Team 3						
Rating Scale	Q7	Q8	Q9	Q10	Q11	Q12
Strongly Agree	3	2	2	1	2	2
Tend to Agree	0	1	1	2	1	0
Neither Agree nor Disagree	0	0	0	0	0	1
Tend to Disagree	0	0	0	0	0	0
Strongly Disagree	0	0	0	0	0	0
Total	3	3	3	3	3	3
Team 4						
Rating Scale	Q7	Q8	Q9	Q10	Q11	Q12
Strongly Agree	1	0	2	2	2	1
Tend to Agree	1	2	0	1	1	1
Neither Agree nor Disagree	1	0	1	0	0	1
Tend to Disagree	0	1	0	0	0	0
Strongly Disagree	0	0	0	0	0	0
Total	3	3	3	3	3	3
Team 5						
Rating Scale	Q7	Q8	Q9	Q10	Q11	Q12
Strongly Agree	3	4	2	3	2	2
Tend to Agree	2	1	3	2	3	1
Neither Agree nor Disagree	0	0	0	0	0	2
Tend to Disagree	0	0	0	0	0	0
Strongly Disagree	0	0	0	0	0	0
Total	5	5	5	5	5	5
Team 6						
Rating Scale	Q7	Q8	Q9	Q10	Q11	Q12
Strongly Agree	2	2	2	2	2	2
Tend to Agree	0	0	0	0	0	0
Neither Agree nor Disagree	0	0	0	0	0	0
Tend to Disagree	0	0	0	0	0	0
Strongly Disagree	0	0	0	0	0	0
Total	2	2	2	2	2	2
Team 7						
Rating Scale	Q7	Q8	Q9	Q10	Q11	Q12
Strongly Agree	3	4	2	2	2	1
Tend to Agree	2	1	3	3	3	4
Neither Agree nor Disagree	0	0	0	0	0	0
Tend to Disagree	0	0	0	0	0	0
Strongly Disagree	0	0	0	0	0	0
Total	5	5	5	5	5	5
Team 8						
Rating Scale	Q7	Q8	Q9	Q10	Q11	Q12
Strongly Agree	3	3	2	3	1	1
Tend to Agree	0	0	1	0	0	0

Table D.4 continued from previous page

Neither Agree nor Disagree	0	0	0	0	2	2
Tend to Disagree	0	0	0	0	0	0
Strongly Disagree	0	0	0	0	0	0
<b>Total</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>

Table D.4: Survey Response of Collaboration

Self-organization

<b>Self-Organization</b>			
<b>Team 1</b>			
<b>Rating Scale</b>	<b>Q13</b>	<b>Q14</b>	<b>Q15</b>
Strongly Agree	4	6	5
Tend to Agree	2	0	1
Neither Agree nor Disagree	0	0	0
Tend to Disagree	0	0	0
Strongly Disagree	0	0	0
<b>Total</b>	<b>6</b>	<b>6</b>	<b>6</b>
<b>Team 2</b>			
<b>Rating Scale</b>	<b>Q13</b>	<b>Q14</b>	<b>Q15</b>
Strongly Agree	0	0	1
Tend to Agree	1	0	1
Neither Agree nor Disagree	2	1	1
Tend to Disagree	0	2	0
Strongly Disagree	0	0	0
<b>Total</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>Team 3</b>			
<b>Rating Scale</b>	<b>Q13</b>	<b>Q14</b>	<b>Q15</b>
Strongly Agree	2	2	2
Tend to Agree	1	1	1
Neither Agree nor Disagree	0	0	0
Tend to Disagree	0	0	0
Strongly Disagree	0	0	0
<b>Total</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>Team 4</b>			
<b>Rating Scale</b>	<b>Q13</b>	<b>Q14</b>	<b>Q15</b>
Strongly Agree	2	1	2
Tend to Agree	0	2	1
Neither Agree nor Disagree	1	0	0
Tend to Disagree	0	0	0
Strongly Disagree	0	0	0
<b>Total</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>Team 5</b>			
<b>Rating Scale</b>	<b>Q13</b>	<b>Q14</b>	<b>Q15</b>

Table D.5 continued from previous page

Strongly Agree	2	4	3
Tend to Agree	3	1	2
Neither Agree nor Disagree	0	0	0
Tend to Disagree	0	0	0
Strongly Disagree	0	0	0
Total	5	5	5
<b>Team 6</b>			
Rating Scale	<b>Q13</b>	<b>Q14</b>	<b>Q15</b>
Strongly Agree	2	2	1
Tend to Agree	0	0	1
Neither Agree nor Disagree	0	0	0
Tend to Disagree	0	0	0
Strongly Disagree	0	0	0
Total	2	2	2
<b>Team 7</b>			
Rating Scale	<b>Q13</b>	<b>Q14</b>	<b>Q15</b>
Strongly Agree	5	5	3
Tend to Agree	0	0	2
Neither Agree nor Disagree	0	0	0
Tend to Disagree	0	0	0
Strongly Disagree	0	0	0
Total	5	5	5
<b>Team 8</b>			
Rating Scale	<b>Q13</b>	<b>Q14</b>	<b>Q15</b>
Strongly Agree	3	1	2
Tend to Agree	0	1	1
Neither Agree nor Disagree	0	0	0
Tend to Disagree	0	1	0
Strongly Disagree	0	0	0
Total	3	3	3

Table D.5: Survey Response of Self-Organization

### Empowerment

<b>Empowerment</b>					
<b>Team 1</b>					
Rating Scale	<b>Q16</b>	<b>Q17</b>	<b>Q18</b>	<b>Q19</b>	<b>Q20</b>
Strongly Agree	4	2	4	4	3
Tend to Agree	2	3	1	2	2
Neither Agree nor Disagree	0	1	1	0	0
Tend to Disagree	0	0	0	0	1
Strongly Disagree	0	0	0	0	0
Total	6	6	6	6	6

Table D.6 continued from previous page

Team 2					
Rating Scale	Q16	Q17	Q18	Q19	Q20
Strongly Agree	0	0	1	1	0
Tend to Agree	3	0	1	1	0
Neither Agree nor Disagree	0	1	0	1	3
Tend to Disagree	0	1	1	0	0
Strongly Disagree	0	1	0	0	0
Total	3	3	3	3	3
Team 3					
Rating Scale	Q16	Q17	Q18	Q19	Q20
Strongly Agree	0	1	1	3	1
Tend to Agree	3	1	2	0	2
Neither Agree nor Disagree	0	1	0	0	0
Tend to Disagree	0	0	0	0	0
Strongly Disagree	0	0	0	0	0
Total	3	3	3	3	3
Team 4					
Rating Scale	Q16	Q17	Q18	Q19	Q20
Strongly Agree	2	1	2	2	2
Tend to Agree	0	1	1	0	0
Neither Agree nor Disagree	0	0	0	1	1
Tend to Disagree	1	1	0	0	0
Strongly Disagree	0	0	0	0	0
Total	3	3	3	3	3
Team 5					
Rating Scale	Q16	Q17	Q18	Q19	Q20
Strongly Agree	1	3	4	3	2
Tend to Agree	4	2	1	2	3
Neither Agree nor Disagree	0	0	0	0	0
Tend to Disagree	0	0	0	0	0
Strongly Disagree	0	0	0	0	0
Total	5	5	5	5	5
Team 6					
Rating Scale	Q16	Q17	Q18	Q19	Q20
Strongly Agree	1	1	0	1	1
Tend to Agree	1	1	2	1	1
Neither Agree nor Disagree	0	0	0	0	0
Tend to Disagree	0	0	0	0	0
Strongly Disagree	0	0	0	0	0
Total	2	2	2	2	2
Team 7					
Rating Scale	Q16	Q17	Q18	Q19	Q20
Strongly Agree	3	2	3	3	2
Tend to Agree	2	3	2	2	3

Table D.6 continued from previous page

Neither Agree nor Disagree	0	0	0	0	0
Tend to Disagree	0	0	0	0	0
Strongly Disagree	0	0	0	0	0
Total	5	5	5	5	5
<b>Team 8</b>					
Rating Scale	<b>Q16</b>	<b>Q17</b>	<b>Q18</b>	<b>Q19</b>	<b>Q20</b>
Strongly Agree	3	2	2	2	2
Tend to Agree	0	0	0	1	1
Neither Agree nor Disagree	0	1	1	0	0
Tend to Disagree	0	0	0	0	0
Strongly Disagree	0	0	0	0	0
Total	3	3	3	3	3

Table D.6: Survey Response of Empowerment

## Values

<b>Values</b>			
<b>Team 1</b>			
Rating Scale	<b>Q21</b>	<b>Q22</b>	<b>Q23</b>
Strongly Agree	4	5	0
Tend to Agree	1	0	1
Neither Agree nor Disagree	0	1	3
Tend to Disagree	1	0	1
Strongly Disagree	0	0	1
Total	6	6	6
<b>Team 2</b>			
Rating Scale	<b>Q21</b>	<b>Q22</b>	<b>Q23</b>
Strongly Agree	1	0	0
Tend to Agree	1	2	1
Neither Agree nor Disagree	1	1	2
Tend to Disagree	0	0	0
Strongly Disagree	0	0	0
Total	3	3	3
<b>Team 3</b>			
Rating Scale	<b>Q21</b>	<b>Q22</b>	<b>Q23</b>
Strongly Agree	2	2	0
Tend to Agree	1	1	0
Neither Agree nor Disagree	0	0	1
Tend to Disagree	0	0	1
Strongly Disagree	0	0	1
Total	3	3	3
<b>Team 4</b>			
Rating Scale	<b>Q21</b>	<b>Q22</b>	<b>Q23</b>
Strongly Agree	2	0	1

Table D.7 continued from previous page

Tend to Agree	0	1	0
Neither Agree nor Disagree	1	1	2
Tend to Disagree	0	1	0
Strongly Disagree	0	0	0
<b>Total</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>Team 5</b>			
<b>Rating Scale</b>	<b>Q21</b>	<b>Q22</b>	<b>Q23</b>
Strongly Agree	2	2	1
Tend to Agree	2	3	1
Neither Agree nor Disagree	1	0	1
Tend to Disagree	0	0	1
Strongly Disagree	0	0	1
<b>Total</b>	<b>5</b>	<b>5</b>	<b>5</b>
<b>Team 6</b>			
<b>Rating Scale</b>	<b>Q21</b>	<b>Q22</b>	<b>Q23</b>
Strongly Agree	1	2	0
Tend to Agree	1	0	0
Neither Agree nor Disagree	0	0	1
Tend to Disagree	0	0	1
Strongly Disagree	0	0	0
<b>Total</b>	<b>2</b>	<b>2</b>	<b>2</b>
<b>Team 7</b>			
<b>Rating Scale</b>	<b>Q21</b>	<b>Q22</b>	<b>Q23</b>
Strongly Agree	3	3	0
Tend to Agree	1	2	0
Neither Agree nor Disagree	1	0	2
Tend to Disagree	0	0	1
Strongly Disagree	0	0	2
<b>Total</b>	<b>5</b>	<b>5</b>	<b>5</b>
<b>Team 8</b>			
<b>Rating Scale</b>	<b>Q21</b>	<b>Q22</b>	<b>Q23</b>
Strongly Agree	2	3	0
Tend to Agree	1	0	1
Neither Agree nor Disagree	0	0	0
Tend to Disagree	0	0	2
Strongly Disagree	0	0	0
<b>Total</b>	<b>3</b>	<b>3</b>	<b>3</b>

Table D.7: Survey Response of Values

# Appendix E

## Survey analysis

The results from survey was analyzed using the framework of the Evaluation Environment which was proposed by Balci, Adams, Myers, and Nance (2002). We have adapted the method for our research. The nominal score for each factor for different teams was calculated using the below defined steps

### Step 1: Compute a weight for each indicator

Initially a weight is assigned to each indicator. The weight is usually a number between 0 to 1 and it implies the weightage given to that specific indicator. Indicators are questions that helps to measure each factor. In our case “Self-organization” factor has 3 questions hence 3 indicators. We had given equal weightage to all the indicators. Hence, the weightage of each indicator will be equal to 0.33 (obtained from  $1/3 = 0.33$ ).

### Step 2: Compute the weighed interval for indicators and interval range for each factor

Assume that one of the survey response for self-organization Factor looks like in the Table E.1

Value	0-20	20-40	40-60	60-80	80-100
Question 1		x			
Question 2				x	
Question 3					x

Table E.1: Sample Interval Range

The next step is to calculate weighted interval. The low end weighted interval is calculate by multiplying the Interval low end \* weight. The high end weighted interval is calculated by multiplying the Interval high end \* weight for each of the Question. The weight is 0.33 which is determined in Step 1. For Example, in this case the response for Q1 was in (20-40) range. The Low end is 20 and High end is 40 for this response. The Interval low end \* Weight for this case is ( $0.33 * 20 = 6.6$ ). The Interval high end \* Weight for this case is ( $0.33 * 40 = 13.3$ ). This step is repeated for all the three questions and results are populated as seen in Table E.2.

Question	Computed Weight	Interval Low End	Interval High End	Interval Low End * Weight	Interval High End * Weight
Q1	0.3	20	40	6.6	13.3
Q2	0.3	60	80	19.9	26.6
Q3	0.3	80	100	26.6	33.3
				53.3	73.3
			<b>Interval Range</b>	53	73

Table E.2: Weighted Interval



### Step 3: Calculate Interval Result Range

The Interval Result Range is then computed by computing the Lower and Upper range for each factor. This is achieved by adding all of the weighed intervals from the previous step. The sample below demonstrates how this is accomplished (See last two columns in Table E.2 ). .

Lower Range = Sum of all weighed low end values from Step 2.

The lower range result is:  $6.6+19.9+26.6 = 53$

Upper Range = Sum of all weighed high end values from Step 2.

The upper range result is:  $13.3 + 26.6 + 33.3 = 73$

The Interval Range of the self-organization factor is between 53-73 in that team

### Step 4: Convert interval range into nominal score

Translate interval range into nominal score. The nominal score is represented in the below Table E.3

Not Achieved	0%-35%
Partially Achieved	35%-65%
Largely Achieved	65%-85%
Potentially Fulfilled	85% - 100%

Table E.3: Nominal Score

The interval range calculated from previous step is 53-73. It does not fit perfectly into the nominal score as represented in Table E.3. Hence, we take an average of interval range and upon taking average it could be seen that it fits in Partially Achieved 35-65% Nominal score. Hence the nominal value for self-organization factor is Partially Achieved 35-65%.

These steps are repeated to calculate the nominal range for each factor of the respective teams. Special attention needs to be given while calculating interval range of value factor. The *Q23* question has a negative trait and hence the scale of each option varies for *Q23* (See table D.2). So interval low end and interval high end values should be populated based on different scale for *Q23*.

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