

On the Usage and Benefits of Agile Methods & Practices

A Case Study at Bosch Chassis Systems Control

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Abstract. Since software became a major part of the car, we were interested in identifying which agile practices are used and adapted at Bosch automotive. Therefore, we conducted a multi-case study with nine interviews from five Bosch projects. Our results showed a strong focus on Scrum. Most of the Scrum practices are adapted due to the specific project context. Practices from other agile methods, e.g. XP, are used and adapted as well. We further collected the benefits of the practices, most often resulting in improved transparency and planning. The results are used to support automotive projects in selecting and applying agile practices according to their specific process improvement goals.

Keywords: Automotive · Agile practices · Scrum deviations · Case study

1 Introduction

Within software engineering, agile development has shown to be a commonly used approach [8, 9, 12]. Since embedded domains struggle with the integration of different disciplines, e.g. hardware and electronics, there is a lot more communication necessary [11]. These domains are currently using agile only to some extent in order to profit from the benefits of agile development, e.g. shorter time-to-market. This was one of the major reasons for Bosch Chassis Systems Control (CC) to become more agile. Thus, the state of agile in projects is interesting. Knowledge about usage, adaptations of Agile Methods and Practices, and their benefits should help spreading of agile.

2 Chassis Systems Control of the Bosch Group

The division CC is part of the business sector Mobility Solutions of the Bosch Group. The business sector Mobility Solution generated sales of 41.7 billion euros in 2015 (Bosch Group in total: 70.6 billion euros) which makes the Bosch Group to one of the world's largest automotive suppliers. The division CC develops and manufactures innovative components, functions and systems that are designed to make driving a safe and

comfortable experience. The projects of this study are developing systems for (highly) automated driving, e.g. a highway pilot.

3 Study Design

Research Questions. Our objective is to better understand the usage, reasons and adaptations as well as benefits of agile methods and practices within Bosch CC. Thus, we ended up with the following research questions: RQ1 - Which agile elements (incl. agile methods and agile practices [3]) are used? RQ2 - How is the usage of the agile practice deviating from the textbooks? RQ3 - What are the benefits of the agile practices?

Case and Subject Selection. Possible cases (Bosch CC projects) and subjects (interviewees) were identified by Bosch based on the organizational scope and their usage of agility. The latter was mandatory for participation. We identified 15 candidates representing five projects. Nine of the 15 candidates participated, covering all five projects.

Data Collection Procedure. We conducted structured interviews with the participants, seven face-to-face and two via phone. The questions were categorized into (1) introduction, (2) usage and (3) benefits of agile elements (first methods, then practices), and (4) project context. The principal author conducted all interviews as follows: He explained the idea and reason behind this study, the data collection, and the guaranteed anonymity. He asked for used agile methods and agile practices. He discussed about the experienced impacts, mainly benefits of the different elements. During the gathering of the benefits, we were open to any mentioned benefits. If they had no idea, we named potential benefits as triggers. For not biasing them, the interviewees had to give examples for these benefit triggers. We ended up in a coded list of the benefits (cf. Table 2).

Analysis Procedure. We analyzed the notes of the interviews qualitatively. First, we extracted the data from each interview (usage of agile elements, where and how, and their benefits). Second, we compared and aggregated information from interviews related to the same project. Third, we compared the project-aggregated results among each other and with our experience and literature.

4 Results

We covered different team sizes and developed functions and considered different roles of the interviewees: group leaders, department leaders, project leaders/managers (cf. Table 1). Two participants performed the Scrum Master role.

4.1 RQ1: Usage of Agile Methods and Practices

Four Agile Methods were used by the projects: Scrum ($n = 4$ projects), Flow ($n = 2$), iPeP ($n = 1$), and SAFe ($n = 1$). The practices that were used in **all five projects** belong to Scrum, namely Sprint, Backlog, Sprint Planning, and Daily Stand-Ups, although one

Table 1. Project characteristics

Project	Size	Locations	Project phase [6]	Participating roles
P1	60 persons, 7 sub-teams	2 in Germany	Pre-development	system project lead
P2	8 teams	1 in Germany, Europe, Asia each	Pre-development	technical project lead & project lead
P3	33 persons	2 in Germany	Series development	project lead & team lead
P4	8 persons	1 in Germany	Pre-development	Group lead
P5	70 persons	1 in Germany, Europe, Asia each	Pre-development	project lead, SW project lead & department lead

project reported that it is not using Scrum. The practices that were used in **most projects** were Sprint Review, Sprint Retrospective, Burndown-charts, Definition of Done, Scrum Master, and Product Owner (PO) (all Scrum), and User Stories and Epics (both XP). Continuous Integration, Release Planning and Scrum-of-Scrums completed the set. The practices that were used in **few projects** were: Planning Poker and Pair Programming (both XP), 80%-rule and Pull-system (both Lean/Flow), and Backlog Grooming (Scrum). In Table 2, we show the use of agile practices.

Table 2. Benefits of used agile practices on goals (numbers indicate how many projects mentioned a benefit)

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Agile Practice	understandability	knowledge transfer	communication	transparency	feedback	satisfaction	team empowerment	focusing	structuredness	planning	time-to-market	risk management	# adressed benefits	# using projects
Daily Stand-Up		3	5							2			3	4
Sprint				2				1	2	1		1	5	5
Sprint Review	1		2	1						1			4	4
Retrospective		1			1	1							3	4
Sprint Planning						1				4		1	3	5
Backlog	1			2					1	1			4	5
Burndown-Charts				3									1	4
Scrum Master						1	1						2	4
Product Owner				1			1			1			3	4
80%-Rule									1	2		2	3	2
Planning Poker							1			2			2	1
User Stories								1					1	4
Epics										3			1	3
Cont. Integration				2							1		2	3
Scrum-of-Scrums			4	1					1	1			4	3
# practices	2	1	3	8	1	3	3	2	4	10	1	3		

4.2 RQ2: Deviations of Agile Practices

The used practices are now discussed regarding their deviations from existing guidelines, e.g. the Scrum Guide:

The major issue of the **Scrum Master** was the manifestation as “caretaker”, e.g. in one team the Scrum Master was only inviting for the different Scrum meetings. Further, often the Scrum Master was not the only role. Being a project leader or a PO in combination might result in a conflict of interests. The **PO** also deals with the aspect of several roles by one person without problems. But some teams defined an additional “feature responsible”, which covered POs tasks, e.g. breaking down the features into Stories. Finally, within one project, they struggled with the issue of having a Chief-PO communicating with the customer high-level, but not knowing the requirements in detail.

The most deviating aspect of **sprints** was their length. For one project (needing four weeks) more than two weeks were necessary for the integration of hardware aspects. Another one worked with varying lengths over time.

The **Scrum-of-Scrums** meetings conducted weekly by the larger teams or projects was in one case a team-meeting in which all project members participated. In another case, it was conducted by the project lead to keep the offshore team on track.

The **Daily Stand-Ups** deviated in three different aspects: (1) Usage only for status-tracking purpose, (2) Meetings lasting up to one hour, (3) Frequency of the meeting: Instead of every day, teams conducted it every other day, every three days, once a week, or irregularly. An extended duration of the meeting (one hour) was the consequence.

Sprint Planning: Within the sprint shift (Review, Retrospective, and upcoming Planning), most of the teams performed all three meetings en-block in about three days. In one of the larger teams, they found a solution to break down the Backlog to the teams by the PO. The planning itself was conducted within the single teams without the PO.

Sprint Review: The composition of meeting participants ranged from meetings without the customer and only with the team leaders and functional owners up to an “open event”. Some meetings were unstructured without agenda or open topic list. Others were not conducted as an “acceptance meeting” with stakeholders or PO.

Sprint Retrospective: This meeting varied within the timing: One team performed it every other sprint, because two weeks were too short to resolve impediments. Another team directly resolved smaller impediments during the meetings. One interviewee mentioned that the retrospective was only weakly defined and valued within their team.

Within the **Backlog**, two major variations existed: Some included prioritization, whereas other did not. Different backlogs were used, from team-, project- or overall backlogs up to release backlogs. These kinds also contained various backlog items, e.g. User Stories vs. Epics. Two teams did not use **User Stories** as prescribed by the given templates, since they were not used to it and needed more information.

Planning Poker: One team used this practice for estimating the granularity-level to refine the story or not. Furthermore, not all teams used “story points” as values, but e.g. person hours or days. Finally, one deviation was that in one team just the “key player” (a senior developer or feature responsible) decided on the estimation value.

Within the **80%-Rule**, one interviewee mentioned that they are not considering it for the workload, but on their throughput. In the only case using the **pull-principle**, the

responsibility regarding the different functions was clear such that it was “obvious who is going to pull what”. Thus, sometimes one team member just “assigned” the tasks.

4.3 RQ3: Benefits of Agile Practices

Most of the considered agile practices are beneficial for *planning* (10 practices) and *transparency* (8), followed by *structuredness* (4), *communication*, *risk management*, *satisfaction*, and *team empowerment* (each 3). Checking the overall number of addressed benefits per practice (cf. Table 2), e.g. the highest with five is the sprint, three yield four benefits, and five yield three benefits.

Except for the Definition of Done and the Backlog Grooming, we could gather at least one impact for each of the Scrum practices. Considering the Scrum meetings, except the retrospective, all impact *planning*. Sprint Review as well as the Stand-Ups also influence *communication* and *transparency*. The Sprint Retrospective was the only practice dealing with *feedback* and *knowledge transfer*. The Burndown-Chart is a quite good mechanism for *transparency*. Both Scrum roles impact the *team empowerment*. The improved *satisfaction* resulting from the Scrum Master correspond with that. The PO provides *transparency* as well as *planning* aspects. Considering the Non-Scrum practices, there is information about the impact of six practices: *Risk management*, *planning* and *structuredness* were impacted by the 80%-Rule. Planning Poker increases *planning* and *team empowerment*. User Stories and Epics influence *planning* (Epics) or *focusing* (User Stories). Continuous Integration improves *transparency* and *time-to-market*. Finally, Scrum-of-Scrums was quite good for *communication* and it affects *transparency*, *structuredness*, and *planning*.

5 Related Works and Discussion

Distribution/Frequency of Agile Practices. Within VersionOne [12], the most used agile practices were Daily Stand-Ups, prioritized Backlogs, short Iterations (=Sprints), Retrospective, Iteration Planning, and Release Planning. All of them were used by at least one project, except for the Release Planning. For the other practices mentioned by [12], there are some differences: The Sprint Reviews are used less often than in our study, whereas, Continuous Integration is more common. Focusing on agile practices, Kumos [9] reports that almost all of the top six used agile practices are Scrum practices, all used by the Bosch projects. Scrum is also the prevalent agile method in automotive [8]. Similar to our results, the Planning, Daily Stand-Ups, Review, and Retrospective are used. We cannot confirm that the Sprint Review is used less often. In our study it was the Retrospective.

Deviations of Agile Practices. A prior study on Scrum variations [1] showed similar patterns, with the Scrum Master and PO given to people already owing a role, e.g. developer or team lead. However, within our cases most of the Scrum roles were staffed. Considering the 15–30 min of the Daily Stand-Ups, this timeframe is exceeded by some cases and extended up to one hour. The frequency deviation of the Stand-Up is also

common [1]. For the sprint length variance from two to four weeks could be confirmed. Only one project reasonably decided to have four weeks due to synchronizations of teams and disciplines such as hardware and software.

Benefits of Agile Practices. Considering the benefits reported by [12], we see some similarities: The benefits *increased team productivity, improved project visibility, increased team moral/motivation, better delivery predictability, and reduced project risk* can directly be mapped to the ones reported to us. In contrast, the benefits dealing with engineering and quality, such as *enhancing software quality, software maintainability, or improving engineering discipline*, were not mentioned within our interviews. Compared to [9], five of nine benefits were also mentioned by our participants: *transparency, customer orientation, timing, teamwork, and employee motivation*. The results of [9] (similar to [12]) additionally showed *quality* as highly impacted, not indicated by our results.

Besides these studies, there are some practices studied in detail with their different impacts, e.g. User Stories [4], Planning Poker [5] or Pair Programming [7]. Furthermore, some studies analyzed which agile practice influence one specific benefit, e.g. [10] dealing with communication: Daily Stand-Ups improve *communication and transparency*, due to keeping developers, project leaders, and customers aware of the status. Iteration Planning created awareness of the *project plan* and iteration goals, whereas the Retrospective was a good way for working on *process improvement*. Even if we consider the benefits on a more fine-granular level, the results confirm each other.

6 Validity of the Results

An interview guideline and data collection sheet eased aggregation and comparisons. The guideline reduced the risk of misinterpretation and increased the objectivity. We could not recognize any misunderstanding, since all interview participants were aware of the common concepts, methods and practices. Additionally, we experienced that assuring anonymity led the interviewees to answer openly. Regarding the interviewed people within a project, we selected independent ones (not from the same team). Thus, our data is a representative sample of agile development in the area of autonomous driving. Within the data analysis, the aggregation of interview data within one project was the most difficult and error-prone, because of considering different project roles and teams with their viewpoints into one data set. The IESE and Bosch team discussed the aggregated results involving colleagues for an external point of view. We provided a summary report of the results via e-mail and gathered the feedback. We also performed a presentation and discussion session with all participants. That our qualitative results from Bosch CC are in line with most of the related work is another strong indicator for their validity.

7 Conclusions and Future Work

Within this paper, we present the results of an interview series covering five different automotive projects at Bosch CC with overall nine interviews on the topic of usage, deviation, and benefits of single agile practices.

The usage of agile methods as well as the underlying agile practices shows a similar picture as common studies. The most commonly used method is Scrum, which is adapted and extended by other practices. There seem to be similar variations of agile practices in the automotive domain as in information systems. Our study could confirm some of the benefits mentioned by other agile surveys, and could provide further answers to the question, which agile practice provides what specific benefits, and furthermore, that agile practices overall are most beneficial for *transparency* and *planning*.

Within future work, we intend to use the elicited data to instantiate the Agile Capability Analysis [2] for Bosch CC, a goal-oriented SPI approach using agile practices. The next step will be the integration of A-SPICE® and connection to the agile practices.

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