The Manifestation of Self-regulation, Co-regulation and Socially Shared Regulation in

Software Development Teams

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Abstract

In the industry of software development, teams are the basic unit of work and it is argued by most development methods that teams should self-manage. Because teams should self-manage, the concept of regulation becomes essential. While research regarding the concepts of regulation as part of processes during teamwork on the individual- and on the team-level has been relatively sparse in the field of organizational research, this is not so much the case for the educational research field. Therefore, the concepts of regulation of the educational field of research have been applied in this study, investigating three software development teams using the Scrum method. The teamwork of the teams was observed by means of video recordings which were coded afterwards, focusing on the way the different types of regulation (self-regulation, co-regulation & socially shared regulation) and phases of regulation (planning, monitoring, evaluating) manifested. Due to time constraints and in order to reduce the scope of this study, it was randomly chosen to focus on investigating only regulation activities that occurred during the planning phase of regulation.

Different patterns were observed for the way in which the different types and phases of regulation manifested in the different teams. The types of regulation always occurred together with the corresponding perspectives (I-perspective, you-perspective & we-perspective) for the different types of regulation. Moreover, the Scrum masters of the teams protruded in so far as they were the team members who overall showed most regulation activities in their team.

Keywords: self-regulation, co-regulation, socially shared regulation, self-managing, scrum

Introduction

In the industry of software development, teams rather than individuals are the basic unit of work (Moe, Dingsoyr & Dyba, 2009). Moreover, it is favorable for teams to manage and organize themselves (Rising & Janoff, 2000; Schatz & Abdelshafi, 2005), which is the case in so called *self-managing teams*. In fact, self-managing teams show increased team performance compared to traditional teams (Rousseau & Aubé, 2010). As the main characteristic of self-managing teams is their authority to decide themselves how they organize their work, the concept of regulation is essential for the working together of the team. In the field of organizational research, research concerning the regulation processes during (collaborative) teamwork on both individual- and team-level has been relatively sparse (Acuña, Gómez & Juristo, 2009; DeShon, Kozlowski, Schmidt, Milner & Wiechmann, 2004; Kirkman & Rosen, 1999). This, however, is not so much the case in the educational field of research. Here, research on regulation processes in teamwork considering both the individual- and the team-level categorizes three main types of regulation (DeShon et al., 2004). These types of regulation are *self-regulation*, *co-regulation* and *socially shared regulation* (Järvelä & Hadwin, 2013).

Consequently, this study aims to contribute to the research concerning regulation processes on the individual-level as well as on the team-level (Acuña, Gómez & Juristo, 2009; DeShon et al., 2004; Kirkman & Rosen, 1999). Furthermore, it aims to contribute to the research needed on agile project management methods such as Scrum (Dybå & Dingsøyr, 2008). The main focus will be on the way the different phases of regulation (planning, monitoring & evaluating) and the different types of regulation (self-regulation, co-regulation and socially shared regulation) manifest during teamwork.

The working together of people in groups and teams is nowadays a crucial component of many organizations (Rousseau & Aubé, 2010). This is especially the case in the industry of software development, where teams and not individuals are the basic unit of work (Moe, Dingsoyr & Dyba, 2009), as was predicted by Katzenbach & Smith (1993), who stated that "teams will become the primary unit of performance in high-performance organizations" (p. 10). A team is defined by the same authors as "a small number of people with complementary skills who are committed to a common purpose, set of performance goals, and approach for which they hold themselves mutually accountable" (Katzenbach & Smith, 1993).

According to the majority of development methods, it is favorable for teams to manage and organize themselves (Rising & Janoff, 2000; Schatz & Abdelshafi, 2005). This fits with the ongoing trend of organizations trying to increase the autonomy of their teams

(Langfred, 2000). A method characteristic for this way of working is *Scrum*. Scrum is an agile software development method that is designed for projects in which it is difficult to work according to a strict plan and includes as its core element so-called "feedback loops" (Dybå & Dingsøyr, 2008, p. 835). Here, people work together in a group that is self-organizing, meaning that they share the authority and responsibility when making a decision and monitor their own progress and process. The steps necessary in order to achieve the desired result are made incrementally, in so-called *sprints*.

According to Rising & Janoff (2000), there are many advantages the scrum method provides, for example that "the product becomes a series of manageable chunks" (p. 8). This leads to the fact that there is often (at least some) progress made, as work is divided into smaller steps that have to be taken. This in turn motivates the team as everyone sees more frequently that progress is made together so that "the team shares successes along the way and at the end" (Rising & Janoff, 2000, p. 8). Furthermore, the Scrum method increases the communication among team members, as they have to inform each other about the progress made more frequently (Rising & Janoff, 2000). Not only the team itself, but also the customers for whom the team is working profit from Scrum. They are enabled to "see on-time delivery of increments" (Rising & Janoff, 2000, p. 8) as well as to get feedback about the product and the process of its manifestation. Rising & Janoff (2000) consider the above mentioned advantages of Scrum as ultimately leading to "a culture […] where everyone expects the project to succeed" (p. 8), which therefore increases the chances of the project to actually succeed.

These advantages of Scrum are supported by Tata & Prasad (2004), who see the strength of self-management (and thus of Scrum, since Scrum is a method used by self-managing teams) particularly in bringing the power to make a decision to the "level of operational problems and uncertainties" (p. 250), so that the speed as well as the accuracy increases while solving a problem, as the team is able to decide how to respond to problems without being limited in their authority to do so.

However, all these advantages that the Scrum method brings forth compared to traditional working methods are subject to certain conditions that have to be met to a certain extent. As described by Moe, Dingsoyr & Dyba (2009), it is not sufficient to create an effective team by just putting people together in a group, so that it is of significant importance in which way teamwork is organized and facilitated. As Scrum is a method designed to be used by self-managing and self-organizing teams in which team members are given the authority to (collaboratively) decide how to organize and monitor their work, the concept of

self-regulation is essential. This is because once team members are given the authority to decide themselves how they organize and monitor their work, they must actually do so by influencing their own behavior (regulating themselves) in order to work optimally (Zimmerman & Schunk, 2011). Moreover, Vancouver & Day (2005) have identified various field intervention studies in their literature review on the concept of self-regulation. These studies, which were not directly about self-regulation but rather "designed around self-regulation principles" (Vancouver & Day, 2005, p. 178), showed to be significantly effective with regard to "job and task performance… [and] …follower development and performance, as well as team efficacy and performance" (Vancouver & Day, 2005, p. 178).This indicates that the concept of self-regulation, regarding its potential advantages, might be essential in work-related contexts (Vancouver & Day, 2005). The concept of self-regulation originally stems from the field of psychotherapy in which it is proposed that individuals are able to control themselves (Luthans & Davis, 1979). Self-regulation is defined by Zimmerman & Schunk (1989) as the self-controlled regulation of one's own thoughts, feelings, as well as behaviors in order to accomplish certain goals. It is a concept (especially in the organizational field) grounded on the shift of focus from "the worker" to "the purposeful, goal-striving human" (Vancouver & Day, 2005, p. 156). This focus is based on the individual level, as it is concerned with the goal(s) of an individual and the behavior of the individual related to the goal(s). At this level, the providence of goals and feedback considering performance are considered to be some of the most effective ways to improve performance (Locke & Latham, 1990).

However, the application of these ways of improvement for individuals to the team level has led to conflicting results, for which two limitations are significantly responsible (DeShon, Kozlowski, Schmidt, Milner & Wiechmann, 2004). The first limitation according to DeShon et al. (2004) is that most research concentrates on either "the effect of team goals and team feedback on individual-level outcomes—ignoring the fact that individuals are functioning in a team context—or the effect of team goals and team feedback on team-level outcomes—ignoring the impact of the manipulations on the individuals nested within the teams" (p. 1035). The second limitation is that there is no model yet that describes how the intervention of providing goals and feedback operates on the team level (DeShon et al., 2004). Especially the first limitation is of quite preeminent status in the field of organizational research, as it was pointed out in other words by Kirkman and Rosen (1999) already 17 years ago, when they stated that "what is needed most now in the team effectiveness literature is research that examines empowerment at the individual and team levels simultaneously". The

fact that there is thus a "relative lack of research" on processes that are responsible in order for a team to perform (well) "is both surprising and disturbing" according to DeShon et al. (2004, p. 1035), who further point out that a clear understanding of these processes is absolutely necessary in order to "predict the effects of training interventions designed to develop high-performing teams" (DeShon et al., 2004, p. 1035).

However, while in the field of organizational research, research concerning the regulation processes during (collaborative) teamwork on both individual- and team-level simultaneously has been relatively sparse (Acuña, Gómez & Juristo, 2009; DeShon et al., 2004; Kirkman & Rosen, 1999), this is not so much the case concerning the educational field of research. Here, research on regulation processes in teamwork considering the individual- and the team-level simultaneously has been done distinguishing three main types of regulation (Hadwin, & Oshige, 2011). These types of regulation are *self-regulation* (students regulating themselves), *co-regulation* (students regulating each other) and *socially shared regulation* (the regulation of the group as a whole) (Järvelä & Hadwin, 2013). Additionally, according to Järvelä & Hadwin (2013), each of these three types of regulation has a corresponding perspective with which the individual acts. These perspectives can function in the context of different types of regulation as a "classifying criterion for understanding the different terms for social phenomena of regulation" (Schoor, Narciss & Körndle, 2015, p. 104).The term self-regulation will be used as defined above by Zimmerman & Schunk (1989), who define it as the self-controlled regulation of one's own thoughts, feelings, as well as behaviors in order to accomplish certain goals. With regard to self-regulation, the individual acts based on the *I-perspective* (*I* think…, *I* do…, *my* thoughts about this are…).The term co-regulation will be used as suggested by Järvelä & Hadwin (2013), who state that "Co-regulation occurs when individual's regulatory activities are guided, supported, shaped, or constrained by and with others" (p. 28). In co-regulation, there is a *you-perspective* based on which the individual acts (*you* should…, why don't *you* do this…, what are *your* thoughts about…). The term socially shared regulation is defined by Vauras, Iiskala, Kajamies, Kinnunen & Lehtinen (2003) as "constant monitoring and regulation of joint activity, which cannot be reduced to mere individual activity" (p. 35) as well as "egalitarian, complementary monitoring and regulation over the task" (p. 35). It is therefore seen as "the most profoundly social mode of regulation" (p. 219), as it refers to individuals acting "as a genuine social entity, aimed at a single direction, that is, the fully shared goal for the activity" (Volet, Vauras & Salonen, 2009, p. 219). Concerning the concept of socially shared regulation, there is a *we-perspective* (*we* should do this…, *we* think…).

These different types of regulation occur during different phases of regulation, which are *planning*, *monitoring* and *evaluating* (Molenaar & Chiu, 2014). Planning is in this study defined as suggested by Rogat & Linnenbrink-Garcia (2011) "Discussing how to go about solving the problems" (p. 384) and includes discussing strategies, goal setting, collaboratively discussing task directions, translating directions into a clear plan and designating tasks (Rogat & Linnenbrink-Garcia, 2011). Monitoring is defined as "Checking progress and comprehension of the task" (Molenaar & Chiu, 2014, p. 157) as well as comparing a current state with a desired state and monitoring content understanding, assessing progress, recognizing what remains to be completed as well as monitoring the pace and time remaining (Rogat & Linnenbrink-Garcia, 2011). Evaluating is defined as making a judgement about goal attainment (Rogat & Linnenbrink-Garcia, 2011).

Concluding, this study aims to contribute to the research concerning regulation processes on the individual- and on the team-level (Acuña, Gómez & Juristo, 2009; DeShon et al., 2004; Kirkman & Rosen, 1999), as well as contributing to the research needed on agile project management methods such as Scrum (Dybå & Dingsøyr, 2008). This will be done by applying the concepts of the educational research field concerning regulation processes to the field of organizational research. The study will focus on the way in which self-regulation, co-regulation and socially shared regulation (Järvelä & Hadwin, 2013; Iiskala, Vauras, Lehtinen & Salonen, 2011) manifest during teamwork, taking into account their corresponding perspectives as well as the manifestation of the different regulation phases (planning, monitoring & evaluating).

Method

Study context

Three teams of an ICT company based in a Dutch city participated in this study. The company is working on software solutions for the Dutch government, designing and implementing software.

The teams participating in this research work with the Scrum-method. According to the Scrum-method, a team is made up of a product owner, who is representative for the stakeholders ordering the product, a scrum master, who takes care that the scrum method is followed correctly and the development team, which creates and delivers the products. The teams deliver their products in short periods of time, called sprints. A sprint starts with a sprint planning event, in which the aim of the sprint is discussed. Each sprint ends with a review and a retrospective. In the review, the completed work is presented to the product owner and other stakeholders, who then give feedback. During the retrospective the team

reflects on the last sprint. During each sprint, the team has daily meetings, called stand-ups. In these stand-ups, which last a maximum of 15 minutes, three questions are discussed: What was done yesterday, what will be done today and are there any problems impeding the aim from being met? (Hossain, Babar & Paik, 2009).

Moreover, there are two types of backlogs. There is a product backlog, which determines the requirements for a product and a sprint backlog, which keeps in track the tasks that have to be done by the team in the next sprint. Finally, there are two burn-down charts. A sprint burn down chart, keeping track of the work in the sprint backlog that still has to be done and a release burn down chart, which enables the team to monitor their progress (Hossain, Bannerman & Jeffery, 2011).

Design

A multiple-case field study was designed to investigate the teamwork of three different teams working for the same company according to the Scrum-method. The focus was on observing the way the different types of regulation as well as the different phases of regulation manifest. The focus was moreover on differences between the teams concerning the types and phases of regulation.

Participants

It was chosen that only participants who participated in about 80% of all meetings were included for analysis in this study. Therefore, altogether, there were 15 participants. The first team (titled *team 1*) consisted of 6 members, all members were male. The average age was 39 years. The second team (titled *team 2*) consisted of 5 members, all members were male. The average age was 36.2 years. Finally, the third team (titled *team 3*) consisted of 4 members, of which 3 were male and 1 female. The average age here was 41.25 years. All participants of this study were independent contractors.

Materials

A 360 degree video camera was used to record the meetings of the teams. Altogether, 3 stand-ups and one retrospective, which in total amount to 223 minutes of video material, were recorded and analyzed for each team. Afterwards, the tapes were coded according to a coding scheme. The coding scheme was divided, for the purpose of clarity, into 2 tables, which are shown below. In table 1, the different phases in which the different regulation activities occurred are shown. These include planning, monitoring and evaluating. Table 2 shows the different types of regulation that occurred, which were self-regulation, co-

regulation and socially shared regulation.

Table 1

The three different phases of regulation

Code	Description of the Code
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. Comparing a current state with a desired state. Monitoring content understanding, assessing progress, recognizing what remains to be completed, monitoring the pace and time remaining
Evaluating	Making a judgement about goal attainment

Table 2

The three different types of regulation

Code	Description of the Code
Self-regulation	Regulation of one's own thoughts, feelings, as well as behaviors in order to accomplish certain goals
Co-regulation	Guiding, supporting, shaping or constraining each other's regulatory activities
Socially shared regulation	Constant monitoring and regulation of joint activity, which cannot be reduced to mere individual activity" as well as "egalitarian, complementary monitoring and regulation over the task

In order to determine inter-rater reliability, Cohen's Kappa was calculated. This was done by letting another researcher code 20% of the videos that were used for this study, which was about 45 minutes of video material. The videos coded consisted of two randomly selected stand-ups and 20 minutes of one retrospective. This other researcher coded the videos according to the same coding scheme and the same coding procedure. The results were used in order to calculate Cohen's Kappa. The resulting kappa was $k=0.54$. According to Landis & Koch (1977), the strength of agreement of a kappa between 0.41 and 0.60 is "moderate" (p. 165). However, this cannot be considered a good result. A possible explanation for this kappa is that neither the researcher who carried out this study nor the researcher who coded 20% of the videos used in this study received any training for coding. Moreover, due to time constraints, it was not possible to discuss the inter-rater reliability with the other researcher in order to reach a higher kappa.

Procedure

The information about this study as well as the procedure was presented and explained to all teams by another researcher, the data-collector. The team members were informed about the aim of the study, the time it will take, the method that will be used to collect data, as well as how their privacy will be protected. The team members were free to ask questions at any point of time. After this, the team members were able to choose whether they wanted to participate in the study or not. It was made clear that a team was only able to participate if all team members chose to participate in the study. After all questions had been answered and the teams chose to participate, a pilot of two weeks was done in order for the participants to familiarize with the video cameras. After this period, the team members again had the chance to withdraw their participation in the study. The researchers were asked to sign a non-disclosure agreement and the participants were asked to sign an informed consent form. In this form, it was made clear that the collected data will only be shown to third parties confidentially and anonymously. Furthermore, it was made clear in this form that participation in this study is voluntary and that the participants always have the right to cancel their participation without declaring any reason. All this was done by another researcher.

After this, the study officially started and the meetings of the teams were recorded by a 360 degree video camera. The camera was turned on shortly before the beginning of the meetings by the data-collector, who was not present during the meetings if the participants were against this.

Data Analysis

First of all, the meetings of the teams were videotaped, using a 360 degree video

camera. This was done by the data-collector and enabled the coder to be more objective, as the coder was not involved in collection of data. Moreover, there was no interaction at all between the coder and the participants, making it all the more possible for the coder to objectively analyze the data. After the meetings were recorded, the recordings were coded based on the coding schemes.

First of all, the recordings were coded based on the phases of regulation, which were planning, monitoring and evaluating. A regulation phase (planning, monitoring, evaluating) was coded from the first utterance about a certain topic until the last utterance about that topic if the utterances were related to one of the regulation phases. Once an utterance belonged to a different regulation phase or a different topic, another code was given. This means that for example a meeting began by someone talking about a topic in a way that was coded as planning. In this case, every utterance about the same topic occurring in the phase of planning was coded as planning. A new code was only given when the topic or the phase changed. In this case, once someone talked about the same topic but it occurred in another phase, a new code was given, for example monitoring. From there on, if the team talked about monitoring (considering a certain topic), it was coded as monitoring until the time the topic changed or the team was not monitoring anymore. However, if for example the topic changed and the team continued with monitoring, a new monitoring code was given. Utterances that occurred outside the regulation phases were coded from the first utterance to the last utterance as *other*. These utterances were considered not relevant for this study and were therefore not included for analysis.

Second, the different types of regulation (self-regulation, co-regulation & socially shared regulation) were coded. At this, it has been randomly chosen to focus on investigating only regulation activities that manifested in the planning phase of regulation. This has been done due to time-constraints, so that the expense of this study was kept within feasible bounds. The different types of regulation were coded from the first utterance until the last utterance they occurred in one planning phase of regulation. A new code was given once the regulation occurred in another planning phase and also if a regulation activity was shown by another person.

In addition to the codes, notes were made based on emerging patterns that were observed. Quotes that were included for analysis and/or discussion were translated from Dutch to English.

The collected data was analyzed by means of a content analysis. The focus was laid on the way in which the different types of regulation and the different phases of regulation

manifested during the working together of the teams.

First of all, frequencies were used in order to get an overview of the distribution of the different types and phases of regulation. Was there for example a certain type of regulation that occurred most in a planning phase? Afterwards, emerging patterns were described based on how they occurred during the project and what was said by the participants. Moreover, these patterns were compared across teams.

Results

Phases of regulation

First of all, it was observed that certain phases of regulation occurred only during certain meetings. It was observed that during the stand-ups that were held by the teams, there was no evaluating at all. None of the three teams showed behavior that was considered to be categorized as evaluating. The reason for this may be that the definition of evaluating includes making a judgment about the attainment of a goal. However, during the stand-ups, the teams talked about their progress so far in terms of what should be achieved for the next sprint as well as what had to be done to achieve the goals for the next sprint. This way, the teams were monitoring their progress and planning their future actions during the stand-ups, which is probably why the only regulation phases that were observed during the stand-ups were planning and monitoring.

Moreover, this kind of observation was also made for the retrospectives. Here, the teams came together to reflect on the last sprint. They were evaluating, for example judging their way of working, as well as planning, as they planned how they wanted to change their behavior in the future based on the judgments given. This may be the reason for the observation that none of the teams showed any behavior that was to be categorized as monitoring.

Considering the fact that stand-ups and retrospectives differed in the way different phases of regulation were present, they were analyzed and described separately in this section.

Taking a look at the different phases of regulation (planning, monitoring and evaluating), different patterns were observed for each team in the stand-ups and retrospectives respectively.

Stand-ups.

Overall, all teams showed nearly the same amount of planning in their stand-ups (N team 1=18, N team 2=19 and N team 3=19). Team 2 and team 3 also showed nearly the same amount of monitoring (N team 1=15 N team 2=23 and N team 3=24). However, after calculating the percentages to which the teams were planning and monitoring in relation to

their total amount of regulation phases during the stand-ups, it was observed that 55 % of the

regulation phases of team 1 were planning and 45 % monitoring. In team 2, 44 % of the

regulation phases were planning and 56 % monitoring. The distribution of team 3 regarding

regulation phases was 45 % planning and 55 % monitoring. Therefore, team 1 was the team

that was relatively planning the most, followed by team 2 and team 3 who showed roughly the

same relative amount of planning and monitoring. The amounts of planning phases as well as

the corresponding relative percentages to which a certain phase occurred for each team are

shown in table 3 below.

Table 3

The amounts and relative percentages of the different phases of regulation for each of the

three teams during the stand-ups

Team	Planning	Monitoring	Evaluating
1	18 **(55%)**	15 **(45%)**	0 **(0%)**
2	19 **(44%)**	24 **(56%)**	0 **(0%)**
3	19 **(45%)**	23 **(55%)**	0 **(0%)**

Note. The percentages to which the different phases occurred in relation to the total amount of phases for each

team are shown in brackets and bold.

In order to get some insight into the ways that the different phases of regulation

manifested during the teamwork of the different teams, it was looked at the patterns of how a

certain phase of regulation follows or is followed by another phase of regulation. Therefore,

relative percentages were calculated for each team. At team 1, a planning phase was followed

by another planning phase in 6 % of the cases. Here, a monitoring phase was always followed

or preceded by at least one planning phase and there were no cases in which a monitoring

phase was followed by another monitoring phase. At team 2, in 9 % of the cases a monitoring

phase was followed by another monitoring phase. There were no cases in which a planning

phase was followed by another planning phase and a planning phase was always followed or

preceded by at least one monitoring phase. The same pattern occurred at team 3, except that

here a monitoring phase was followed by another monitoring phase in 7 % of the cases. The

percentages to which the planning and monitoring phases were followed or preceded by

themselves are shown in table 4 below.

Table 4

The total relative percentages to which the three different phases of regulation were

preceded or followed by themselves for each of the three teams during the stand-ups

Team	Planning	Monitoring	Evaluating
1	6 %	0 %	0 %
2	0 %	9 %	0 %
3	0 %	7 %	0 %

It was thus that the team which showed the most planning phases according to relative percentages, team 1, was also the only team in which a planning phase was followed by another planning phase. This shows how the planning of team 1 differed from the planning of team 2 and team 3, where planning was always followed or preceded by a monitoring phase. Team 1 was therefore planning differently compared to the other teams in so far as it was planning two or more different main topics successively. The other teams however were always first monitoring about a new main topic before they began with their planning on a new topic.

Retrospectives.

In the retrospectives, different patterns were observed than in the stand-ups. First of all, team 1 again was the team that planned most of all teams, as 51 % of their regulation phases were planning and 49 % were evaluating. Team 2 and team 3 again differed from team 1 in so far as they were evaluating more than they were planning. The relative percentage of planning was 43 % for Team 2, with 57 % evaluating. In team 3, planning occurred for 33 % and evaluating for 67 %. Table 5 shows the total amounts and relative percentages of the three different types of regulation for each of the three teams during the retrospectives.

Table 5

The amounts and relative percentages of the different phases of regulation for each of the

three teams during the retrospectives

Team	Planning	Monitoring	Evaluating
1	22 **(51%)**	0 **(0%)**	21 **(49%)**
2	30 **(43%)**	0 **(0%)**	39 **(57%)**
3	18 **(33%)**	0 **(0%)**	37 **(67%)**

Note. The percentages to which the different phases occurred in relation to the total amount of phases for each team are shown in brackets and bold.

Moreover, the patterns in which the phases of regulation were followed or preceded by

themselves were different across teams. The corresponding percentages of these patterns are shown in table 6 below. In all teams, planning phases were sometimes followed or preceded by other planning phases. This occurred for 9 % of the cases in team 1, for 6 % of the cases in team 2 and for 5 % of the cases in team 3. Therefore, the pattern that was observed in the stand-ups was also observed here, as team 1 was planning most, with the highest relative percentage of successive planning phases. However, all teams differed in their relative percentages on successive evaluating phases. Team 1 showed the lowest relative percentage, as an evaluating phase was followed or preceded by another evaluating phase in 7 % of their total regulation phases. The percentage of team 2 in this case was 20 %. For team 3, which was relatively evaluating the most during the retrospectives, the percentage of successive evaluating phases was 67 %. Team 3 was thus the team with the highest relative percentage of succession considering the phase of evaluating.

Table 6

The total relative percentages to which the three different phases of regulation were preceded or followed by themselves for each of the three teams during the retrospectives

Team	Planning	Monitoring	Evaluating
1	9 %	0 %	7 %
2	6 %	0 %	20 %
3	5 %	0 %	67 %

Therefore, the same pattern that emerged in the stand-ups was also emerging in the retrospectives, which was that the team with the highest relative percentage considering a certain phase was also the team with the highest percentage of succession of that certain phase.

Moreover, it was analyzed to which extent a planning phase was followed by an evaluating phase in order to find out about the frequencies to which the different teams took action based on their evaluations. The percentage to which an evaluating phase was followed by a planning phase is 40 % for team 1, 33 % for team 2 and 24 % for team 3.

Types of regulation

While for the phases of regulation a pattern was to be observed with regard to which phase was preceded or followed by another phase, this was not the case regarding the different types of regulation (self-regulation, co-regulation & socially shared regulation). Here, no pattern was observed regarding which type of regulation was preceded or followed by another type of regulation.

In order to gain some insight into how much a given team was showing regulation activities on average during a planning phase, a regulation per planning ratio was calculated. Therefore, the total amount that the different types of regulations (self-regulation, co-regulation & socially shared regulation together) occurred were divided by the total amount of planning phases in which they occurred. For team 1, the regulation per planning ratio during the stand-ups was 1.67, during the retrospective it was 0.64. For team 2, the ratios were 1.79 and 0.73 respectively. Team 3 showed a regulation per planning ratio of 1.74 during the stand-ups and a ratio of 0.72 during the retrospective. A pattern that was observed here was that the team with the highest relative percentage of planning as well as the highest relative percentage of succession considering the phase of planning in both stand-ups and retrospectives, team 1, had the lowest regulation per planning ratio. However, this pattern was not as strong looking at the retrospectives of team 2 and team 3, which differed only slightly in their regulation per planning ratio (0.73 and 0.72 respectively), while they differed in their relative percentage of planning by 10 percentage points (43 % and 33 % respectively).

The total relative percentages of the types of regulation of the teams are shown in table 7 below. Team 1 again differed most from the other teams, as there was clearly a dominant type of regulation, which was socially shared regulation with a total relative percentage of 64 %. Again, team 2 and team 3 showed similar patterns, they differed only slightly in their relative percentages of socially shared regulation. Team 2 had a percentage of 47 % and team 3 a percentage of 44 %. Moreover, team 2 was the team with the highest relative percentage of co-regulation (30 %), although closely followed by team 3 with 28 %, so they showed quite similar patterns. Team 1 was the team with the lowest relative percentage of co-regulation (18 %) as well as self-regulation (18 %) and team 3 had the highest relative percentage of self regulation (28 %).

Table 7

The total amounts and relative percentages of the three different types of regulation for each of the three teams

Team	Self-regulation	Co-regulation	Socially shared regulation
1	18 % **(8)**	18 % **(8)**	64 % **(28)**
2	23 % **(13)**	30 % **(17)**	47 % **(26)**
3	28 % **(13)**	28 % **(13)**	44 % **(20)**

Note. The corresponding amount to which a certain type of regulation occurred in each team is shown in brackets and bold.

Stand-ups.

For the stand-ups, the relative percentages of the different types of regulation for each team are shown in table 8 below, together with the relative percentages for the retrospectives under the subsection *Retrospectives*. This was done to enable the reader to have a better overview over the amounts and relative percentages for the stand-ups and retrospectives.

In the stand-ups, it was observed that here also team 1 showed the highest relative percentage of socially shared regulation (64 %). Moreover, team 1 showed more co-regulation (23 %) and less self-regulation (13 %). Compared to the total relative percentages, team 2 showed more co-regulation in the stand-ups (40 %), but less socially shared regulation (36%), while their self-regulation activity remained roughly the same (24 %). Furthermore, team 3 showed roughly the same co-regulation (30 %), less self-regulation (21 %) and a bit more socially shared regulation (49%) compared to the total relative percentages of the different types of regulation.

Retrospectives.

Here, different patterns were observed than in the stand-ups for each team. The relative percentages of the different types of regulation for each team are shown in table 5 below.

In the retrospectives, all teams showed completely different patterns for at least one type of regulation compared to the stand-ups. Looking at team 1, it was observed that their relative percentage of socially shared regulation was exactly the same (64 %), however, their relative percentage with regard to self-regulation and co-regulation changed. Their relative percentage of self-regulation was 16 percentage points higher than in the stand-ups. A possible explanation for this observation will be given in the section *The way the different regulations manifested*. However, while team 1 always had been the team having a much higher relative percentage of socially shared regulation, this was not the case anymore with regard to the retrospectives. Here, team 2 had nearly the same amount of percentage points regarding socially shared regulation with 63 %. The pattern showed by team 2 therefore changed significantly considering the fact that during the stand-ups they were the team with the lowest percentage of socially shared regulation. A more detailed description of this observation will be given in the section *The way the different regulations manifested*, where also the behaviors of team members dominating certain meetings were described. As team 2 showed more socially shared regulation (relative to the total amount of regulations done by them) in the retrospective than during the stand-ups, they in place showed way less co-regulation, which decreased by 26 percentage points. What was observed at team 3 is that

they showed way different behavior considering their self-regulation activities. While during the stand-ups their relative percentage of self regulation was 21 %, their percentage of self-regulation during the retrospective was 46 %. However, the reason for this large increase in self-regulation activity was likely to be found in an incident that occurred during the retrospective, which will also be described in the next section, called *The way the different regulations manifested*.

Table 8

The relative percentages of the three different types of regulation for each of the three teams during the stand-ups and the retrospectives

Team	Self-regulation	Co-regulation	Socially shared regulation
1	**13 % (4)** 29 % (4)	**23 % (7)** 7 % (1)	**64 % (19)** 64 % (9)
2	**24 % (8)** 23 % (5)	**40 % (14)** 14 % (3)	**36 % (12)** 63 % (14)
3	**21 % (7)** 46 % (6)	**30 % (10)** 23 % (3)	**49 % (16)** 31 % (4)

Note. The corresponding amount to which a certain type of regulation occurred in each team is shown in brackets. The amounts and relative percentages of a certain type of regulation corresponding to the stand-ups are shown in bold.

The way the different regulations manifested

The observations made from looking at the way the different types of regulation manifested in stand-ups and retrospectives were extended by investigating the way the different types of regulation manifested during the stand-ups and retrospectives with regard to the different teams.

Team 1.

Overall, the way the different types of regulation manifested in team 1 was best characterized by statements like "I will have to do…", "…take care that you control…so that you…" and "We still have to build…". Therefore, the regulation activities of team 1 were mostly about things that needed to be done either as a group or by individuals, which is because only regulation activities based in the phase of planning have been coded.

It was observed that the relative percentage of self-regulation of team 1 increased by 16 percentage points comparing the retrospective with the stand-ups, while their relative percentage of co-regulation decreased to 7 %. Considering the way the self-regulation activities of team 1 manifested during the retrospective and the stand-ups, it was observed that the Scrum master of team 1 was showing 65 % of all regulation activities in the retrospective and 30 % of all regulation activities during the stand-ups, making him the one who was

showing most of the regulation activities in team 1. In the retrospective, 33 % of his

regulation activities were categorized as self-regulation, so that the increase in self-regulation

activity of team 1 is clearly influenced by the regulation activities of the Scrum master.

Looking at the way the Scrum master was showing regulation activities, it protrudes that the

regulation activities of the Scrum master were about the way he was able to influence the

finding of a solution for one big problem and/or certain other problems. As it was seldom

possible to understand the precise content of conversations regarding technical problems in

software development, it cannot clearly be stated whether the team was dealing with one big

problem or several problems. However, the Scrum master was showing a lot of self-regulation

activity like "I will report this to…" or "I will gladly try to find out the reasons for…" or "Yes

I will report this". Apparently, the Scrum master was taking responsibility in order to help the

team find a solution for something, offering to take a close look at something as well as

confirming that he will report something to another instance.

Apart from the increased relative percentage of self-regulation activity, team 1 was

always the team showing the highest relative percentage of socially shared regulation in

stand-ups and in the retrospective, where the percentage was 64 % respectively. The way

socially shared regulation was shown by team 1 was characterized by statements like "We

have to begin [working on] this" as well as "We should remember that this is how we agreed

to act so we should act that way" and "We don't have to discuss this again". The socially

shared regulation activities of team 1 were therefore not only characterized by statements that

were directed at giving rise to a certain action related to creating a product, but also by

statements describing the way the team wanted to work and communicate together.

Team 2.

With regard to team 2, the way the different types of regulation manifested were best

characterized by examples like "I will look after this", "You should take a look at this" or

"We have to fix this". Therefore, the overall regulation activities of team 2 were quite similar

to the regulation activities of team 1.

Just like team 1, team 2 seemed to be dealing with one or more problems that were

mostly discussed during the retrospective. Here, 63 % of the regulation activity of team 2 was

socially shared regulation, while in the stand-ups team 2 was the team with the lowest relative

percentage of socially shared regulation with 36 %. The way team 2 showed socially shared

regulation activities was best characterized by statements like "If this is finished, we don't

need to change…" or "So then we have to look at what else there is to do". However, what

was special about the retrospective of team 2 is that it was the only retrospective across teams

in which the Scrum master was not the one showing the most regulation activities. In fact, the Scrum master was only showing 9 % of the total regulation activities in this retrospective. The person that was showing most regulation activities was in this case the product owner, who was showing 55 % of the regulation activities, of which 67 % was socially shared regulation. There was one incident during this retrospective in which a problem was discussed and all the regulation activities that occurred were shown by the product owner. Examples of his regulation statements were "If you really think that…this is not enough, then we will have to ring the alarm", "I will ring the alarm", "But you have to say it [if something is not right], I cannot say this of course" as well as "I think we have to include this point in the evaluation". There was thus a problem discussed that was related to the fact that seemingly a product was not finished properly. The team discussed about this, but it was the product owner who was ultimately giving input for concrete action mostly by means of socially shared regulation activities but also by self- and co-regulation activities.

However, in contrast to the retrospective, in team 2 the Scrum master was responsible for most of the regulation activities during the stand-ups, with a relative percentage of 50 %.

Team 3.

The pattern that the Scrum master was the one who was showing most of the regulation activities was also obvious in team 3. Here, the Scrum master was showing 45 % of the regulation activities in the stand-ups and 77 % of the regulation activities in the retrospective. Looking at the stand-ups, the way the different types of regulation manifested was quite similar to that of the other teams in so far as they were characterized by statements pointing to a certain action that was done or should be done. Some examples of regulation activities are "I will try to change it and apply it" or "I think you should create…" and "Then we will do this".

It was observed that in team 3, the relative percentage of self-regulation changed to a large degree comparing the stand-ups and the retrospective. While their percentage of self-regulation was 21 % in the stand-ups, this relative percentage increased in the retrospective to 46 %. The reason for this increase likely occurred during the retrospective, where the Scrum master and another team member had a discussion about the teamwork of the team. The other team member said that he had the impression that Scrum hinders human communication, because according to him working with Scrum meant that everything had to be done in a way that fitted the Scrum method. Therefore, when he sometimes had a question or wanted to discuss something, he would have to wait because according to the method something else had to be discussed first. The statements of the team member were coded as evaluating, as he

was judging the way the team worked together and was not pleased with the way the Scrum method was carried out sometimes. The Scrum master answered that not the Scrum method was causing the problem, but his own behavior. He was able to recognize himself in what the team member had said, as he was so engaged with a problem sometimes that he was not able to listen to what other team members were saying to him. The Scrum master said: "I should apologize, this is completely me", acknowledging his mistake. After this, the Scrum master repeatedly mentioned that he will behave differently in the future, saying for example "I will again try to work on this". This was coded several times as self-regulation, which was why the relative percentage of self-regulation activity of team 3 increased to such a large degree in the retrospective in comparison with the stand-ups.

After this, the other team member further described why he thinks behaviors like the one the Scrum master showed are generated by the Scrum method. He said that according to Scrum everything would first have to be written down before it is talked about independently on the agenda of topics and made sure that he did not want to start an argument. He said "I just want to mention…that we don't make the same mistake", making clear that his intention was to improve the working together of the team in the future rather than to start an argument. He further said: "We want to prevent these kinds of things", which was coded as socially shared regulation activity. After the team member again mentioned that, in his opinion, the Scrum method is causing the problem, the Scrum master answered: "Be careful there, this is your interpretation". He further said that the aim of Scrum is to increase rather than to hinder human communication and that the team member therefore did not understand the Scrum method properly. However, time was up and the retrospective had to be ended so that the two could not further discuss this topic.

Discussion

In this study, different patterns were observed in terms of the ways the different phases of regulation (planning, monitoring & evaluating) manifested. Additionally, certain patterns were observed concerning the ways in which one phase of regulation was followed or preceded by another regulation phase. A key observation with regard to the different phases of regulation is that the occurrence of a certain phase of regulation was related to the type of meeting that was held by a team. Apart from the phase of planning, which occurred in stand-ups as well as in retrospectives, the phases of monitoring and evaluating only occurred during certain types of meetings respectively. The phase of monitoring only occurred during stand-ups. Here, teams are supposed to discuss their progress so far as well as what will be done

next and whether there are any obstacles that have to be dealt with (Hossain, Babar & Paik, 2009). It therefore seems logical that only the phases of planning and monitoring occurred, since the phase of evaluating is about judging the attainment of a goal, which is not the purpose of a stand-up. However, this judgment regarding the attainment of a goal is the purpose of a retrospective, since here the teams are supposed to reflect on the last sprint (Hossain, Babar & Paik, 2009). This way, the fact that in all of the teams during the stand-ups only the phases of planning and monitoring occurred, indicates that the teams indeed worked according to the Scrum method with regard to the way they structured and facilitated the different stand-ups. Furthermore, since the purpose of a retrospective is to reflect on the last sprint, it was expected that the phase of evaluating would protrude in these meetings. However, what was observed is that, given the purpose of a retrospective, the teams showed a lot of behavior that was classified as planning. Looking at the relative percentages regarding the occurrence of the phases of planning and evaluating in the retrospectives, team 1 showed 51 % planning and 49 % evaluating, team 2 showed 43 % planning and 57 % evaluating and team 3 showed 33 % planning and 67 % evaluating. These results indicate that regarding the retrospectives, the teams might not have worked as well according to the Scrum method as they did with regard to the stand-ups. However, this result also indicates that the teams took action relatively quick after evaluating, which is supported by the relative percentages to which an evaluating phase was followed by a planning phase. These are 40 % for team 1, 33 % for team 2 and 24 % for team 3.

The ways in which the types of regulation manifested differed with regard to stand-ups and retrospectives. Furthermore, each team showed different patterns in terms of the ways the different types of regulation (self-regulation, co-regulation & socially shared regulation) manifested. With regard to the different types of regulation, no pattern was found concerning the ways in which one type of regulation was followed or preceded by another type of regulation. A key observation regarding the different types of regulation was made with regard to the regulation per planning ratio that was calculated for each team. It was found that team 1, which was the team with the highest relative percentage of succession regarding the phase of planning, had the lowest regulation per planning ratio. Therefore, team 1 was the team who was showing the least amount of regulation activity per planning phase. This could indicate a lower quality of regulation activity since one planning phase was always about one topic that the team talked about and therefore team 1 showed on average less regulation activity than the other teams with regard to one topic being discussed. However, this finding could also indicate that team 1 had on average a higher quality of regulation activity, since

they could have been more effective with regard to their regulation activity, as they maybe didn't have to use as much regulation activities as the other teams in order to discuss a certain topic. Whether or not this can be seen as an indicator for better or worse quality could be determined by further research, concentrating on the frequencies and ways that the different types of regulation occur during the planning phase of regulation. In addition, it was observed that also the occurrences of the types of regulation differed with regard to the type of meeting that was held by the teams. The patterns in which the different types of regulation (self-regulation, co-regulation & socially shared regulation) manifested per team differed with regard to stand-ups and retrospectives. As explained in more detail in the section *The way the different regulations manifested*, the reason for these differences in types of regulation shown by the teams is likely to be found in certain incidents or team discussions about a bigger problem. Moreover, it was observed that on average, the type of regulation that was most shown by all teams was socially shared regulation. This indicates that the focus of the teams while they were showing regulation activity was most of all on the team as a whole. These observations could also be of particular interest for future research on the quality of regulation processes with regard to the different types of regulation investigated in this study as well as on to what extent the teams understand themselves as a team working collaboratively.

Moreover, in all of the three teams, the Scrum master was the team member who was showing most of the regulation activities. He therefore also was the person giving most input for a certain action to occur in each team. This result is of particular interest, as a key characteristic of self-managing teams (and the Scrum method) is the fact that they are expected to work collaboratively, deciding how to organize and monitor their work independent of a superior authority (Rising & Janoff, 2000). The results of this study with regard to the behaviors of the Scrum masters in the different teams, as well as the product owner of team 2 in the retrospective, challenges whether this notion of self-management in teams is actually put into practice, since all meetings of all teams were dominated by at least one team member. Apart from the retrospective of team 2, where the product owner was the dominant person showing most of the regulation activities, the dominant team members were always the Scrum masters, showing in total, stand-ups and retrospectives together, 40 % (team 1), 35 % (team 2) and up to 55 % (team 3) of all regulation activities. There are no definite guidelines to which extent all team members of a team should at least contribute to the team meetings, regarding their relative percentages of regulation activities, in order to determine whether or not a team is to be classified as self-managing and working collaboratively. However, it may be assumed that the percentages of regulation activities of

the dominant team members (mostly the Scrum masters) found in this study are too high to classify the teams of this study as completely self-managing and working collaboratively, as they were clearly not independent of a superior authority. This finding is supported by what Moe, Dingsoyr & Dyba (2009) found in their case-study investigating a software development team working according to the Scrum-method. They reported that in their study, "Only a few team-members participated in the decision-making and the Scrum master focused more on command-and-control than providing direction and support for other team members" (Moe, Dingsoyr & Dyba, 2009, p. 488). They further point out the effect that this behavior of the Scrum master may have had, since a developer taking part in their study reported that "The daily meetings are mostly about reporting to the Scrum master. When he is not there, the meetings are better because then we communicate with each other" (Moe, Dingsoyr & Dyba, 2009, p. 487), indicating that the Scrum master was even hindering communication between team members.

Corresponding Perspectives

With regard to the different perspectives (I-perspective, You-perspective & We-perspective) corresponding to the different types of regulation (Self-regulation, Co-regulation & Socially shared regulation) as was suggested by Järvelä & Hadwin (2013), it was observed that in all of the cases something was coded as a regulation activity, the different types of regulation occurred together with the corresponding perspectives. However, problems in coding arose once team members talked in imperatives. For example, the Scrum master of team 3 once said: "Write down this action point for me". With this statement, the Scrum master was clearly showing a regulation activity, but it was not obvious to whom this activity was directed at, since this statement could have been directed at one or more team members. In this case, a type of regulation would have occurred without its corresponding perspective. However, as it was in such cases not doubtlessly clear to which team member(s) a statement really was directed, it was chosen not to code such cases as a regulation activity of any kind. Moreover, it was difficult in such cases to determine the exact type of regulation, since if the statement would be directed at one team member, it would be co-regulation, but if it would be directed at the whole group, it would be socially shared regulation. Therefore, this study supports the notion of Schoor, Narciss & Körndle (2015), who stated that the corresponding perspectives could be used as a "classifying criterion for understanding the different terms for social phenomena of regulation" (p. 104). The different types of regulation could indeed be better classified by taking into account their corresponding perspectives.

Limitations

A main limitation of this study is that there may be several biases in the way the data was collected. First of all, the data was collected by another researcher, the data-collector, who recorded the meetings of the different teams. In doing so, it cannot be excluded that the data-collector, who recorded the meetings influenced the participants of this study with her presence. Furthermore, there is the possibility that the other researcher, who carried out this study, had not enough knowledge or information about the context of this study. However, the data-collector was always available for any questions on this.

Moreover, another limitation of this study is its design, as this study was a multiple-case field study, investigating three teams of the same company during a certain period of time. Therefore, limitations that apply for this study are inter alia low generalisability and external validity as well as researcher subjectivity and the fact that it may prove difficult if not impossible to replicate this study.

Furthermore, as the researcher who carried out this study had nearly no technical knowledge of what the teams were working on, it was sometimes very difficult to determine the context of a given situation or whether or not different statements of team members were related to the same or another topic. For a better understanding of the way the teams worked together, it had surely been beneficial if the researcher has had more technical knowledge about the things the teams were working on (or software development in general).

Implications for future research

The paragraphs on the phases of regulation show how teams differ in their frequency and succession of different regulation phases and it could be of value for further research to focus on this. Further research could therefore focus on the differences in the quality of the different phases of regulation, depending on their (relative) occurrence and (relative) succession in different teams. Further research could also investigate more extensively the frequencies that teams are showing regulation activities per regulation phase, by calculating something like a regulation per planning ratio, as was done in this study. This could deliver more insights into the relationship between the different types of regulation and the different phases of regulation. As was shown, team 1, the team with the highest relative percentage of planning as well as the highest relative percentage of succession considering the phase of planning, had the lowest regulation per planning ratio. Further research could focus on whether there is a correlation between these factors, whether a high relative percentage of planning could for example indicate a lower quality of planning or the other way round.

Moreover, it was also team 1 who constantly showed higher socially shared regulation

activities compared to the other teams. Further research could investigate whether the
(relative) occurrence of a particular type of regulation is related to team performance. Is for
example the team with the highest amount of socially shared regulation performing better than
the other teams? Were the team members of this team regarding themselves more as a team
than the members of the other team?

In the retrospective of team 3 there was a discussion between the Scrum master and
another team member on whether Scrum is hindering or encouraging communication between
team members. According to the Scrum master, the team member did not properly understand
the Scrum method. Further research on larger samples could focus on the way teams with
differently accurate understanding of the Scrum method, which would have to be tested
beforehand, are performing and showing regulation activities.

Furthermore, for every team it was observed that the Scrum master was the one who
was showing most regulation activities. How would for example teams regulate if there is no
Scrum master at a meeting or if the role of the Scrum master would frequently be carried out
by someone else? Is there an effect on team performance and on the way the different phases
and types of regulation manifest? The fact that the Scrum masters showed most of the
regulation activities in their teams also challenges the notion that in self-managing teams and
the Scrum method, team members are collaboratively deciding how to organize and monitor
their work (Rising & Janoff, 2000). Further research could focus on whether the authority of
organizing and monitoring the work in self-managing teams is actually allocated to the group
as a whole (thus working collaboratively) or whether the Scrum master is actually taking
more authority over these processes.

Conclusion

Concluding, this study indicates that it seems quite a challenge for software
development teams to actually work according to the Scrum method in order to benefit from
the various advantages it is said to deliver, one of them being increased communication
among team members (Rising & Janoff, 2000) as well as responding to problems without
being limited in the authority to do so (Tata & Prasad, 2004). Therefore, as was reported by
Moe, Dingsoyr & Dyba (2009), it was also indicated by this study that some of the advantages
of Scrum are likely subject to the way in which the teamwork is actually organized and
facilitated. Observations that protruded in this study were most of all the differences in the
ways the different phases of regulation (planning, monitoring & evaluating) and types of
regulation (self-regulation, co-regulation & socially shared regulation) manifested, especially
with regard to the type of meeting held by the teams (stand-ups and retrospectives). Other

protruding observations were that the teams showed mostly socially shared regulation activity as well as the role of the Scrum masters and that there was at least one dominant person showing most of the regulation activities per team in every meeting.

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