SOCIALLY SHARED REGULATION IN SCRUM TEAMS

A multiple case study into the regulation processes in Scrum team meetings and variations both within and across teams

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18-05-2017

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PREFACE

I am very proud to present to you my master thesis. This master thesis is the final step to complete the master programme of "Educational Science and Technology" at the University of Twente. This thesis is the result of a year of hard work, challenges and important learning experiences. During this time, I received great support from many people, and I would like to thank them.

At first, I would like to thank my supervisors from the University of Twente, Maaike Endedijk and Marijn Wijga. Maaike, thank you for your help to give this research a clear direction, and for the constructive feedback you gave me in our meetings. Thank you for giving me the freedom to develop myself as a researcher. I learned a lot about myself and my capabilities, which I am really thankful for. Also Marijn, thank you for all the time and effort you have put in guiding me through the data gathering and analysing process. Without your support and time, I couldn't have realized this thesis. Your enthusiasm helped me through several difficulties.

I would also like to thank the Dutch software organization for the possibility to perform my research there. I would like to thank all participants for their willingness to participate in my research.

And last, but not least, I would like to thank my family and friends for supporting me during my master programme and final project. Thank you for your interest, and for listening even though you didn't always understand what I was talking about. I would also like to thank my parents for stimulating me to keep developing myself. Finally, thank you Niels, for your support and encouragement, even when I doubt myself sometimes.

To all of you, thank you, I couldn't have done this without your support.

Alieke Muller
May 2017

SUMMARY

In our knowledge economy, organizations highly depend on the performance of their teams. Innovative software organizations often make use of agile software development methods, for example Scrum, in which software developers combine their knowledge, and work in small self-managing teams. However, many Scrum teams experience difficulties concerning the interaction in the team, the coordination of teamwork and the evaluation of performance. There is still much unknown about these difficulties in Scrum teams from the perspective of software development. From educational perspective, we know that the regulation processes planning, monitoring and evaluation are essential for effective teamwork. These regulation processes appear to be most effective when regulation is socially shared in Scrum teams, which means that the team functions as a whole, and regulation occurs in unison.

In order to solve the difficulties Scrum teams face in teamwork, it is very important to acquire more knowledge about how Scrum teams regulate, and to what extent regulation is socially shared. It is essential as well to investigate where variations in regulation, to be able to determine the cause of the problems in Scrum teams. Therefore, this study focused on two research questions. The first research question was: *How do Scrum teams regulate during meetings?* The second research question was: *To what extent can variations in regulation be related to the type of meetings and individual differences?*

To investigate this, a multiple case study was employed using mixed methods. This case study was conducted at a software organization in the Netherlands. The 19 Scrum team members from three different teams in this organization all participated in the research. Meetings of the Scrum teams were videotaped and analysed to investigate regulation processes. Furthermore, team members participated in a short questionnaire each sprint, in which team characteristics were measured.

Result in this study showed a low amount of evaluations in Scrum teams. Results also showed that Scrum teams often spent little time to reflect on how they work and what can be improved. Another key finding of the present study was that only a few socially shared regulation episodes were found in the Scrum meetings. A lot of engaging contributions of team members was observed in the meetings, but a lot of these discussions ended without a clear conclusion. This indicates that teams may find it hard to draw conclusions and to make plans on how to improve their work. Results of this study also showed differences in participatory roles of team members. During meetings, the Scrum Masters showed a more leading role than the other team members, they were often in charge of leading the meetings. Future research is needed to further explore the influence of participatory roles in Scrum teams on socially shared regulation and team performance. The present study gave valuable insights in regulation in Scrum teams, which can be built on by future research.

Keywords: Scrum, regulation, socially shared regulation, participatory roles

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1. INTRODUCTION

1.1 Problem statement

In our knowledge economy, there is great emphasis on the knowledge and performance of teams. Especially in software development, organizations highly depend on the functioning of teams (McAvoy & Butler, 2009). A growing amount of innovative software organizations use agile software development methods, for example Scrum. In Scrum, software developers combine their knowledge, and work in small self-managing teams (Stray, Moe, & Dingsøyr, 2011). Team members have great responsibility for many aspects of their work, including planning, monitoring, task assigning, and decision-making (Moe, Aurum, & Dybå, 2012). The team has full authority to do whatever they think is needed to achieve their goal (Moe, Dingsøyr, & Dybå, 2008). For a Scrum team to be successful, qualitative interaction is needed between team members (Moe, 2013). Effective face-to-face conversations between team members are essential to share knowledge and information within the team (Moe, 2013). Also, continuous evaluation is important for a successful Scrum team. Evaluations lead to improved productivity, capability, quality and learning in the team (Derby & Larsen, 2006; Ringstad, Dingsøyr, & Moe, 2011).

However, many Scrum teams experience difficulties working effectively as a team (Moe, Dingsøyr, & Dybå, 2010; Stray et al., 2011). Interaction between team members appear to be a big bottleneck in Scrum teams (Dingsøyr & Hanssen, 2003; Moe, 2013; Stray et al., 2011). Another difficulty for teams is to carry out successful evaluations (Dybå, Dingsøyr, & Moe, 2014; Moe, 2013; Stray et al., 2011). Many teams spend little time to evaluate their performance (Dybå et al., 2014). Other teams evaluate regularly, but struggle to solve their issues and to change their daily practice (Stray et al., 2011). These difficulties Scrum teams experience, are related to the interaction in teams, the coordination of teamwork and the evaluation of performance. Little is known about these difficulties from the perspective of software development. From educational perspective, we know that regulation processes are essential processes for effective teamwork. Regulation processes exist of planning, monitoring and evaluation processes (Zimmerman, 1989). Planning involves goalsetting and the division of tasks. Monitoring includes the communication in the team to compare current performance with the team goals. Evaluation involves strategies to improve teamwork and to learn from mistakes. These regulation processes appear to be most effective when regulation is socially shared in the Scrum team (Schoor, Narciss, & Körndle, 2015). Socially shared regulation means that the team functions as a whole, and regulation occurs in unison. Teams have shared awareness of goals and joint monitoring of progress towards a shared outcome. Socially shared regulation processes are expected to be beneficial to the interaction and coordination in teams, because team members regulate, set goals, determine strategies and make decisions collectively (Schoor et al., 2015).

Thus, existing literature on regulation shows that regulation processes, and especially socially shared regulation can positively affect teamwork and collaboration (Saab, 2012; Schoor et al., 2015; Stray, Moe, & Aurum, 2012). In order to solve the difficulties Scrum teams face in teamwork, it is

essential to acquire more knowledge about how Scrum teams regulate. The goal of this research is to give insight in the regulation processes in Scrum teams. This study sets also light on the perspective of social regulation in Scrum teams. The quality of social regulation in Scrum teams is examined in this study, because more socially shared regulation in Scrum teams can make the teams more successful. This study also tries to give insight in variations in regulation and tries to explain these variations. The results of this study can be used in practice to design interventions for Scrum teams to use planning, monitoring and evaluation processes more effectively and more socially shared in the teams.

1.2 Overview

In the next chapter, chapter 2, the conceptual framework of this study will be described. The important concepts in this study will be explained, followed by the research questions. Chapter 3 describes the methods used in this study. Also the instrumentation and procedure are discussed in this chapter. In chapter 4, the results of this study are described. The discussion and conclusions of the research are discussed in chapter 5.

2. CONCEPTUAL FRAMEWORK

2.1 Regulation

The term regulation is often used in constructivism, in which learners are viewed as active participants in the learning process (Hadwin & Oshige, 2011; Pintrich, 2004). Regulation is defined as the systematic planning, monitoring, and regulating of cognitive, behavioural, and motivational processes towards the completion of a goal (Hadwin & Oshige, 2011; Schoor et al., 2015; Zimmerman, 1989). Regulation is always directed to a certain standard or goal, against which the performance is monitored (Hadwin & Oshige, 2011).

In order to reach the desired goals, three phases of regulation are important. These regulation phases are planning, monitoring and evaluation processes, which are all aimed at completing the goal (Schoor et al., 2015; Zimmerman, 1989). Planning processes involve goalsetting, selecting appropriate strategies and resources to organize and prepare for a task, and deciding the order of completing tasks (DiDonato, 2013). Monitoring processes consist of strategies that individuals or teams employ as they compare their performance with their desired goals (DiDonato, 2013). These monitoring processes generate feedback that can be used to guide further action (Schoor et al., 2015). Evaluation processes involve strategies to assess and reflect on learning processes and outcomes. The evaluation of actual performance can reveal discrepancies to the desired goal, and can lead to decisions to change daily practice (DiDonato, 2013; Schoor et al., 2015). Evaluation processes are most effective when they are performed frequently (DiDonato, 2013). These three phases of regulation (planning, monitoring and evaluation) are important to discover variations in the quality of regulation both within and across teams (Rogat & Linnenbrink-Garcia, 2011).

In the context of teamwork, team members not only have to regulate their own learning, but also each other's learning and the team learning (Schoor et al., 2015). In literature, three types of regulation are distinguished, namely self-regulation, co-regulation and social regulation. Someone is self-regulated when someone is metacognitively, motivationally, and behaviourally active in one's own learning process (Zimmerman, 1989, p. 329). Co-regulation is the transitional process where experts help learners to get used to self-directed learning (Hadwin & Oshige, 2011). Social regulation involves the collective regulation of the team, in which goals and standards are co-constructed by the team members (Hadwin & Oshige, 2011).

2.2 Social regulation

The main focus in this study is on social regulation, which refers generally to all regulation in teams (Volet, Summers, & Thurman, 2009). Social regulation involves the processes in which team members regulate their collective activities (Hadwin & Oshige, 2011). Teams use social regulation to control and monitor the team activities, and select the appropriate activities to achieve their goals (Molenaar, 2011; Volet et al., 2009). The quality of social regulation in the team is determined by the extent to which the regulation is socially shared in the team (Rogat & Linnenbrink-Garcia, 2011). So, socially shared

regulation is seen as the highest quality of social regulation. In literature, several other aspects are associated with social regulation in the teams. The following sections address these aspects, starting with socially shared regulation.

2.2.1 Socially shared regulation

As mentioned before, socially shared regulation is seen as the highest quality of social regulation. Socially shared regulation involve the processes in which team members regulate their joint activities by constantly monitoring and coordinating group activities (Schoor et al., 2015; Vauras, Iiskala, Kajamies, Kinnunen, & Lehtinen, 2003). This type of regulation is important for the coordination in teams, the planning of activities and the monitoring of the team progress (Volet et al., 2009). In socially shared regulation, the team functions as a whole, regulation occurs in unison, and the team operates together as one single entity (Schoor et al., 2015). The goals, regulatory activities, and cognitive actions are shared among the members of the team. This means that the regulation processes planning, monitoring and evaluation are co-constructed in the team, as well as the goals and standards (Hadwin & Oshige, 2011; Schoor et al., 2015). The shared regulation in the team is not reducible to individual activity, but is the activity of the social entity. Socially shared regulation also involves multiple team members engaging in elaborating on each other's ideas, providing feedback, giving critical comments and jointly monitoring content contributions (Molenaar, 2011). This can help solving problem situations in the team.

Socially shared regulation is seen as the most profoundly mode of social regulation in teams, because the team has shared awareness of goals and joint monitoring of progress toward a shared outcome (Schoor et al., 2015). Socially shared regulation positively affects team performance and team learning (DiDonato, 2013; Saab, 2012; Schoor et al., 2015). Therefore, socially shared regulation should occur often in the team regulation because it can make teams more successful.

2.2.2 Type of interactions in social regulation

To ensure high quality socially shared regulation in the team, intensive interaction in the team is essential (Molenaar, 2011; Volet et al., 2009). It is essential for teams to exchange information, because through good interaction, team members can improve the quality of their products (Hoegl & Parboteeah, 2007; Kim, 2007). In effective teams, team members can communicate openly, coordinate the group activities, ensure that all team members can contribute, mutually support each other, set norms of high effort and foster an adequate level of team cohesion (Hoegl & Gemuenden, 2001). According to Molenaar (2011), team learning and effectiveness depend heavily on the quality of the interaction and discussions between team members. When team members react on each other's contributions, for example giving feedback to each other and engaging in arguments, learning is fostered in the team (Molenaar, 2011). The discussions and interactions in the team lead to knowledge that individual group members are unlikely to generate by themselves (Molenaar, 2011). Positive interactions in the team, when team members are

respectful of each other, can foster high quality social regulation in the team (Grau & Whitebread, 2012; Rogat & Linnenbrink-Garcia, 2011).

The extent to which team members contribute to the conversation and react on each other is called transactivity. More transactive interaction between team members benefits teamwork and socially shared regulation in the team (Molenaar, 2011; Schoor et al., 2015). Different transactivity is present in the following four different types of interaction, as distinguished by Molenaar (2011). These activities are called metacognitive activities, but are similar to regulation activities.

1. Ignored metacognitive activities: these activities occur when one team member tries to monitor the learning activities of the team, but he or she is ignored by the other team members.
2. Accepted metacognitive activities: these activities occur when metacognitive contributions are engaged in by other team members.
3. Shared metacognitive activities: these activities occur when a team member monitors the learning activities of the team and another team member relates to this.
4. Co-construct metacognitive activities: these activities occur when metacognitive contributions are discussed by the other group members.

These activities are ordered from low transactivity to high transactivity, and from low quality social regulation to high quality, socially shared, regulation. Teams need to have high transactive activities and social regulation to make co-constructive decisions. Ignored activities are least effective for social regulation, so these activities should be avoided. These negative interactions in the team diminish the quality of social regulation and can lead to a lack of respect and discouraged team members (Rogat & Linnenbrink-Garcia, 2011). Accepted activities are sometimes needed in social regulation, because they are effective to finish quickly with routine tasks. For most effective social regulation, shared and co-construct activities are the most desired activities. Discussions of team members in which they co-construct knowledge and engage in each other's contributions are needed to ensure high quality social regulation in the team. Additionally, it is important for team members to use these metacognitive activities to draw conclusions on how to approach the team tasks. The absence of conclusions in discussions can undermine the quality of socially shared regulation and learning in the team (Rogat & Linnenbrink-Garcia, 2011).

2.2.3 Direction of activity in social regulation

Not only interaction is important for the quality of social regulation, but what the team is regulating, the direction of activity, also matters. Teams can regulate about the content of the project, about the team processes and about the meeting (Rogat & Linnenbrink-Garcia, 2011). For example, regulating the meeting can involve helping other team members to stay on-topic. According to Stray et al. (2012), a large part of team meetings is perceived as ineffective. However, team meetings that include more regulation about the content of the project are associated with higher team productivity (Stray et al., 2012). Also regulation aimed at structuring and organizing the meetings and the team processes is

positively linked to team success (Stray et al., 2012). However, off-topic talk in team meetings can result in less and lower quality social regulation in the team (Rogat & Linnenbrink-Garcia, 2011). Therefore, an effective direction of activities in team meetings is essential to encourage high quality, socially shared, regulation in the team (Stray et al., 2012).

2.2.4 Individual differences in social regulation

Little research exists that has investigated individual roles in teams and its effect on the quality of socially shared regulation in the team. However, a phenomenon that has emerged in literature related to this subject, is directive regulation (Rogat & Linnenbrink-Garcia, 2011; Schoor et al., 2015). Directive regulation refers to the phenomenon in which one person in the team dominates the regulation in the team (Rogat & Linnenbrink-Garcia, 2011). This person is in control, might also tell the others what to do and monitors the progress of the team (Schoor et al., 2015). Findings of Rogat and Linnenbrink-Garcia (2011) showed that a directive team member can cause lower quality social regulation in the team. Also according to Hoegl and Gemuenden (2001), it is important to the quality of the teamwork that all team members' contributions are in balance. Especially in software teams that consist of team members with different knowledge and experience, it is important that every team member can contribute all task-relevant knowledge and ideas to the team. Discussions and decision-making processes shouldn't be dominated by one person, because all team members have specific expertise and knowledge (Hoegl & Gemuenden, 2001; Stray et al., 2012). This is an important factor in the self-managing Scrum teams, in which leadership and regulation should be shared (Moe et al., 2008; Stray et al., 2012). So, literature showed that the quality of social regulation may depend on the different roles and participation of team members in the Scrum teams.

2.3 Scrum

In this study, social regulation is investigated in software teams that work with the Scrum method. Scrum is a software development methodology for small teams. In Rugby, a scrum is a team of eight individuals. Teams work as units, in which each team member fulfils a well-defined role, and the team as a whole focuses on a shared goal. Collaboration and flexibility is essential to reach the goal. These characteristics are also important for software development, and especially for Scrum (Rising & Janoff, 2000). Software is developed in sprints of two weeks. Each sprint ends with working code that can be presented to the customers.

In Scrum, software is developed by self-managing teams, which exists of a Product Owner, a Development Team and a Scrum Master. Software features that need to be implemented in the software system are registered in a Backlog. The Product Owner decides in accordance with the stakeholders which items from the Backlog will be developed in the following sprint, and lists these items in the Sprint Backlog. The Scrum Master is in charge of solving problems that stop the team from working

effectively (Dybå & Dingsøyr, 2008). Together, the teams have the responsibility to deliver working software every sprint.

Scrum teams have several team meetings in the sprint. The sprint starts with a sprint planning meeting, in which is determined what tasks will be performed in the upcoming sprint (Dybå et al., 2014). During the sprint, team members coordinate their work in a daily stand-up meeting. In that meeting, each team member answers the following questions: What did I do yesterday? What will I do today? Do I see any impediment (Stray et al., 2012)? By discussing these questions, team members understand what other members are doing and it can help them to identify obstacles (Kim, 2007). Sometimes a refinement meeting is held, in which the backlog and priorities are made up-to-date. The sprint ends with a retrospective, in which is discussed what went well in the sprint and what could be improved in the next sprint. Decisions about change are made based on these evaluations (Dybå et al., 2014).

Scrum teams need to have socially shared regulation processes, which requires continuous interactions between team members, both during daily meetings and during workdays (Kim, 2007; Licorish & MacDonell, 2014). Planning processes are essential to ensure that tasks are coordinated and everyone is engaged. Planning and coordination are also important for team orientation, team consensus, shared understanding and attitudes that team members have towards one another (Stray et al., 2011). Especially during the sprint planning these processes should be present to discuss about the planning of the sprint and the priority of the tasks (Kim, 2007). Monitoring processes are needed to measure mutual performance (Moe & Dingsøyr, 2008). This involves applying appropriate strategies to monitor performance on a daily basis. Monitoring processes should especially be present in the daily stand ups. The burndown chart gives a clear picture of team progress. Evaluation processes are important to evaluate what happens during the sprint and to adjust strategies based on the outcomes (Moe & Dingsøyr, 2008). Effective evaluation can help teams solve their challenges and foster team learning (Schoor et al., 2015). Evaluation processes should also be regularly present in the meetings to reflect on the progress and the quality of products (Kim, 2007).

Leadership should be shared in the team, which means that the leadership should be divided between the team members (Moe & Dingsøyr, 2008). Decisions about the tasks are made involving the entire team. The Scrum Master acts as a facilitator, the team organizes itself. The social regulation in the team should be evenly distributed between the team members in the Scrum team (Stray et al., 2012).

2.4 Research questions

The focus of this research is to investigate planning, monitoring and evaluation processes at a Dutch software organization. More information is needed about these regulation processes in Scrum teams, in order to support Scrum teams to work more effectively. This research focuses on the regulation processes in Scrum teams and to what extent this regulation is socially shared. This research also

attempts to give insight in variations in regulation within and across teams. This empirical study tries to answer the following research questions:

RQ 1: *How do Scrum teams regulate during meetings?*

a. *To what extent does regulation occur during Scrum meetings?*
b. *What is the direction of the regulation activities in Scrum teams?*
c. *What is the quality of interaction in Scrum meetings?*
d. *To what extent is regulation socially shared in Scrum teams?*

RQ 2: *How can variations in regulation be explained?*

a. *To what extent can variations in regulation be related to the type of meetings?*
b. *To what extent can variations in regulation be related to individual differences?*

3. METHOD

3.1 Research design

This study was an exploratory multiple case study. Exploratory research is very helpful when little research exists about a topic, which is the case here with social regulation processes in Scrum teams. Exploratory research can help to gain deeper insights on regulation processes and the quality of social regulation in Scrum teams. Mixed methods were used to investigate multiple Scrum teams (multiple cases) at a Dutch software organization. This design made it possible to investigate regulation processes in multiple teams and to discover variations in regulation both within and across teams. Quantitative data and qualitative data were obtained simultaneously in this study. The main focus in this study is on qualitative data. Team meetings of the Scrum teams were video recorded and analysed to investigate the regulation processes in Scrum teams. Quantitative data was collected by a questionnaire, which was used to measure team characteristics in the organization.

3.2 Participants

The respondents in this research were Scrum team members. The Dutch software organization that participated in this study has three Scrum teams. All teams were asked to participate in this study, and they all agreed to participate. The teams consisted of between five and seven team members. A total of 19 employees, from the three Scrum teams, participated in this study. The average age was 37 year and 11 months, ranging from 27 to 54 years old. All participants had a Dutch nationality. In Table 1, the team characteristics of the three teams are presented. The cohesion and satisfaction of the teams, measured with the questionnaire, is presented in Table 1. Cohesion was lowest in Team A, suggesting that was the least cohesive team. Satisfaction was high in all three teams, and highest in Team C, indicating that Team C is the most satisfied team.

Table 1

Team characteristics of the three Scrum teams in this study

		Team A	Team B	Team C
Team size		7	5	7
Gender	Male	5	4	6
	Female	2	1	1
Age	Mean	37	38	38
Education	Academic university	2	1	0
	University of applied sciences	5	4	4
	Vocational education	0	0	1
	Secondary education	0	0	2
Function	Scrum Master	1	1	1
	Product Owner	1	1	1
	Developer	3	3	5
	Tester	2	0	0
Team in current composition		1 month	3 months	1 month
Cohesion		3.09	3.61	3.54
Satisfaction		3.71	3.87	4.17

3.3 Measures

In this study, data was collected from video observations and questionnaires. The main data collection method in this study were the video observations. The video observations were used to measure regulation processes and variations in regulation in Scrum teams. The questionnaire was used to measure team characteristics in the teams.

3.3.1 Video observations

In order to understand the regulation processes in the Scrum teams, the meetings were video recorded. It was impossible to collect all conversations during the entire workday, so the choice was made to record only the Scrum meetings and conversations during the meetings to investigate regulation processes. The reason for this is that during meetings most conversations are related to coordination and regulation of work. These are the most interesting moments to collect data about regulation. During the workday, often other topics are discussed, and a substantial part of the day there are no conversations at all.

All three Scrum teams were videotaped during two sprints, and a total of four weeks. Every sprint the Scrum teams have a number of meetings scheduled. The sprint starts with a sprint planning,

every day there is a short stand up meeting, and the sprint ends with a sprint retrospective. Sometimes, the teams also have refinements. All these meetings were video recorded. In total, a number of 78 meetings were video recorded, and more than 36 hours of video recordings. However, analysing these meetings was very time consuming, so only 39 meetings could be analysed and used for this research. During the selection of meetings for analysis, it was strived to keep the amount and type of meetings in balance for all three teams. However, the teams don't have an equally amount of meetings in their sprints. Also, not every Scrum team has refinement meetings. Therefore, it was not possible to analyse exactly the same amount and type of meetings for all teams. In Table 2, the number of observations per team and per type of meeting is presented.

Table 2

Number of video observations per team and per type of meeting

		Team A	Team B	Team C
Number of observations	Sprint planning	3	1	2
	Stand-ups	9	7	8
	Refinements	0	3	0
	Sprint retrospective	3	2	1
	Total	15	13	11

The 39 observed meetings included over 20 hours of video material. The Scrum meetings lasted on average 30 minutes. The analysed meetings consisted of a total of 10,220 utterances. A total of 358 episodes were distinguished, an average of 9.18 episodes per meeting. These episodes lasted on average 202 seconds.

3.3.2 Questionnaire

The questionnaire was used to measure team characteristics in Scrum teams. The questionnaire focused on two aspects of the Scrum team, namely cohesion and satisfaction. The questionnaire started with a few personal questions regarding gender, year of birth, educational degree, nationality, team, start date in current team, and function. In total, the survey consisted of 13 items. The questions can be found in Appendix A.

Cohesion. The scale from Hoegl, Praveen Parboteeah, and Gemuenden (2003) was used to measure cohesion in the team. The scale includes three items, rated on a Likert scale (1; totally disagree to 5; totally agree). An example statement was "During the last sprint, it was important to the members of our team to be part of this project." Reliability of this scale was good, α= .83.

Satisfaction. The satisfaction of the team members was measured by three items that were adapted from Gladstein (1984). The three items were rated on a Likert scale (1; totally disagree to 5;

totally agree). An example statement from this scale was: “I am satisfied with the way my colleagues and I worked together during the last sprint.” Reliability of this scale was high, α= .95.

3.4 Procedure

All Scrum team members were approached and asked for their participation in this research. The procedure and research aim were first explained to the team leaders and the team. It was explained how the data would be collected, what time team members needed to invest and how would be coped with privacy issues. Team members could ask questions and try out the camera. Every team member could decide for themselves if they wanted to participate in the study. A Scrum team was only included in the study if all team members have agreed to participate. Everyone agreed to this and signed the informed consent form, so all three Scrum teams could be included in the research.

A pilot test was set up before the official data collection to test the cameras. One Scrum team volunteered to participate in the pilot, which was performed during one sprint. This sprint was used to figure out how the camera works, where the camera should be placed and how team members react on the presence of the camera. The video camera used was a small 360degrees camera. During the pilot, it appeared that the team members barely saw the camera. The presence of the camera and researcher didn’t bother them, and it didn’t make them uncomfortable to speak up in the meetings.

At the end of April 2016 the official data collection started. Two cameras were available, so two Scrum teams could be recorded in parallel. The researcher started the video recording before the meeting, and ended the recording after the meeting. The team members didn’t have to do anything for the video recordings. The Scrum teams often had meetings at the same time, which meant that the researcher couldn’t always attend all meetings of the Scrum teams. The researcher made sure the video cameras recorded every meeting.

The last day of the sprint, at Friday, the team members received an email and were asked to fill in a short digital questionnaire. The questionnaire was accessible via a link to the online survey tool Qualtrics. It took the participants about 15 minutes to complete the questionnaire. In this questionnaire, also some personal information was asked.

The data of the participants was anonymized. All personal information and other references to a certain participant was changed into a code. The code list with the connections between codes and participants was stored safely and could only be accessed by using a password.

3.5 Data analysis

Several steps were taken to analyse the data that was collected in the study. The video recordings of the team meetings were analysed using The Observer XT 13. The videos were imported and coded in The Observer. This was done without transcribing the videos but by coding the video segments. All utterances of the team members were given several codes. The coding scheme from Wijga and Endedijk (2016) was used during this analysing process. This coding scheme is based on literature on regulation,

and the framework of Molenaar (2011) was used to determine the quality of interaction. This framework was adapted to the context of Scrum meetings, and therefore some codes were removed and added to make the coding scheme suitable for this context. The coding steps followed during the coding process are described below, in which also all codes are explained. The entire coding scheme, with examples included, is presented in Appendix B. The coding steps are also explained in a figure that can be found in Appendix C.

1. Determine episodes: An episode is a sequence of utterances about the same topic. An episode starts with the first utterance about a new topic and ends with the last utterance about the same topic. This step isn't focused yet on identifying regulation processes. So, also episodes can exist without any regulation utterances. An episode can be interrupted by short 'social talk' when they afterwards continue with the same topic.

Episode

- A sequence of utterances about the same topic.

2. Social regulation utterances: In this step a distinction is made between regulation utterances and cognition utterances. The goal of this step is to make clear what activities do and don't fall in the category "regulation". The cognition utterances are identified to define the boundaries of regulation.

Social regulation

- Intentional and goal directed group efforts to regulate its conceptual understanding and task work.
- Collectively shared regulatory processes orchestrated in the service of shared outcome.

Cognition

- Utterances about the content of the task and the elaboration of this content.

Off-topic

- When communication is too hard to understand or the sound is unclear.

Social talk

- Talk not aimed at regulating the project or the team processes.

3. Regulation phases: A distinction is made between the different regulation phases: *planning*, *monitoring* and evaluation. Every utterance that is assigned to the category 'Social Regulation' in step 2, will get one of these three sub codes. During the coding process, step 2 and 3 are often carried out simultaneously.

Planning

- Discussing how to go about solving problems, discussing strategies, goal setting, collaboratively discussing task directions, translating directions into a clear plan, designating tasks.

Monitoring

- Checking progress and comprehension of the task (I do not understand, you are doing it wrong). Comparing a current state with a desired state (goal standard). Monitoring content understanding, assessing progress, recognizing what remains to be completed, monitoring the pace and time remaining.

Evaluating

- Making a judgement about goal attainment.
- Discussing what could be improved next time.

4. Direction of activity: In this step, the goal of the regulation activity is specified. Regulation activities can be aimed at regulating (a) the content of the project, (b) the meeting, or (c) the organization and logistics of the collaboration process. Cognition activities also get a direction of activity code when they have a clear direction.

Project

- Regulation directed to planning, monitoring or evaluation of the design process. Regulation activities about the content of the project.

Meeting

- Regulation activities directed to the practical organization and logistics of the meeting.

Organization

- Regulation activities directed to the practical organization and logistics of the (collaboration) process. E.g., a discussion about the value of planning points *(can we split a 6 and a 8 to a 7).*

5. Quality of interaction: In this step the quality of the interaction in the regulation process is indicated. Dependent on how team members react on each other's regulation utterances, three types of interaction can be distinguished: *ignoring*, *accepting*, and *engaging*. These codes are always an response to a previous regulation activity, that's why a category *initiating* was added. The first regulation activity in an episode always receives the code 'initiating'. To distinguish episodes with and without a clear conclusion, also a category *concluding* was added to the coding scheme.

Initiating

- Initiating regulation activity. This can coincide with the ignoring code when the initiating activity is at the same time an ignoring activity of the previous activity.

Ignoring

- When the group members do not relate to nor engage in another group member's regulation activity.

Accepting

- When the group members engage in a regulation activity with a cognitive activity. E.g., confirming, repeating, performing an activity on the spot (answering a question with a non-regulation activity).

Engaging

- When group members relate or engage in each other's regulation activities. Responding by further specifying or clarifying the previous regulation activity or further develop the previously initiated idea.

Concluding

- When a group member ends the topic with a short summary or conclusion of the discussion.

6. Socially shared regulation: In this step the focus shifts from coding on utterance level, back to coding on episode level. Socially shared regulation is often seen as co-constructing and discussing while working on tasks. However, in this study regulation is only analysed during Scrum meetings and team members are not working on tasks simultaneously. Therefore, in this study regulation is called socially shared when team members are engaged in the discussion and when this discussion is ended by a conclusion. Regulation is not seen as effective when team members only engage in each other's contributions, but no one draws a conclusion. Regulation in the team is most effective when discussions are ended by a shared conclusion in the team. Therefore, it is important to measure socially shared regulation on episode level. When an episode contains engaging interaction, so when team members engage in the discussion, and this discussion ends with a conclusion, the episode is called socially shared. Socially shared regulation is defined as: "an episode that contains engaging interaction, and which ends with a shared concluding utterance."

Socially shared regulation

- An episode that contains engaging interaction, and which ends with a shared concluding utterance.

The coding steps and coding scheme were used to guide the video analysis. During the coding of the videos, a team of researchers constantly compared their results and discussed the codes until agreement was reached. Several meetings were used to reach a clear consensus on the codes. After the coding of all meetings, Chi-square analyses were performed on the coded regulation activities to analyse what the variations in regulation were related to. Post-hoc adjusted residual (AR) analyses were added to test also

whether particular cells in the crosstabs showed a significant deviation from the expected frequency. Following Field (2009), a Bonferroni correction was performed to correct for the multiple post-hoc analyses on a single crosstab. The Bonferroni correction was used to determine when the adjusted residuals were considered to be statistically significant.

The questionnaire was analysed using SPSS. Descriptive statistics were calculated and analysed to explore differences between the teams in cohesion and satisfaction. The questionnaire was also used to discover other characteristics of the team members, such as age and education. The results of this questionnaire are presented in Table 1, in which the characteristics of the three teams are described.

During analyses of the video observations, it appeared that the participation of team members changed per episode and per meeting. Therefore, the interaction flow was measured of a number of significant episodes. Interaction flow refers to "a mode of interaction in which team members express a joint heightened participation in the conversation, and team members build on one another's contributions" (Oortmerssen, Woerkum, & Aarts, 2015).

4. RESULTS

The video observations were analysed to determine how Scrum regulate in their meetings and what the variations in regulation are related to. A total of 10,220 utterances was distinguished from the video observations. Only one of these utterances was coded as off-topic, so this code was left out of further analyses. Only 10,219 utterances were included in the analyses.

4.1 Variations in regulation of Scrum teams during meetings

The first research question was: *How do Scrum teams regulate during meetings?* To find answers for this question, results from the Chi-square analyses were used.

4.1.1 Variations in regulation in Scrum teams

Variations in regulation were analysed to determine any differences in how often regulation occur in the meetings and to explore differences between teams. Table 3 presents the results of the amount of social regulation, cognition and social talk in the meetings. The results from the Chi-square test showed a significant relationship between teams and regulation, χ^2 (4) = 129.890, p = .000. Table 3 also shows the detailed results of the Chi-square test. Following the results of the Bonferroni correction, when the adjusted residuals are <-2.77 or >2.77, the differences between two cells are considered to be statistically significant.

Table 3

Crosstab with teams and regulation, including Observed Frequencies, Expected Frequencies and Adjusted Residuals

Team		Social regulation	Cognition	Social talk	Total
Team A	Observed Frequency	2671	762	527	3960
	Expected Frequency	2698.6	863.0	398.4	3960.0
	Adjusted Residual	-1.2	**-5.0**	**8.7**	
Team B	Observed Frequency	2206	613	251	3070
	Expected Frequency	2092.1	669.0	308.8	3070.0
	Adjusted Residual	**5.3**	**-2.9**	**-4.1**	
Team C	Observed Frequency	2087	852	250	3189
	Expected Frequency	2173.2	695.0	320.8	3189.0
	Adjusted Residual	**-4.0**	**8.1**	**-5.0**	
Total	Observed Frequency	6964	2227	1028	10219
	Expected Frequency	6964.0	2227.0	1028.0	10219.0

Significant deviations of the observed frequency from the expected frequency are presented in **Bold**.

A striking result was the large amount of social regulation in the meetings of Scrum teams. 6964 out of 10219 utterances were coded as social regulation, indicating that a large part of the Scrum meetings is spent regulating. Also a substantial part of the meetings is spent talking about cognition, which consists of utterances about the content of the task. Results also showed that a lot of time in meetings is used for social talk, for example to discuss the weather or the holidays. 1028 social talk utterances were distinguished, which means that 1 out of every 10 utterances was social talk.

Results on the post-hoc analyses in Table 3 showed significant deviations from the expected frequencies in the teams. Results showed that Team B is the only team in which social regulation was observed more often than the expected frequency (AR = 5.3). On the contrary, Team C showed less social regulation (AR = -4.0) than the expected frequency. Cognition was less often observed in Team A (AR = -5.0) and in Team B (AR = -2.9). In Team A, social talk was significantly more observed in the meetings (AR = 8.7). However, Team B (AR = -4.1) and Team C (AR = -5.0) showed less social talk.

In Table 4, social regulation is further divided in planning, monitoring and evaluation. The results from the Chi-square test showed a significant relationship between teams and regulation, χ^2 (4) = 361.536, p = .000. Following the results of the Bonferroni correction, when the adjusted residuals are <-2.77 or >2.77, the differences between two cells are considered to be statistically significant.

Table 4

Crosstab with teams and social regulation processes, including Observed Frequencies, Expected Frequencies and Adjusted Residuals

Team		Planning	Monitoring	Evaluation	Total
Team A	Observed Frequency	1536	496	639	2671
	Expected Frequency	1506.9	660.1	504.0	2671.0
	Adjusted Residual	1.4	**-9.4**	**8.5**	
Team B	Observed Frequency	1077	586	543	2206
	Expected Frequency	1244.6	545.2	416.2	2206.0
	Adjusted Residual	**-8.7**	2.4	**8.3**	
Team C	Observed Frequency	1316	639	132	2087
	Expected Frequency	1177.5	515.8	393.8	2087.0
	Adjusted Residual	**7.3**	**7.5**	**-17.5**	
Total	Observed Frequency	3929	1721	1314	6964
	Expected Frequency	3929.0	1721.0	1314.0	6964.0

Significant deviations of the observed frequency from the expected frequency are presented in **Bold**.

Generally, results revealed that planning utterances are much more frequent in the meetings than the other regulation processes. 43% utterances in meetings are utterances about planning issues in the team. This indicates that Scrum teams talk more about planning in their meetings than about monitoring and evaluation. The least amount of utterances in the meetings is about evaluation. This indicates that the Scrum teams all spent little time in their meetings evaluating.

The analysis show that in the meetings of Team A, evaluation utterances were observed significantly more often (AR = 8.5). However, monitoring utterances were observed significantly less often than the expected frequency in Team A (AR = -9.4). The meetings of Team B showed significantly less planning utterances (AR = -8.7), but more evaluation utterances (AR = 8.3) than the expected frequency. In Team C, evaluation utterances occurred significantly less frequently (AR = -17.5). Team C showed the least evaluation of all three Scrum teams. On the other hand, Team C showed more planning utterances (AR = 7.3) and monitoring utterances (AR = 7.5).

4.1.2 Variations in direction of activity in Scrum teams

The direction of activities in the Scrum team was also analysed to explore differences in the direction of regulation utterances. The direction of activity code was only given to regulation utterances, and to some of the cognition utterances that had a clear direction. The results showed that teams were significantly related to direction of activity, $\chi^2(4) = 177.399$, $p = .000$. In Table 5, the results of the Chi-square analysis are presented. Following the results of the Bonferroni correction, when the adjusted residuals are <-2.77 or >2.77, the differences between two cells are considered to be statistically significant.

Table 5

Crosstab with teams and direction of activity, including Observed Frequencies, Expected Frequencies and Adjusted Residuals

Team		Project	Meeting	Organization	Total
Team A	Observed Frequency	2712	222	52	2986
	Expected Frequency	2738.2	171.1	76.8	2986.0
	Adjusted Residual	-2.2	**5.1**	**-3.6**	
Team B	Observed Frequency	2388	136	14	2538
	Expected Frequency	2327.3	145.4	65.2	2538.0
	Adjusted Residual	**5.3**	-1.0	**-7.8**	
Team C	Observed Frequency	2070	90	135	2295
	Expected Frequency	2104.5	131.5	59.0	2295.0
	Adjusted Residual	**-3.1**	**-4.4**	**11.9**	
Total	Observed Frequency	7170	448	201	7819
	Expected Frequency	7170.0	448.0	201.0	7819.0

Significant deviations of the observed frequency from the expected frequency are presented in **Bold**.

The findings on direction of activity showed that almost all of the utterances in the Scrum meetings were directed at the project. This indicates that most of the discussions and conversations in the meeting are aimed at regulating the project and tasks of the team. Only a small part of the utterances was directed at either regulating the meeting or regulating the organization of the team process.

The results show that in the meetings of Team A, less utterances were observed about the organization of the team processes (AR = -3.6). On the other hand, Team A showed significantly more utterances about regulation of the meeting than the expected frequency (AR = 5.1). Also, in the meetings of Team B less utterances were observed about the organization (AR = -7.8). Team B talked significantly more about regulating the project (AR = 5.3). Finally, Team C talks more about the organization of the team processes than the other teams and significantly more than the expected frequency (AR = 11.9). The results showed significantly less utterances about the project (AR = -3.1) and the meeting (AR = -4.4) in Team C.

4.1.3 Variations in quality of interactions in Scrum teams

The quality of interaction in the meetings was analysed to explore how Scrum teams interact during their meetings. The interaction codes were given to the regulation utterances. Also, some of the cognition utterances received an quality of interaction code when the cognition was aimed at accepting a regulation utterance. Results of the analysis show a significant relationship between teams and interaction types, χ^2 (6) = 29.868, p = .000. Table 6 show the detailed results of the analysis. The interaction type 'ignoring' is removed from the analysis, because the total occurrence of this type of interaction is only

four times. This wasn't enough to include it in the Chi-square analysis. Following the results of the Bonferroni correction, when the adjusted residuals are <-2.87 or >2.87, the differences between two cells are considered to be statistically significant.

Table 6

Crosstab with teams and interaction, including Observed Frequencies, Expected Frequencies and Adjusted Residuals

Team		Initiating	Accepting	Engaging	Concluding	Total
Team A	Observed Frequency	121	316	2339	33	2809
	Expected Frequency	124.9	321.5	2327.6	35.1	2809.0
	Adjusted Residual	-.5	-.4	.7	-.4	
Team B	Observed Frequency	124	328	1933	38	2423
	Expected Frequency	107.7	277.3	2007.7	30.3	2423.0
	Adjusted Residual	2.0	**3.9**	**-4.9**	1.7	
Team C	Observed Frequency	86	208	1897	22	2213
	Expected Frequency	98.4	253.3	1833.7	27.6	2213.0
	Adjusted Residual	-1.5	**-3.6**	**4.3**	-1.3	
Total	Observed Frequency	331	852	6169	93	7445
	Expected Frequency	331.0	852.0	6169.0	93.0	7445.0

Significant deviations of the observed frequency from the expected frequency are presented in **Bold**.

Overall, these results showed little initiating and concluding utterances. Only 331 initiating utterances and 93 concluding utterances were observed in the Scrum meetings. Especially the low amount of concluding utterances is striking. A substantial amount of accepting utterances was observed in the Scrum meetings in all teams. Results showed that most of the utterances in the Scrum meetings were engaging interaction. This indicates that most of the interaction in Scrum meetings exists of team members engaging in discussion and in each other's contributions.

The results showed no significant deviation in the occurrence of the interaction types in Team A. Team B showed significantly more accepting utterances (AR = 3.9) than the expected frequency. However, Team B showed significantly less engaging utterances in the meetings than the expected frequency (AR = -4.9). Team C accepted significantly less often in the meetings (AR = -3.6), but engaged significantly more than the expected frequency (AR = 4.3). No significant deviations were found in the occurrence of concluding interaction. The next paragraph presents the results of the concluding interaction in more detail.

4.1.4 Variations in socially shared regulation in Scrum teams

Socially shared regulation was defined as "an episode that contains engaging interaction, and which ends with a shared concluding utterance." The results showed that every episode contained engaging interaction, but not every episode ended with a conclusion. Therefore, to measure socially shared regulation, this study looked at the concluding interaction in the meetings. The Chi-square analysis showed no significant relationship between teams and socially shared regulation, $\chi^2(2) = .226$, $p = .893$. Table 7 shows the detailed results of the analysis. Following the results of the Bonferroni correction, when the adjusted residuals are <-2.64 or >2.64, the differences between two cells are considered to be statistically significant.

Table 7

Crosstab with teams and socially shared regulation, including Observed Frequencies, Expected Frequencies and Adjusted Residuals

Team		Socially shared regulation	Not socially shared regulation	Total
Team A	Observed Frequency	33	93	126
	Expected Frequency	32.7	93.3	126.0
	Adjusted Residual	.1	-.1	
Team B	Observed Frequency	38	103	141
	Expected Frequency	36.6	104.4	141.0
	Adjusted Residual	.3	-.3	
Team C	Observed Frequency	22	69	91
	Expected Frequency	23.6	67.4	91.0
	Adjusted Residual	-.5	.5	
Total	Observed Frequency	93	265	358
	Expected Frequency	93.0	265.0	358.0

Significant deviations of the observed frequency from the expected frequency are presented in **Bold**.

The results show that only 93 out of 358 episodes were coded as socially shared regulation. 74% of the episodes in the Scrum meetings isn't observed as socially shared regulation. Only about a quarter of the episodes can be called socially shared regulation. So, results show a very low amount of socially shared regulation in the Scrum teams. The results in Table 7 show no significant deviation between the observed frequency and the expected frequency of socially shared regulation in Scrum teams.

Table 8 shows an example of what is not called a socially shared regulation episode in a Scrum team. Table 9, on the other hand shows an example of what is called a socially shared regulation episode. In both examples, the teams are evaluating and discussing about what can be improved next sprint. The names in the examples are fictitious.

Table 8

Example of not socially shared regulation episode in Team A

Team member	Utterance	Codes
Arjen	So far, we only have one evaluation point with a direct action point linked to it. We have also discussed the other evaluation points. I think we shouldn't just say: well, something should be improved about this. I think we have to try make action plans for all evaluation points. Maybe we can plan an extra meeting for that?	Evaluation Project Initiating
Ben (Scrum Master)	Well, I actually wanted to do it as before. Last time we discussed about what we think are the most important evaluation points.	Evaluation Project Engaging
Arjen	So you mean, we only choose a couple of points to work on?	Evaluation Project Engaging
Ben (Scrum Master)	Yes, exactly.	Evaluation Project Engaging
Arjen	But, when you take for example velocity. That is an evaluation point, but is not an action point yet. What should we do with that?	Evaluation Project Engaging
Ben (Scrum Master)	Well, then we'll see what we can do about it.	Evaluation Project Engaging

In this episode, Team A is at the end of a retrospective meeting. As Arjen states, a lot of good evaluation points were mentioned and discussed in this meeting. However, Arjen is concerned about what will be done with the evaluation points. He suggests to plan a new meeting to talk about action points to improve the evaluation points that were mentioned in this meeting. Ben (the Scrum Master of the team) wants to act the same as always, and just wait and see what can be done about it. So, a disagreement exists between Ben and Arjen about how to move forward with the evaluation points. They engage in the discussion, but the discussion ends without an agreement and shared conclusion on how to improve the mentioned evaluation points. That's why this episode isn't called a socially shared regulation episode.

Table 9

Example of an effective socially shared regulation episode in Team C

Team member	Utterance	Codes
Anton (Scrum Master)	So you really prefer to see a burndown chart during the sprint?	Evaluation Project Engaging
Bernard	Yes, that is really motivating. And then you can also see if we're still on schedule. Now we don't have a clue about that.	Evaluation Project Engaging
Cornelis	Yes, that's true. Now we have no idea if we are on schedule.	Evaluation Project Engaging
Dirk	Yes, in our old team the burndown chart was very motivating for us.	Evaluation Project Engaging
Anton (Scrum Master	Okay, well that's a good thing to work on the next sprint. I will make sure I keep the burndown chart up-to-date.	Planning Project Concluding

In this episode, Team C is discussing about whether or not using a burndown chart. Two team members (Bernard and Dirk) have just joined this team, about a week before this meeting. They talk about how they used the burndown chart in their old team and how motivating that was for them. The Scrum Master (Anton) asks the team whether they all prefer to work with a burndown chart. Everyone in the team engages in the discussion and agrees to start using a burndown chart. This discussion ends with a clear conclusion, in which the Scrum Master sets a clear plan for the next sprint, this conclusion is shared by the team. Therefore, this is called a socially shared regulation episode.

In Figure 1 below a visualization is shown of a socially shared regulation episode in which the entire team is engaged. Every horizontal bar represents a team member, so this team exists of five team members. As is shown in Figure 1, all team members are engaged in the discussion. All team members react on each other's contributions. The arrows show the flow of the discussions, and who is talking after whom. The figure shows clearly that all team members are responding to each other. There is not one clear person that dominates the discussion, but everyone engages equally. This is a good example of a socially shared regulation episode.

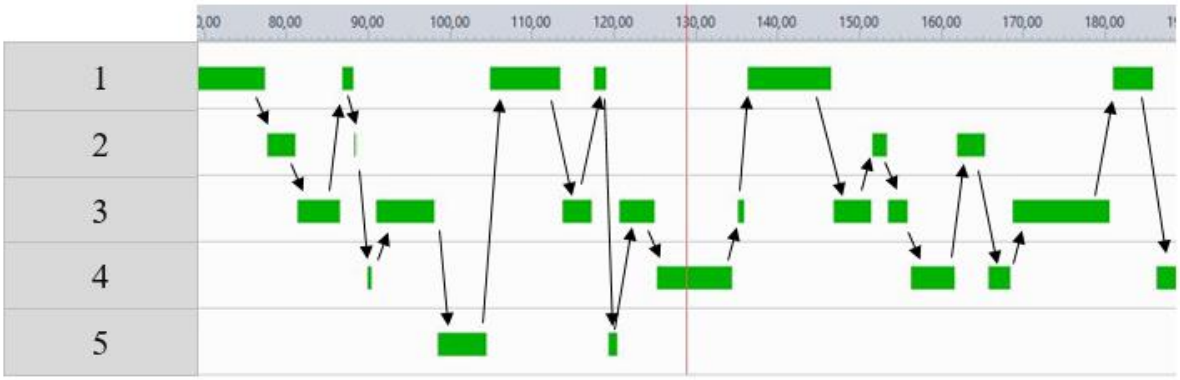

Figure 1. Visualization of good socially shared regulation in team B

4.2 Explaining variations in regulation

The second research question was: *To what extent can variations in regulation be related to the type of meetings and individual differences?* To find answers for this questions, the results of the video observations and Chi-square analysis were used.

4.2.1 Variations in regulation related to the type of meetings

The type of meetings were analysed to explore if they were related to the variations in regulation. At first, the differences between regulation processes in the different meetings were examined. The Chi-square analysis show a significant relationship between type of meetings and regulation processes, χ^2 (9) = 5879.790, p = .000. See Table 10 below for the results of the analysis. Following the results of the Bonferroni correction, when the adjusted residuals are <-2.87 or >2.87, the differences between two cells are considered to be statistically significant.

Table 10

Crosstab with meetings and regulation, including Observed Frequencies, Expected Frequencies and Adjusted Residuals

Meeting		Social regulation	Cognition	Social talk	Total
Sprint planning	Observed Frequency	3376	1184	552	5112
	Expected Frequency	3483.7	1114.0	514.3	5112.0
	Adjusted Residual	**-4.6**	**3.4**	2.5	
Stand up	Observed Frequency	1285	499	122	1906
	Expected Frequency	1298.9	415.4	191.7	1906.0
	Adjusted Residual	-.8	**5.1**	**-5.9**	
Refinement	Observed Frequency	516	222	48	786
	Expected Frequency	535.6	171.3	79.1	786.0
	Adjusted Residual	-1.6	**4.6**	**-3.8**	
Retrospective	Observed Frequency	1787	322	306	2415
	Expected Frequency	1645.8	526.3	242.9	2415.0
	Adjusted Residual	**7.1**	**-11.5**	**4.9**	
Total	Observed Frequency	6964	2227	1028	10219
	Expected Frequency	6964.0	2227.0	1028.0	10219.0

Significant deviations of the observed frequency from the expected frequency are presented in **Bold**.

These results show that about half of the total amount of utterances occurs in the sprint planning meetings. In the sprint planning also most of the social regulation, cognition and social talk occurs. Another striking finding is the low amount of cognition and high amount of social talk in the retrospective, which is totally different from the other type of meetings.

Results show that the observed social regulation in the sprint planning is significantly less than the expected frequency (AR = -4.6). Cognition occurred more often in the sprint planning meetings (AR = 3.4). Results on the stand up meetings showed more cognition than the expected frequency (AR = 5.1), but significantly less social talk (AR = -5.9). In the refinements, similar results were found. Cognition occurred more often in the refinements (AR = 4.6), and social talk occurred less often in the refinements (AR = -3.8). In the retrospective, very different results were found. The retrospective showed significantly more social regulation (AR = 7.1), but less cognition (AR = -11.5) and more social talk (AR = 4.9) than the expected frequency. The retrospective is the only type of meeting in which social regulation is observed more frequently than the expected frequency.

In Table 11, social regulation is divided in planning, monitoring and evaluation. The results from the Chi-square test showed a significant relationship between teams and regulation, χ^2 (6) = 5514.229, p = .000. Following the results of the Bonferroni correction, when the adjusted residuals are <-2.87 or >2.87, the differences between two cells are considered to be statistically significant.

Table 11

Crosstab with meetings and social regulation processes, including Observed Frequencies, Expected Frequencies and Adjusted Residuals

Meeting		Planning	Monitoring	Evaluation	Total
Sprint planning	Observed Frequency	2759	554	63	3376
	Expected Frequency	1904.7	834.3	637.0	3376.0
	Adjusted Residual	**41.3**	**-15.6**	**-35.2**	
Stand up	Observed Frequency	366	912	7	1285
	Expected Frequency	725.0	317.6	242.5	1285.0
	Adjusted Residual	**-22.4**	**42.6**	**-18.6**	
Refinement	Observed Frequency	380	120	16	516
	Expected Frequency	291.1	127.5	97.4	516.0
	Adjusted Residual	**8.2**	-.8	**-9.5**	
Retrospective	Observed Frequency	424	135	1228	1787
	Expected Frequency	1008.2	441.6	337.2	1787.0
	Adjusted Residual	**-32.3**	**-19.5**	**62.5**	
Total	Observed Frequency	3929	1721	1314	6964
	Expected Frequency	3929.0	1721.0	1314.0	6964.0

Significant deviations of the observed frequency from the expected frequency are presented in **Bold**.

Generally, these results show that Scrum meetings are primarily used for their main purpose. The sprint planning is mostly used by the Scrum teams to plan the upcoming sprint and to divide tasks. During stand ups, most of the utterances are about monitoring of the tasks. The retrospective is almost the only moment in the sprint when evaluation processes emerge. However, during the other meetings, there are hardly any evaluation utterances. This indicates that in the sprint planning and during the sprint, almost no time is used to evaluate the current sprint.

The findings reveal during the sprint planning, the Scrum teams talk much more about the planning of tasks (AR = 41.3), and much less about the monitoring of tasks (AR = -15.6) and evaluation (AR = -35.2). Monitoring utterances are more often present in the stand ups than the expected frequency (AR = 42.6). During stand ups, less utterances are about planning (AR = -22.4) and evaluation (AR = -18.6). Refinements show more planning utterances (AR = 8.2), but less evaluation utterances (AR = -9.5) than the expected frequency. The retrospective is the only type of meeting in which more evaluation

utterances occur than the expected frequency (AR = 62.5). However, during retrospectives significantly less talk about planning (AR = -32.3) and monitoring (AR = -19.5) was observed.

Also differences in direction of activity between meetings were analysed to explore if they were related to the variations in regulation. A Chi-square analysis show that the type of meetings is significant related to direction of activity, $\chi^2(6) = 167.571$, $p = .000$. Table 12 shows the detailed results of the analysis. Following the results of the Bonferroni correction, when the adjusted residuals are <-2.87 or >2.87, the differences between two cells are considered to be statistically significant.

Table 12

Crosstab with meetings and direction of activity, including Observed Frequencies, Expected Frequencies and Adjusted Residuals

Meeting		Project	Meeting	Organization	Total
Sprint planning	Observed Frequency	3458	114	125	3697
	Expected Frequency	3390.1	211.8	95.0	3697.0
	Adjusted Residual	**5.6**	**-9.5**	**4.3**	
Stand up	Observed Frequency	1321	130	59	1510
	Expected Frequency	1384.7	86.5	38.8	1510.0
	Adjusted Residual	**-6.6**	**5.4**	**3.7**	
Refinement	Observed Frequency	596	27	2	625
	Expected Frequency	573.1	35.8	16.1	625.0
	Adjusted Residual	**3.5**	-1.6	**-3.7**	
Retrospective	Observed Frequency	1795	177	15	1987
	Expected Frequency	1822.1	113.8	51.1	1987.0
	Adjusted Residual	-2.5	**7.1**	**-5.9**	
Total	Observed Frequency	7170	448	201	7819
	Expected Frequency	7170.0	448.0	201.0	7819.0

Significant deviations of the observed frequency from the expected frequency are presented in **Bold**.

Results show that during all type of meetings, most of the talking is directed at regulating the project. Talk about regulating the meeting occurred most during stand ups and retrospectives. Utterances about the organization of the team processes were observed most during sprint planning meetings and stand ups.

The results of the analysis show that in the sprint planning, significantly more often is being talked about the project (AR = 5.6) and the organization of the team processes (AR = 4.3). The sprint planning is less often used to regulate the meeting than the expected frequency (AR = -9.5). In the stand ups, on the other hand, more regulation about the meeting (AR = 5.4) and the organization (AR = 3.7)

was observed. During stand ups the regulation is less often directed at the project (AR = -6.6). The refinements show more regulation directed at the project (AR = 3.5), but less directed at the organization of the team processes (AR = -3.7). The retrospective contained significantly more utterances directed at regulating the meeting (AR = 7.1), but less utterances about the project (AR = -2.5) and the organization (-5.9).

Also differences in quality of interaction between the different types of meetings were analysed to determine if this was related to variations in relation. The Chi-square analysis revealed a significant relationship between type of meetings and type of interaction, $\chi^2(9) = 277.667$, $p = .000$. The detailed results of this analysis are presented in Table 13. Following the results of the Bonferroni correction, when the adjusted residuals are <-2.96 or >2.96, the differences between two cells are considered to be statistically significant.

Table 13

Crosstab with meetings and interaction, including Observed Frequencies, Expected Frequencies and Adjusted Residuals

Team		Initiating	Accepting	Engaging	Concluding	Total
Sprint planning	Observed Frequency	82	317	3112	53	3565
	Expected Frequency	158.5	407.9	2953.2	44.5	
	Adjusted Residual	**-8.6**	**-6.6**	**9.8**	1.8	
Stand up	Observed Frequency	151	225	1021	15	1414
	Expected Frequency	62.8	161.6	1170.0	17.6	
	Adjusted Residual	**12.7**	**5.9**	**-11.7**	-.7	
Refinement	Observed Frequency	31	108	430	10	579
	Expected Frequency	25.7	66.3	479.8	7.2	579.0
	Adjusted Residual	1.1	**5.7**	**-5.7**	1.1	
Retrospective	Observed Frequency	67	202	1606	15	1890
	Expected Frequency	84.0	216.3	1566.1	23.6	1890.0
	Adjusted Residual	-2.2	-1.2	2.8	-2.1	
Total	Observed Frequency	331	852	6169	93	7445
	Expected Frequency	331.0	852.0	6169.0	93.0	7445.0

Significant deviations of the observed frequency from the expected frequency are presented in **Bold**.

Generally, results show that most initiating utterances occur in the stand ups. Accepting utterances are common in all type of meetings. Also, in all type of meetings engaging utterances are most common. Concluding utterances are the least observed interaction type in all type of meetings, and most of the concluding utterances occurred in the sprint planning meetings.

The results show significantly more often initiating utterances in the stand ups (AR = 12.7), and less initiating utterances in the sprint planning meetings (AR = -8.6). Accepting utterances occurred significantly less often in the sprint planning meetings (AR = -6.6), but more often in the stand ups (AR = 5.9) and the refinements (AR = 5.7). Engaging utterances covered the biggest part of every type of meetings. The engaging utterances occurred significantly more often in the sprint planning meetings (AR = 9.8). The engaging utterances were significantly less often present in the stand ups (AR = -11.7) and the refinements (AR = -5.7).

Differences in socially shared regulation between the different type of meetings was also analysed to explore if this was related to the variations in regulation. The Chi-square analysis showed that type of meetings was significantly related to socially shared regulation, $\chi^2(3) = 80.699$, $p = .000$. Table 14 shows the results of the Chi-square analysis. Following the results of the Bonferroni correction, when the adjusted residuals are <-2.73 or >2.73, the differences between two cells are considered to be statistically significant.

Table 14

Crosstab with meetings and socially shared regulation, including Observed Frequencies, Expected Frequencies and Adjusted Residuals

Meeting		Socially shared regulation	Not socially shared regulation	Total
Sprint planning	Observed Frequency	53	33	86
	Expected Frequency	22.3	63.7	86.0
	Adjusted Residual	**8.6**	**-8.6**	
Stand up	Observed Frequency	15	145	160
	Expected Frequency	41.6	118.4	160.0
	Adjusted Residual	**-6.4**	**6.4**	
Refinement	Observed Frequency	10	31	41
	Expected Frequency	10.7	30.3	41.0
	Adjusted Residual	-.2	.2	
Retrospective	Observed Frequency	15	56	71
	Expected Frequency	18.4	52.6	71.0
	Adjusted Residual	-1.0	1.0	
Total	Observed Frequency	93	265	358
	Expected Frequency	93.0	265.0	358.0

Significant deviations of the observed frequency from the expected frequency are presented in **Bold**.

Results show that in all type of meetings not much socially shared regulation was observed. The only type of meeting with a substantial part of socially shared regulation is the sprint planning. A striking result is the low amount of socially shared regulation in the stand ups. Also the refinement and retrospective meetings show little socially shared regulation.

Post-hoc analyses show that the sprint planning is the only type of meeting in which more socially shared regulation occurs than the expected frequency (AR = 8.6). This indicates that during sprint planning meetings, all team members are engaged in planning the sprint and dividing the tasks, and most of the episodes end with a clear conclusion and plan for the upcoming sprint. The stand ups show significantly less often socially shared regulation (AR = -6.4). Also during the refinement and retrospective meetings the amount of socially shared regulation is rather low, but not significantly. These results show that during most type of meetings, the socially shared regulation of the teams is low.

4.2.2 Variations in regulation related to individual differences

Individual differences in the team were analysed to measure if they were related to variations in regulation. The participatory roles of team members was different per team, see Figure 2,3 and 4. These figures show the total number of utterances in all meetings of the teams.

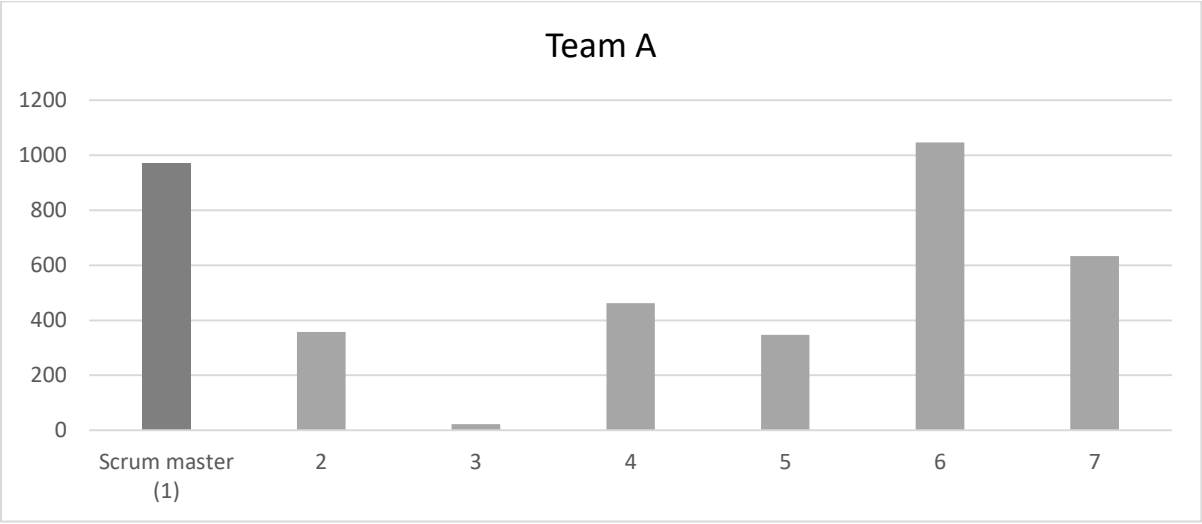

Figure 2. Number of utterances per team member in team A

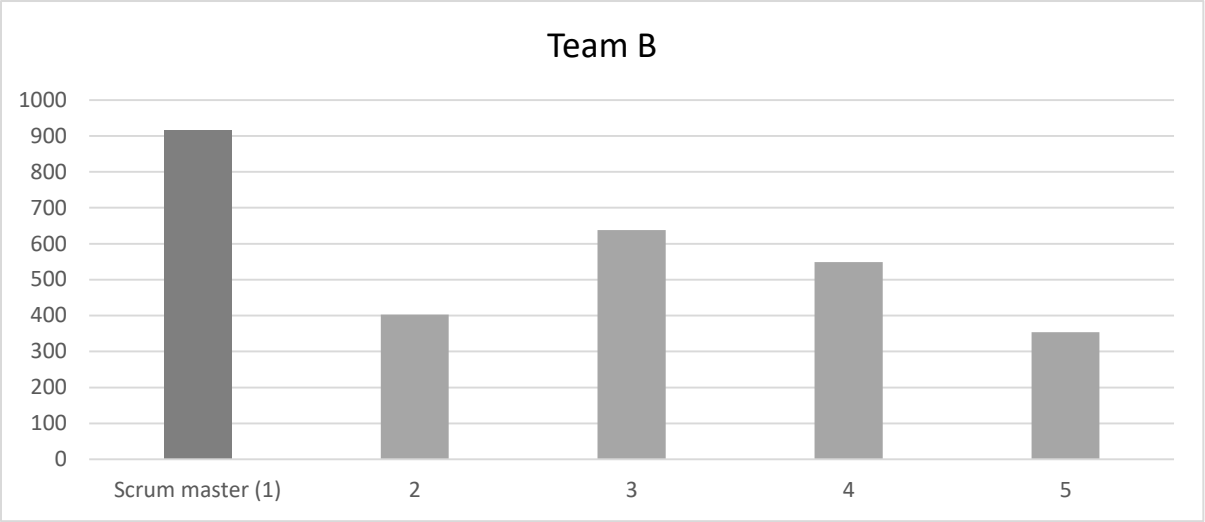

Figure 3. Number of utterances per team member in team B

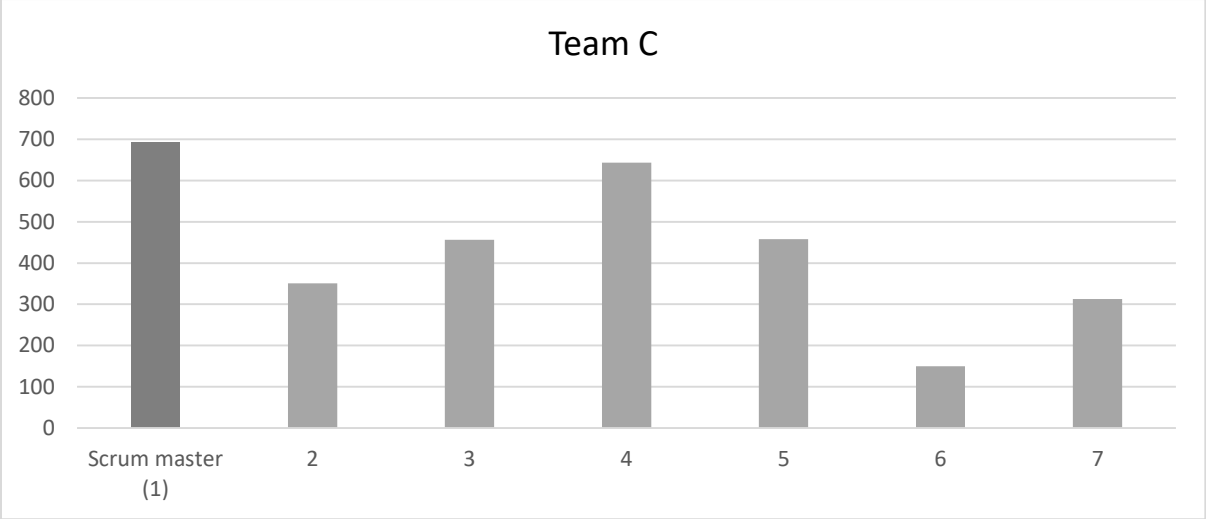

Figure 4. Number of utterances per team member in team C

These results show that in every team the number of utterances per team member are very different. The Scrum Master is most often the team member that has the most utterances in the meetings. This indicates that Scrum Masters have another role than the other team members, and contributes a large part of regulation in the meetings. Other team members also engage in the meetings, but some team members engage more in the meetings than other team members. Table 15 show the division of initiating and concluding utterances in the team.

Table 15

Initiating and concluding utterances per team member

Team		Scrum Master (1)	2	3	4	5	6	7	Total
Team A	Initiating	64 (54%)	6 (5%)	1 (1%)	5 (4%)	6 (5%)	32 (27%)	5 (4%)	119
	Concluding	19 (58%)	1 (3%)	0 (0%)	1 (3%)	0 (0%)	10 (30%)	2 (6%)	33
	Total	**83 (55%)**	**7 (4%)**	**1 (1%)**	**6 (4%)**	**6 (4%)**	**42 (28%)**	**7 (4%)**	**152**
Team B	Initiating	35 (30%)	11 (9%)	17 (15%)	39 (33%)	15 (13%)			117
	Concluding	11 (32%)	1 (3%)	12 (35%)	9 (27%)	1 (3%)			34
	Total	**46 (30%)**	**12 (8%)**	**29 (19%)**	**48 (32%)**	**16 (11%)**			**151**
Team C	Initiating	57 (67%)	1 (1%)	9 (11%)	5 (6%)	6 (7%)	4 (5%)	3 (3%)	85
	Concluding	15 (67%)	2 (9%)	1 (5%)	1 (5%)	1 (5%)	1 (5%)	1 (5%)	22
	Total	**72 (67%)**	**3 (3%)**	**10 (9%)**	**6 (6%)**	**7 (7%)**	**5 (4%)**	**4 (4%)**	**107**

These results show that the Scrum Master often had the most initiating and concluding utterances. Especially in Team C, the Scrum Master had the largest share (67%) in initiating and concluding in the team. The other team members in Team C hardly ever initiated an episode or ended it. This indicates that the Scrum Master in Team C was in charge of the meeting and leaded the discussions. In Team A the Scrum Master managed the meetings to a large extent (55%), but also one other team member (6) had a large share in this. This was the Product Owner of this team, who was very involved in regulating the team. Team B showed the most even distribution of regulation. All team members in Team B were engaged in initiating and concluding the discussions in the meeting.

In the meetings, the team members often directed their utterances directly towards the Scrum Master instead of involving the entire team. Visualizations of the team meetings show this clearly, as presented Figure 5. The Scrum Master is the fourth horizontal bar. All utterances from the team members are followed by an utterance from the Scrum Master. This figure shows that Scrum Masters reacted often on the contributions of other team members.

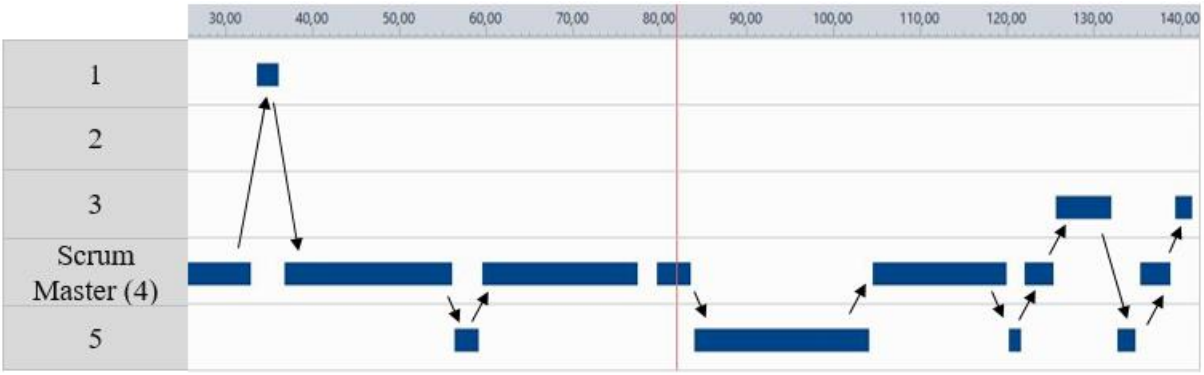

Figure 5. Visualisation of clear leading Scrum Master in Team C

Table 16 also shows an example of an episode in which the Scrum Master takes a leading role. In this example, the Scrum Master tells another team member when she is allowed to speak. Also, the Scrum Master react on his contributions. The names in this example are fictious.

Table 16

Example of leading Scrum Master in Team A

Team member	Utterance	Codes
Ben (Scrum Master)	Bernard, it's your turn now.	Monitoring Meeting Initiating
Anne	Last Friday I have been busy working on support issues. I also started working on the first task for this sprint, I will finish that task today. Then I'll have to find something to do next, because the billboard with tasks is empty.	Monitoring Project Engaging
Ben (Scrum Master)	Yes, that's true. Later today we'll have sprint planning meeting, so until then we'll be working on the tasks that need to be tested.	Planning Project Engaging
Anne	But I can't test them, because I've developed a lot of these tasks.	Planning Project Engaging
Ben (Scrum Master)	Yes, that's true. You have to check if there's one task from Cornelis or Dirk that you can test. I'll try to test a few tasks from you.	Planning Project Engaging
Anne	Okay.	Cognition Project Accepting

Another interesting finding is about the different roles in the teams in the meetings. The results showed that the participation of team members changed per episode and per meeting. Therefore, the interaction flow was measured of a number of significant episodes. Especially the Scrum Master sometimes had a different role in different type of meetings. Table 17 show the findings of the interaction flow in the teams.

Table 17

Examples of interaction flow in Scrum teams and in different type of meetings

Episode	Interaction flow
Team A (SM = 5)	
Sprint planning	7 - 3 - 7 - 1 - 6 - 7 - 3 - 7 - 6 - **5** - 3 - **5** - 6
Stand up	**5** - 4 - **5** - 4 - **5** - 6 - **5** - 6 - **5** - 1 - **5** - 1 - **5**
Retrospective	3 - 7 - **5** - 7 - **5** - 1 - 6 - **5** - 2 - 3 - 6 - 2 - 7 - 3 - 7 - 1 - 3 - **5** - 2
Team B (SM = 5)	
Stand up	4 - **5** - 3 - 1 - **5** - 1 - 3 - **5** - 4 - **5** - 1 - **5** - 2 - **5** - 4 - 2 - 4 - **5** - 1 - 4
Retrospective	2 - 4 - 1 - **5** - 2 - 4 - **5** - 3 - **5** - 4 - 3 - 4 - 2 - **5** - 3 - 4 - 2 - **5** - 4 - 3 - 4 - **5** - 4 - **5** - 2 - **5** - 2 - 1 - 2 - 4 - 2 - **5**
Team C (SM = 5)	
Sprint planning	4 - **5** - 1 - 6 - **5** - 4 - **5** - 2 - **5** - 2 - **5** - 3 - **5**
Stand up	**5** - 7 - **5** - 7 - **5** - 4 - 7 - **5** - 4 - 7
Retrospective	4 - **5** - 4 - **5** - 1 - **5** - 1 - **5** - 4 - **5** - 1 - **5** - 1 - **5**

(SM = Scrum Master)

In team A, results show a clear difference between the stand-up meetings and the other type of meetings. Results showed that during the stand ups, the Scrum Master contributes a lot in the meetings. The Scrum Master reacts on everyone that contributes to the meeting and is in charge of leading the meetings. Every time a team member contributes to the meeting, the Scrum Master react on it. In the stand ups, team members participate much less than in the other type of meetings. During the sprint planning and retrospective of Team A, a more equal contribution of the different team members is present in the discussions. All team member react on each other's contributions, and the Scrum Master responds much less in these type of meetings. On the contrary, Team B shows equivalent discussions during all meetings, regardless the type of meeting. All team members react on each other, and all team member have a similar share in the discussions. In Team C, the Scrum Master is more in control of all meetings. The Scrum Master reacts a lot in the meetings, the other team members in team C respond much less on each other's contributions. These results indicates differences between the teams regarding the role of the Scrum Master and the participatory roles of team members. The results of Team A also indicates different participation of team members in the different meetings.

5. DISCUSSION

5.1 Conclusions

The aim of this study was to investigate regulation processes and socially shared regulation, to give insight in variations in regulation in Scrum teams and what these variations are related to. The first research question was: *How do Scrum teams regulate during meetings?* To answer this question different aspects of regulation were analysed, namely regulation processes, direction of activity, quality of interaction and socially shared regulation.

First, results showed a lot of social regulation in the Scrum meetings. This is a striking result, which can possibly be explained by the type of meetings that was analysed. Only a few refinement meetings were analysed, and refinement meetings contains often more cognition and less social regulation. This can explain why so much social regulation was observed in the meetings. Another possible explanation is our definition of social regulation. In this study, all group efforts to regulate its understanding and teamwork was seen as social regulation. However, this is a broad definition, which could explain why such a large amount of social regulation utterances was found in the Scrum meetings.

Results also showed a lot of social talk in the meetings. According to Rogat and Linnenbrink-Garcia (2011), social talk can positively stimulate cohesion and socioemotional interaction in teams. Other literature sees social talk as distracting, which should be avoided in the meetings (Stray et al., 2012). Thus, existing research is inconclusive about the effects of social talk on the team. The amount of social talk in this study assumes that Scrum teams occasionally need some small talk in the meetings, to help team members coping with the heavy, complex topics. Future research is needed to examine whether this has a positive effect on social regulation in meetings.

Findings also revealed that planning utterances were more frequent in the meetings than monitoring and evaluation utterances, although a more equal distribution was expected. This can possibly be explained by the fact that Scrum teams often have complex tasks, for which teams need more time to plan (Kim, 2007). This finding is also consistent with findings from DiDonato (2013) and Rogat and Linnenbrink-Garcia (2011), who suggested that high quality regulation is associated with more and high quality planning processes in teams. Further research is needed to substantiate these findings and to investigate why Scrum teams have so many planning utterances.

In contrast to the large amount of planning utterances, only few evaluation utterances were observed in the Scrum meetings. This is consistent with findings from Stray et al. (2011) and DiDonato (2013), who also found little evaluation in teams. According to Stray et al. (2011), many teams spend little time evaluating and reflecting on how to improve their work. However, according to DiDonato (2013), evaluation processes are most effective when they are performed frequently. So, further research is needed to investigate why Scrum teams spend so little time evaluating their performance and how this could be solved.

When looking at the direction of activity, results showed that most of the regulation in Scrum teams was directed at the project. Most of the discussions and conversations in the meeting were aimed

at regulating the project and tasks of the team. The other two direction of activity categories, regulation directed at the meeting and the organization of the team processes, are often only briefly discussed in meetings, so this was an expected outcome. This finding is in line with Stray et al. (2012), who also found a large amount of functional interaction in teams, such as problem-solving interaction. They suggested also that more functional interaction in team meetings is associated with higher team productivity (Stray et al., 2012).

Findings on the quality of interaction showed that almost no ignoring utterances were found in the meetings. This indicates that team members didn't ignore each other contributions in the meetings, and payed attention to the ideas of other team members without ignoring them. This is not consistent with the findings of Molenaar (2011), who found more ignoring utterances in the regulation of teams. However, Molenaar (2011) investigated teams while they were working on their tasks, and in this study teams were observed in meetings. Team members are probably less likely to ignore each other's contributions in meetings. So this inconsistency may be attributed to the difference in context.

Furthermore, results showed that most of the regulation in meetings exists of engaging interaction. Engaging interaction means that team members react on each other's contributions and engage in the discussions in the meetings. This finding is in line with results from Molenaar (2011) on metacognitive activities. Molenaar (2011) found a substantial amount of metacognitive activities in which team members related to each other's metacognitive contributions with new metacognitive remarks, which is similar to engaging utterances in this study. However, engaging utterances alone aren't sufficient to ensure effective regulation in Scrum teams. For discussions to become effective, a conclusion is needed at the end of the discussion. Team members can discuss for a long time, but without a conclusion nothing will happen or change, and all the engaging contributions were useless. Therefore, it is important that episodes end with a concluding statement.

This research also studied concluding interaction in the meetings, which in this study is seen as an important prerequisite for socially shared regulation in Scrum teams. Socially shared regulation was defined in this study as: "an episode that contains engaging interaction, and which ends with a shared concluding utterance." Results showed that only 26% of the episodes was coded as socially shared regulation. This indicates that a lot of discussions in the Scrum teams ended without a conclusion. The small amount of socially shared regulation in teams was also found in the studies of Molenaar (2011) and Rogat and Linnenbrink-Garcia (2011) This finding may be explained by the definition of socially shared regulation that was used in this study. An episode was only coded as socially shared regulation when the episode had a clear conclusion. However, episodes without a clear conclusion could also be socially shared in the team, for example when everyone accepts a contribution of a team member. Further research is needed to investigate whether the small amount of socially shared regulation is a result of the used definition, or whether Scrum teams actually have little socially shared regulation in their meetings.

The second research question was: *How can variations in regulation be explained?* To answer this question, differences in type of meetings and individual differences were analysed. Results on type of meetings showed that the Scrum meetings were primarily used for their main purpose. This result was expected, based on findings from Dybå et al. (2014) and Stray et al. (2011). However, the retrospective was almost the only type of meeting in which evaluation occurred. During the other type of meetings hardly any evaluation utterances were observed. This indicates that in the sprint planning and during the sprint, almost no time is used to evaluate the current sprint. This is consistent with findings from Stray et al. (2011). Further research is needed to substantiate this finding and to explain this.

The findings showed differences in initiating utterances between the type of meetings. The stand ups clearly had the most initiating utterances. This difference may be attributed to the nature of the stand-up meeting (Stray et al., 2012). The stand-up meeting is a short meeting in which a lot of different topics are discussed, so a lot of initiating utterances are needed in this type of meeting. The other type of meetings are often longer, and only a small amount of topics are discussed in detail. Further research is needed to substantiate these findings about quality of interaction in Scrum meetings.

Results on type of meetings also showed differences in the presence of socially shared regulation in the meetings. The sprint planning was the only type of meeting in which socially shared regulation was often present. This indicates that during sprint planning meetings, all team members are engaged in planning the sprint and dividing the tasks, and most of the episodes end with a clear conclusion. The stand ups showed less often socially shared regulation, which can be explained by the structure of the stand-up meeting. All team members contribute to the meeting by telling briefly about what they did yesterday and what they are going to do today (Stray et al., 2012). This often doesn't result in a lot of discussions, so only a small amount of episodes in stand ups need to end with a conclusion. Also during the refinement and retrospective meetings, only a few socially shared regulation episodes were observed. In the retrospective meetings, only 21% of the episodes end with a conclusion. This indicates that despite all the discussions about improvement in the retrospective, not a lot of conclusions are drawn to improve the next sprint. Teams may find it hard to draw conclusions and to make plans for improving their work. This assumption is supported by Stray et al. (2011), who found that teams often struggle to convert their evaluation points into changes in action.

Results on individual differences showed that the Scrum Master is most often the team member that has most utterances in the meetings. Especially, the Scrum Master often performed most of the initiating and concluding utterances in the meetings. This indicates that during meetings, Scrum Masters may have a more leading role than the other team members, and may be in charge of leading the meetings. This may indicate that Scrum teams do not always have shared leadership in the meetings, because Scrum Masters take the leading role. This also shows that regulation in the team is not always evenly distributed between the team members in the Scrum team. Moe et al. (2010) also found that leadership was not distributed in the team as it should be in a self-managing team. The Scrum Master

focuses often more on command-and-control the other team members (Moe et al., 2010). However, it is important to the quality of regulation that the contributions of team members are in balance. Everyone in the team should be able to bring in their ideas and the discussions shouldn't be dominated by one person (Moe & Dingsøyr, 2008; Stray et al., 2012). Further research is needed to investigate the role of the Scrum Master in Scrum teams.

Another key finding about individual differences is about the participatory roles in the teams in the meetings. Results of the interaction flow showed that the participation of team members changed per episode and per meeting. In the stand ups, team members often directly reported to the Scrum Master, without talking to each other. Often only the Scrum Master reacted on their contributions, and other team members often didn't react on each other during stand ups. These findings confirm previous research by Moe et al. (2010), by showing that team members sometimes communicate directly to the Scrum Master, without involving the other team members. During discussions in the sprint planning and retrospectives, results showed more equally contributions of all team members. In the sprint planning and retrospective, team members also respond more to each other's contributions. Further research is needed to gain more understanding in the participatory roles of team members in Scrum meetings.

5.2 Limitations and recommendations

This research has given valuable insights in the regulation processes of Scrum teams, socially shared regulation and participatory roles of the team members. However, a few limitations have to be considered as well. First, this was a case study, which means that the results are context-specific. Only a few cases were included in this study, and they were all from one company. We don't know whether this company is a representative sample of all companies that work with Scrum. Such a small sample can be a risk to the generalisability of the results of this study. It is therefore recommended that future research about the regulation processes in Scrum teams comprehends more than one organisation, to be able to draw more solid conclusions.

Another limitation in this research was the analysis of the observations of Scrum meetings. Because analysing these meetings was very time consuming, only half of the observed meetings could be analysed and used for this research. It was strived to keep the amount and type of meetings in balance for all three teams. However, only a few refinement meetings could be analysed. This may have given a wrong impression on the amount of social regulation that was observed in the meetings. The high amount of social regulation may be partly explained by the little amount of refinement meetings that was observed.

Another limitation of this research was the analysis, which was performed by a researcher. During the coding of the videos, a team of researchers often compared their results and discussed the codes. However, coding is always subjective when it is performed by researchers, so this may have biased the results slightly. On the other hand, this data gathering process is very close to reality. By observing and analysing the Scrum meetings, you don't have to rely on the ability of participants to

reflect on their behaviour, which is the case for example in the use of questionnaires. For future research, it is recommended to use additional research methods to minimize the effects of method bias.

Another limitation of this research is the definition that was used for socially shared regulation. An episode was only coded as socially shared regulation when the episode had a clear conclusion. However, also episodes without a clear conclusion can be socially shared in the team, for example when everyone accepts a contribution of a team member. In our operationalisation of socially shared regulation, we didn't take that into consideration. As a result of this, the amount of socially shared regulation that was found in this study may be lower than the actual socially shared regulation in the team. It is recommended for future research to use a more broad definition to involve all types of socially shared regulation in the research.

5.3 Practical implications

In this study, the low amount of evaluations in Scrum teams was a striking result. Results showed that the Scrum teams often spend little time and utterances to reflect on how they work and what can be improved, consisted with findings from Stray et al. (2011). According to DiDonato (2013), it is hard for team members to enact evaluation processes. However, evaluation processes are most effective when they are performed frequently. Therefore, it is important for Scrum teams to receive support on how to evaluate their teamwork and processes more frequently and more qualitative.

A key finding of the present study was that only a few socially shared regulation episodes were found in the Scrum meetings. Only in the sprint planning meeting a lot of socially shared regulation occurred. The results showed a lot of engaging contributions of team members in discussions, but a lot of these discussions ended without a clear conclusion. This might imply that teams find it hard to convert their ideas into action plans. Organisations can use these results to support Scrum teams with translating their ideas and improvement plans into concrete actions, which is especially important in retrospectives. Scrum teams should be given tools by the organisation or by Scrum to making it easier to plan actions and draw conclusions. This could help to improve the socially shared regulation in Scrum teams.

Results of this study also showed differences in participatory roles of team members. During meetings, Scrum Masters showed a more leading role than the other team members, and were often in charge of leading the meetings. This may indicate that Scrum teams do not always have shared leadership in the meetings. Results also showed that the regulation in the team is not always evenly distributed between the team members in the Scrum team. The quality of teamwork and interaction can be harmed when the contributions of the team members are not in balance (Hoegl & Gemuenden, 2001). Especially in software teams that consist of team members with different knowledge, it is important that every team member can contribute all task-relevant knowledge and ideas to the team (Stray et al., 2012). Therefore, it should not be one team member that dominates the regulation in the team (Schoor et al., 2015). These results can be used by organisations to stimulate Scrum teams to have more shared leadership and make sure everyone contributes evenly.

5.4 General conclusion

This study contributed to existing literature by exploring and giving insight in regulation processes in Scrum teams. This study built on existing studies, such as the study of Schoor et al. (2015) and Molenaar (2011), by investigating socially shared regulation in the Scrum teams. Scrum teams engaged a lot in discussions, but this was often not socially shared. It is important for socially shared regulation in Scrum teams that team members draw conclusions in their discussions. Clear conclusions can help Scrum teams to work more effectively together and to improve their teamwork. However, this study showed that Scrum teams may find it hard to draw conclusions in their discussions and to make plans for improvement. The low amount of conclusions in the Scrum team can undermine the quality of learning and teamwork in the Scrum teams.

This study builds further on the study of Volet et al. (2009), and sets light on the participatory roles in Scrum teams. In the current study became clear that teams often have a clear leader in the meetings. The Scrum Master often contributed most in the team meetings. Equally contributions of all team members in Scrum teams didn't happen often in the meetings. This is concerning, because every team member has different knowledge and experience, and for effective teamwork all different perspectives should be considered. Future research is needed to further explore the influence of participatory roles in Scrum teams on socially shared regulation and team performance. The present study gave valuable insights on regulation and participatory roles in Scrum teams, which can be built on by future research.

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APPENDICES

Appendix A – Questionnaire

Original questionnaire (in Dutch)

Geef aan in hoeverre je het eens bent met de onderstaande uitspraken (1, helemaal niet mee eens – 5, helemaal mee eens).

Cohesie
Tijdens de afgelopen sprint was het voor alle teamleden belangrijk om onderdeel te zijn van dit project.
Tijdens de afgelopen sprint waren alle teamleden volledig geïntegreerd in dit team.
Tijdens de afgelopen sprint hadden we een sterke onderlinge band.
Tevredenheid
Ik ben tevreden over het werk van mijn teamleden tijdens de afgelopen sprint.
Ik ben tevreden over de manier waarop we hebben samengewerkt tijdens de afgelopen sprint.
Tijdens de afgelopen sprint heb ik met veel plezier in dit team gewerkt.

Translated questionnaire

To what extent do you agree with the following statements (1, totally disagree – 5, totally agree)?

Cohesion
During the last sprint, it was important to the members of our team to be part of this project.
During the last sprint, all team members were fully integrated in our team.
During the last sprint, our team was sticking together.
Satisfaction
I am satisfied with the work of my colleagues during the last sprint.
I am pleased with the way my colleagues and I worked together during the last sprint.
I am very satisfied with working in this team during the last sprint.

Appendix B – Coding scheme

Code	Definition	Example
Episode	A sequence of utterances about the same topic	Episode about which tasks to perform first this sprint
Social regulation utterances		
Social regulation	Intentional and goal directed group efforts to regulate its conceptual understanding and task work. Collectively shared regulatory processes orchestrated in the service of shared outcome.	-
Cognition	Utterances about the content of the task and the elaboration of this content.	I can't log into the new user interface.
Off-topic	When communication is too hard to understand or the sound is unclear.	-
Social talk	Talk not aimed at regulating the project and the team processes.	I'm playing the wild card now.
Regulation phases		
Planning	Discussing how to go about solving problems, discussing strategies, goal setting, collaboratively discussing task directions, translating directions into a clear plan, designating tasks.	Today I'm working on the customer sessions.
Monitoring	Checking progress and comprehension of the task. Comparing a current state with a desired state. Monitoring content understanding, monitoring the pace and time remaining.	I was too busy yesterday, I didn't have the time to start on that task.
Evaluation	Making a judgement about goal attainment. Discussing what could be improved next time.	I really missed the burndown chart last sprint.
Direction of activity		
Project	Regulation directed to planning, monitoring or evaluation of the design process. Regulation activities about the content of the project.	This task is finished, the other two still need to be tested.
Meeting	Regulation activities directed to the practical organization and logistics of the meeting.	We have fifteen minutes left to discuss this.

Organization	Regulation activities directed to the practical organization and logistics of the (collaboration) process.	At feature Friday I'm not available.
Quality of interaction		
Initiating	Initiating regulation activity.	We have to check what we have to do today.
Ignoring	When the group members do not relate to nor engage in another group member's regulation activity.	- You can put that live … (is interrupted) - I'm going to check if I've checked everything in.
Accepting	When the group members engage in a regulation activity with a cognitive activity.	Yes, you're right.
Engaging	When group members relate or engage in each other's regulation activities. Responding by further specifying or clarifying the previous regulation activity or further develop the previously initiated idea.	- Is there anything I can do? - Maybe you can start solving a few tickets today.
Concluding	When a group member ends the topic with a short summary or conclusion of the discussion.	This time we're going to do it this way, so we have a clear sprint result.
Socially shared regulation	An episode that contains engaging interaction, and which ends with a shared concluding utterances.	-

Appendix C – Coding steps