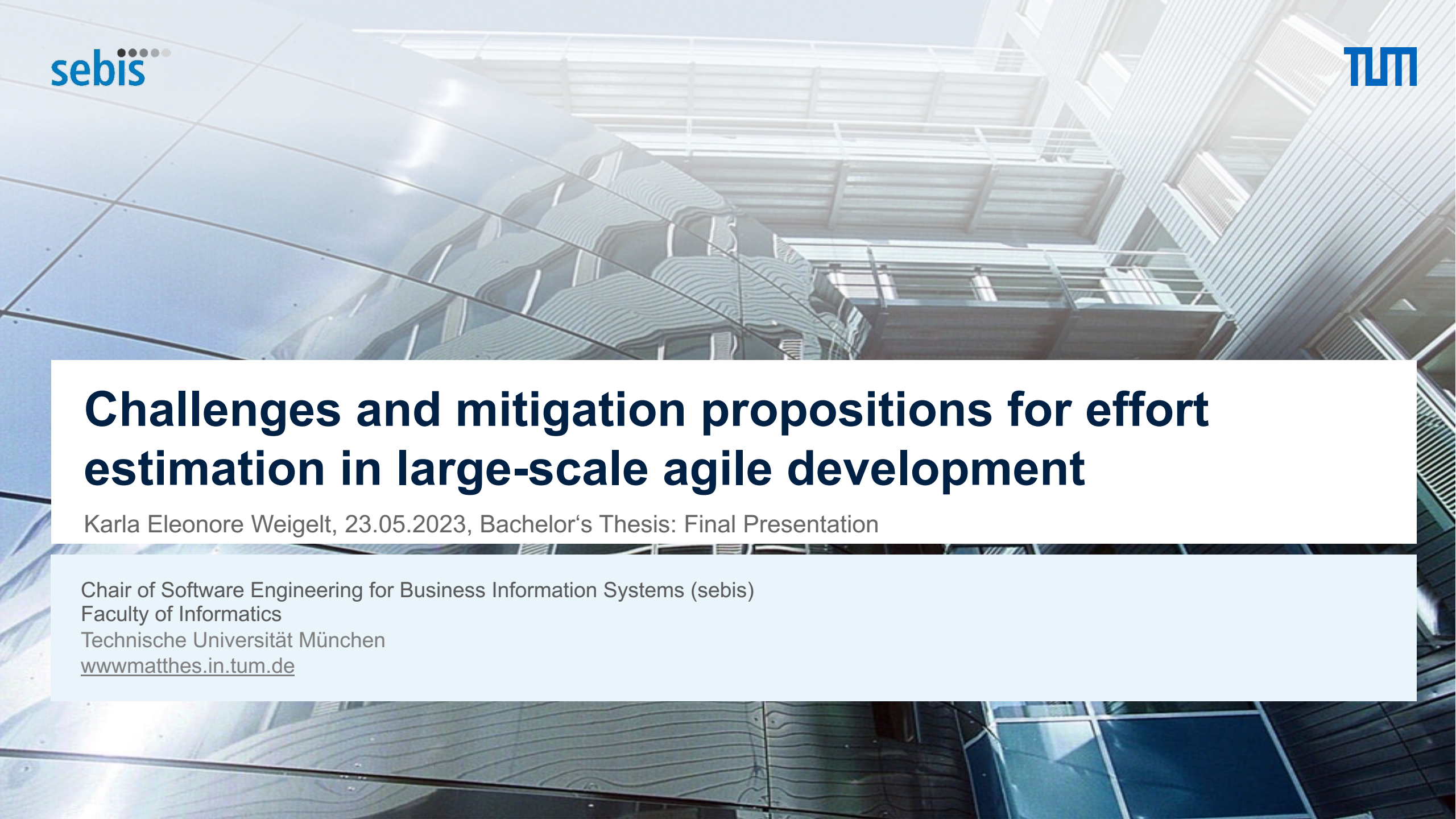

Challenges and mitigation propositions for effort estimation in large-scale agile development

Karla Eleonore Weigelt, 23.05.2023, Bachelor‘s Thesis: Final Presentation

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Outline

Introduction (1/2)

Increasing popularity in applying agile methods at **large-scale**

Digital.ai.16th State of Agile Survey (2022), Dikert et al. (2016)

Increasing **complexity** of projects & **challenge** of maintaining oversight

Dikert et al. (2016), Nerur et al. (2005)

Accurate predictions

Accurate predictions to support tracking the project's progress

Heemstra (1992), Kula (2021), Usman et al. (2018)

Cost and effort estimations are essential to prevent project failure due to time or cost overruns

E. Kula (2021)

Success or failure of a project depends on the accuracy of the estimates

Fernández-Diego et al. (2020), Khuat and Le (2016), Munialo and Muketha (2016)

Accurate predictions have great potential to support project success in large-scale agile development

Kula (2021), Fernández-Diego et al. (2020), Khuat and Le (2016), Munialo and Muketha (2016), Usman et al. (2018)

Introduction (2/2)

Challenges in making accurate estimations

- Estimation is **error-prone** (e.g., due to human biases) - *effort and cost estimate errors may lead to a project failure regarding delivery time or budget*
- **Integrating the effort estimation process** into large-scale agile environments poses a challenge
- Many **cost factors** (e.g., team-related, temporal, geographical, and cultural factors) affecting the effort estimation

- **Little research on effort estimation and challenges in scaling agile environments**
- **Lack of guidance on on how to conduct effort estimation in scaling agile environments**

Goal of the thesis to tried to fill this research gap

Kula et al. (2021), Usman et al. (2018)
Fernández-Diego et al. (2020)
Britto et al. (2014), Popli and Chauhan (2014)
Lagerberg at al. (2013), Coelho and Cao (2008), Sandeep et al. (2022)

Outline

Introduction

Research methodology

Results of the case study

Evaluation

Key findings and future work

Research methodology - research questions

RQ1	How is effort estimation conducted in the case organization?
RQ2	What are challenges in effort estimation in scaling agile environments?
RQ3	How can these challenges in effort estimation in scaling agile environments be addressed?

Research methodology - research approach

16 semi-structured interviews

Yin (2014), Runeson & Höst (2009)

3 semi-structured evaluation interviews

9 evaluation Surveys

Yin (2014), Runeson & Höst (2009)

Action Design Research

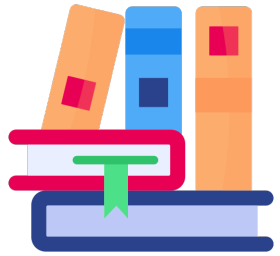
Sein et al. (2011), Hevner et al. (2004)

Problem formulation

Artefact building & evaluation

Artifact
Set of challenges and mitigation propositions

Reflection & learning



Literature and related work

- Effort estimation in agile/ large-scale agile development
- Effort estimation in agile standard software implementation
- Challenges and mitigation propositions in effort estimation

Basten and Sunyaev (2011), Bick et al. (2016), Bick et al. (2017), Coelho and Basu (2012), *Evbota et al. (2016),* ***Hacaloglu and Demirörs (2018), Hill (2011),*** *Madanian et al. (2021),* ***Mallidi and Sharma (2021), Ömüral and Demirörs (2017), Power (2011), Tanveer et al. (2016), Tanveer et al. (2017), Tareq (2016), Usman et al. (2018), Usman et al. (2015),*** *Ziauddin et al. (2012)*

* Literature marked bold was used for the identification of the mitigation propositions

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The case organization

16 Interviews with **20 Experts** from the case organization

The network and infrastructure company:
- **12 experts** in roles as Developer, Product Owner, Product Manager, and Solution Architect
- Between **1 – 10 years of experience in large-scale agile development**

The software company:
- **6 experts** in roles as Program Manager, Solution Architect, Product Manager, and Scrum Master/Agile Coach
- Between **3 – 10 years of experience in large-scale agile development**

The consulting firm :
- **2 experts** in roles supporting the Project Management Office (PMO)
- Between **6 – 10 years of experience in large-scale agile development**

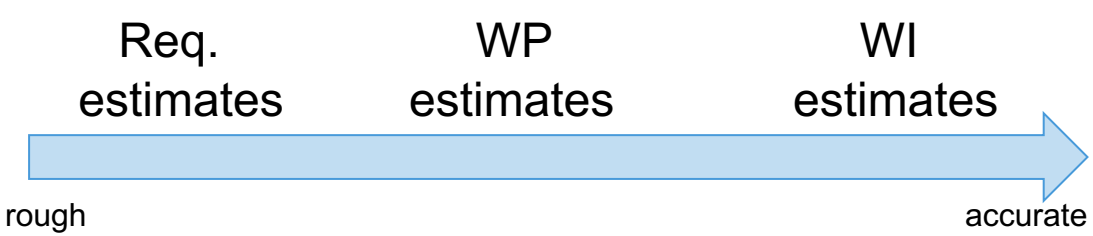
Results of the case study – the effort estimation process

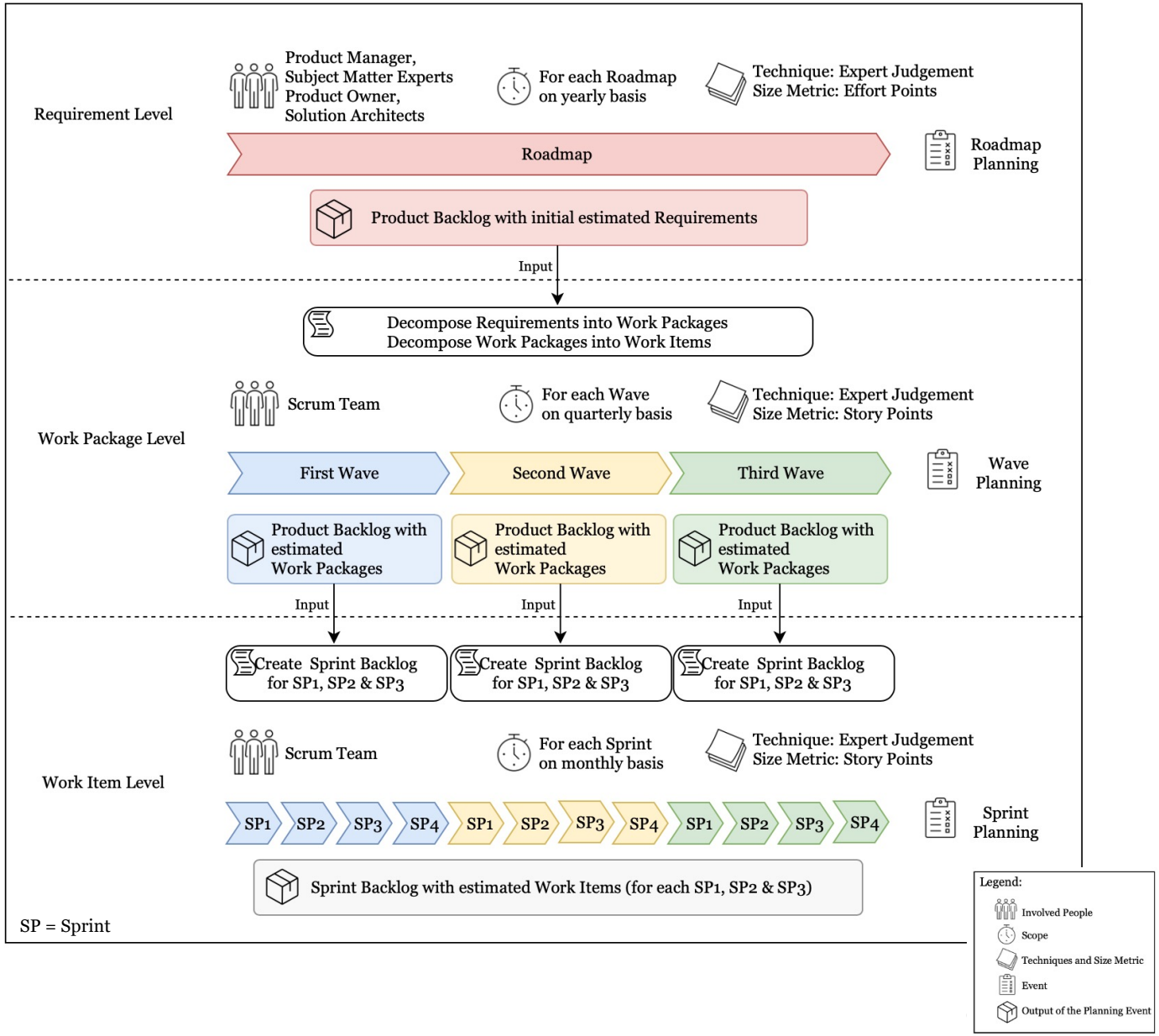
RQ1: How is effort estimation conducted at the case organization?

Effort estimation on three levels:

- Estimates on Requirement level (highest level estimates)
- Estimates on Work Package level (middle level estimates)
- Estimates on Work Item level (lowest level estimates)

Accuracy of estimates increased with the information available:





Results of the case study - the challenges

RQ2: What are challenges in effort estimation in scaling agile environments?

25 challenges devided into **four categories**

Program Setting

C1: Project setting
C2: Time restrictions
C3: Unclear responsibilities
C4: Pressure and control by management
C5: Lack of measures to improve estimations
C6: Inapproriate tool support
C7: Monitoring of estimations and actual efforts
C8: Difficulties to estimate in story points units

Collaboration

C9: Lack of team commitment
C10: Lack of knowledge about contact partners
C11: Efficient communication despite spatial distribution and language barriers
C12: Having a correct and common understanding of requirements
C13: Difficulty to estimate additional overhead
C14: Considering dependencies

Expertise

C15: Subjectivity of estimates
C16: Lack of experts involved in estimates
C17: Lack of involvement of experts in top-level estimations
C18: Lack of knowledge and experience regarding effort estimation
C19: Neglection of relevant factors when estimating
C20: Adjustment of effort estimates

Uncertainties and Information Deficit

C21: Information deficit in the initial estimation of large, complex requirements
C22: Information deficit regarding new requirements
C23: Unclear and incomplete specification of the requirements
C24: Missing knowledge about resources in terms of people involved in the implementation
C25: Unforeseen changes

* Challenges marked in bold are based on agile values and principals

Results of the case study – the mitigation propositions

RQ3: How can these challenges in effort estimation in scaling agile environments be addressed?

21 mitigation propositions

M1: Adding a buffer to estimations in case of uncertainty

M2: Additional phase before the implementation phase to check requirements in detail (feasibility and quality)

M3: Cultivation of a dependency list

M4: Deep dive sessions and workshops to clarify requirements and needed resources

M5: Early and continuous communication between all levels

M6: Events to recap on learning and document those

M7: Guidelines and standard estimates for tasks uniform across all teams

M8: Consider additional effort regarding organizational and process factors during estimation

M9: Include people with experience in estimating effort and reacting to unforeseen in the estimation process

M10: Measures to convince the team that effort estimation is a group/team activity

M11: Normalization of story points (to person days)

M12: Plan requirements for an appropriate time frame to improve the accuracy of estimates

M13: Platforms and meetings to identify and discuss dependencies

M14: Reduce time tracking pressure for employees

M15: Support and motivation by Scrum Masters and Agile Coaches

M16: Tool support to automate the estimation process

M17: Tool/feature to support the estimation process

M18: Tracking of actual efforts

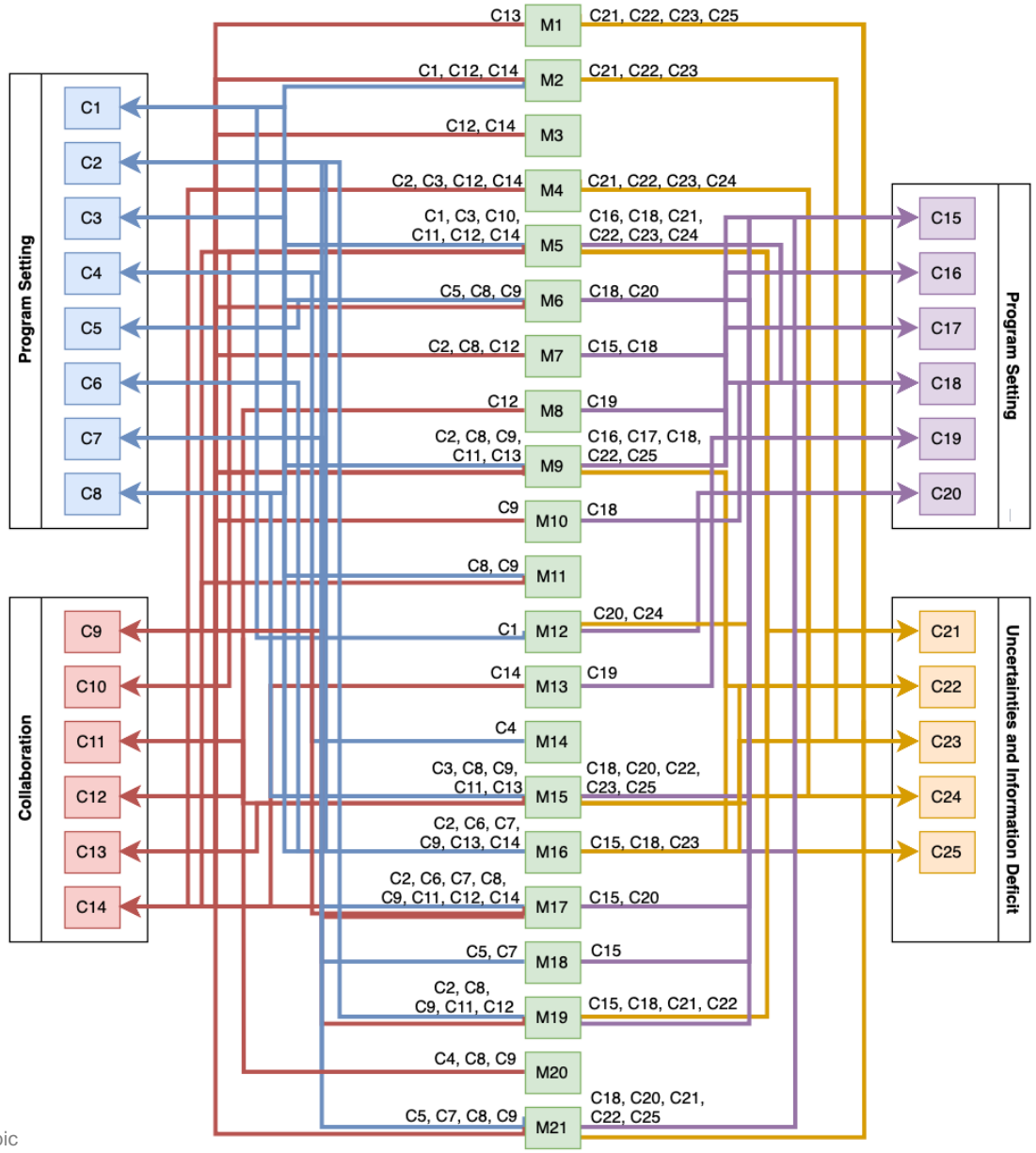
M19: Use of supporting techniques during the estimation process

M20: Use T-Shirt size as an estimation unit to avoid difficulties to estimate in story points and trust the team more

M21: Use agile metrics and store estimates for improvement and future use

* Mitigation Propositions marked in bold are based on agile values and principals

Results of the case study – mapping of challenges to mitigation propositions



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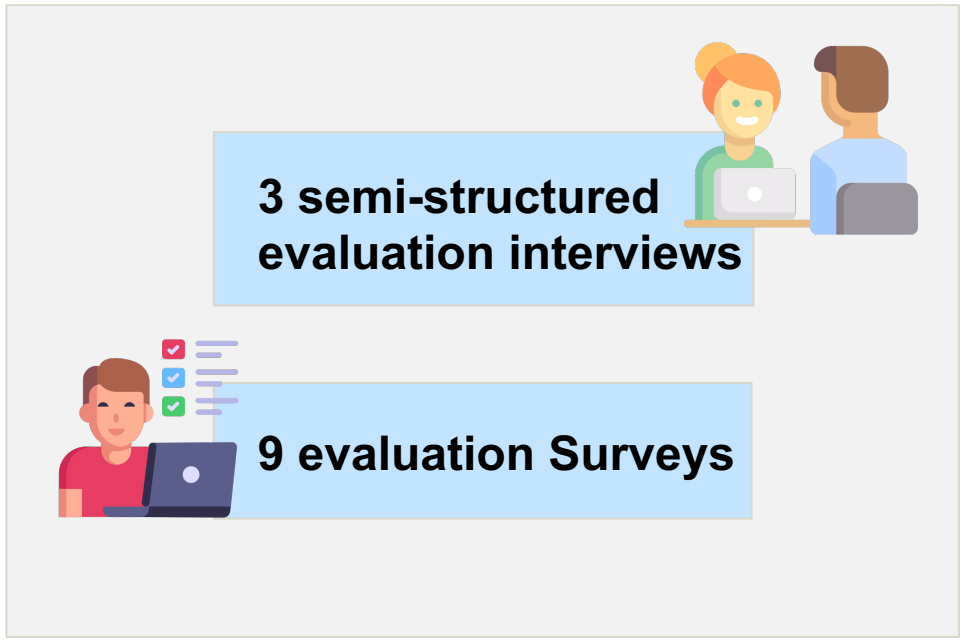
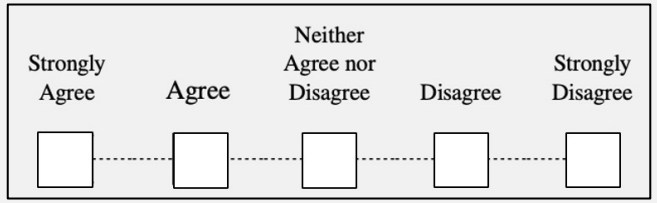
Evaluation

Objective of the evaluation

- Assess the relevance of the identified challenges
- Assess the usefulness of the propositions to mitigate challenges
- Collect improvement suggestions and feedback from the experts



- Likert scale rating

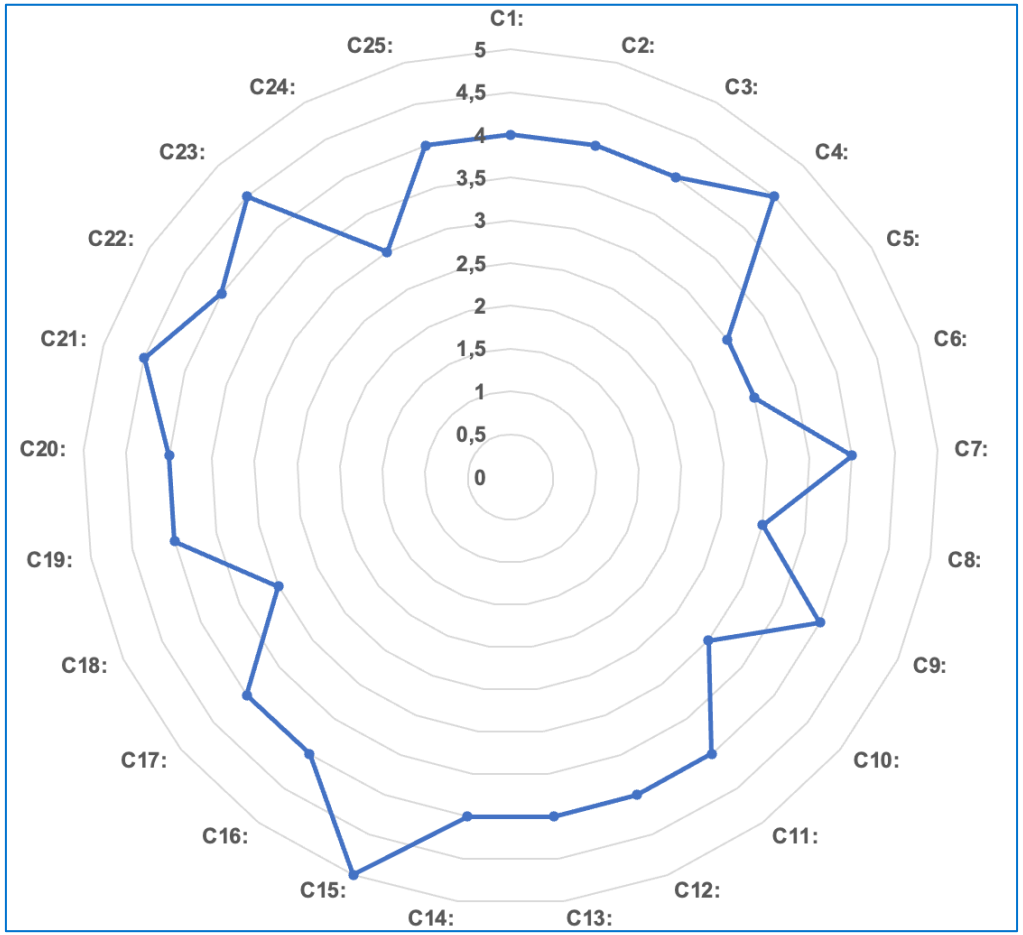


Likert (1932)

- Textboxes for qualitative improvement suggestions and feedback

Evaluation – the challenges

To what extent do you agree that the challenge below is a challenge in the context of effort estimation?



Median
5 = Strongly agree 1= Strongly disagree

No challenge was rejected

Worst median of a **value of 3**, e.g.:

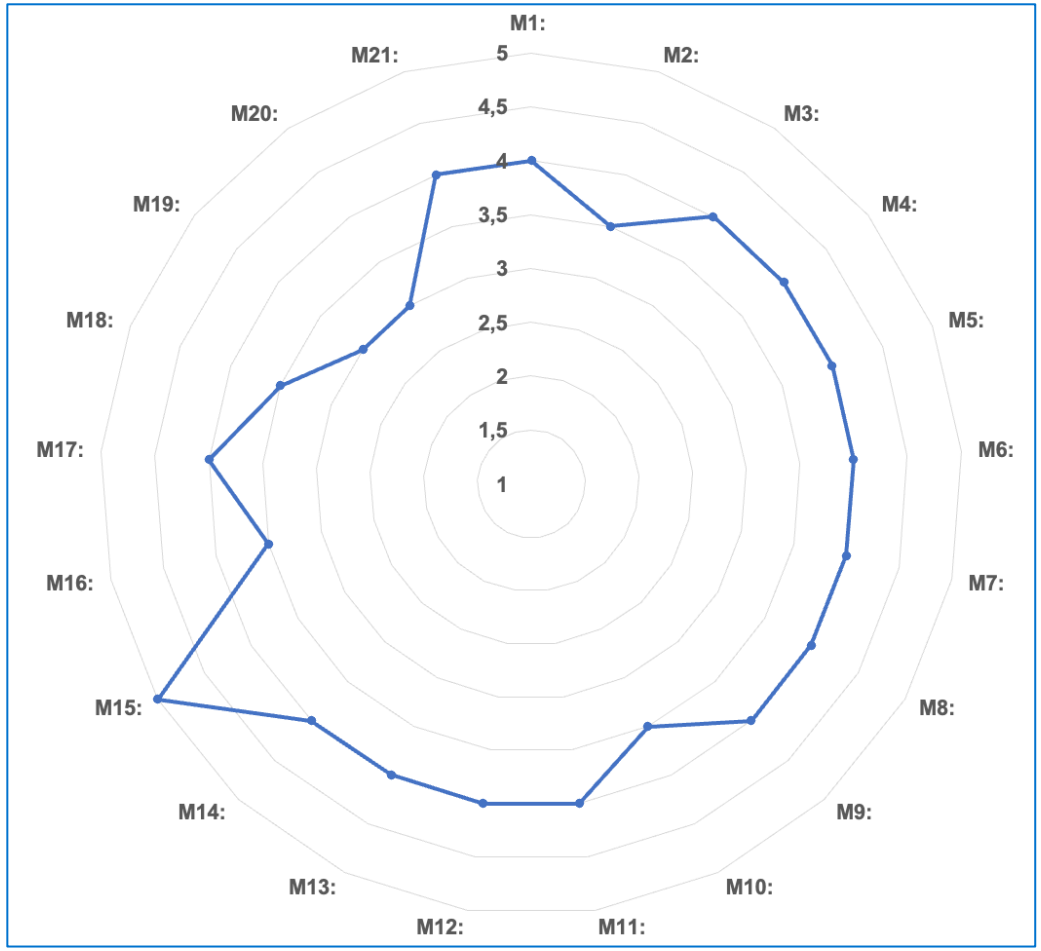
- **C18: Lack of knowledge and experience regarding effort estimation**
- **C24: Missing knowledge about resources in terms of people involved in the implementation**
- **C8: Difficulties to estimate in story point unit**

Best median of a **value of 5**:

- **C15: Subjectivity of estimates**

Evaluation – the mitigation propositions

To what extent do you agree that the mitigation proposition below is a proposition to mitigate challenges in the context of effort estimation?



Median
5 = Strongly agree 1= Strongly diagree

No mitigation proposition was rejected

Worst median of a **value of 3**:

- **M19: Use of supporting techniques during the estimation process**
- **M20: Use T-Shirt size as an estimation unit to avoid difficulties to estimate in story points and trust the team more**

Best median of a **value of 5**:

- **M15: Support and motivation by Scrum Masters and Agile Coaches**

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Introduction

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Key findings

Within the case organization, **effort estimation is performed at three levels**, with the **accuracy** of the estimates **increasing** from highest level to lowest level estimates

Dependencies between teams/workstreams are **difficult to manage** and **remain one of the biggest challenges** in effort estimation in scaling agile environments

Unclear and incomplete functional description of requirements **lead to significant challenges** in effort estimation

Support and motivation by Scrum Masters/Agile Coaches is assessed as good proposition to mitigate challenges in effort estimation

Future work

Further enhancement of mitigation propositions
- Apply the identified propositions in practice
- Investigate the application

Further investigation on challenges and mitigation propositions in effort estimation in large-scale agile development

Generalization of the results

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Icons: https://www.flaticon.com/de/suche/2?word=agile&color=gradient&order_by=4 (Last Access 21.05.2023)

Overview of the interview participants and the companies

Alias	Company	Role	Experience in agile software dev. (years)		Experience in large-scale agile software dev. (years)		Duration (h:m)
			Expert	Company	Expert	Company	
SM1	SoftwareCo	Agile Coach and Scrum Master	6 - 10	6 - 10	6 - 10	6 - 10	0:39
PJM1	SoftwareCo	Project Manager	6 - 10	16 - 20	6 - 10	16 - 20	0:50
SolAr1	SoftwareCo	Solution Architect	3 - 5	16 - 20	3 - 5	16 - 20	0:45
Dev1	NetInfrCo	Developer	1 - 2	6 - 10	1 - 2	3 - 5	0:45
PO1	NetInfrCo	Product Owner	1 - 2	3 - 5	1 - 2	3 - 5	0:44
PO2	NetInfrCo	Product Owner	3 - 5	6 - 10	3 - 5	6- 10	0:31
PM1	SoftwareCo	Product Manager	6 - 10	6 - 10	3 - 5	6 - 10	0:44
PMO1	ConsultCo	PMO	11 - 15	11 - 15	6 - 10	11 - 15	0:40
PO3	NetInfrCo	Product Owner	6 - 10	6 - 10	6 - 10	6 - 10	0:38
Dev2	NetInfrCo	Developer	3 - 5	3 - 5	3 - 5	3 - 5	0:27
SM2	NetInfrCo	Scrum Master	6 - 10	6 - 10	3 - 5	6 - 10	0:29
BC1	NetInfrSubCo	Business Contact	1 - 2	> 20	1 - 2	> 20	0:48
SolAr2	SoftwareCo	Solution Architect	3 - 5	> 20	3 - 5	> 20	0:43
PMO2	ConsultCo	PMO	6 - 10	> 20	6 - 10	11 - 15	0:38
SolAr3	SoftwareCo	Solution Architect	11 - 15	11 - 15	6 - 10	6 - 10	0:47
PM2	NetInfrCo	Product Manager and Product Owner	6 - 10	6 - 10	6 - 10	6 - 10	0:47
BPE1	NetInfrCo	Business Process Expert, Test Coordinator, and Training Coordinator	3 - 5	6 - 10	3 - 5	6 - 10	0:47
SolAr4	NetInfrCo	Solution Architect	6 - 10	3 - 5	6 - 10	3 - 5	0:45
PM3	NetInfrCo	Product Manager	3 - 5	6 - 10	3 - 5	6 - 10	0:45
SM3	NetInfrCo	Scrum Master	6 - 10	6 - 10	6 - 10	6 - 10	0:45

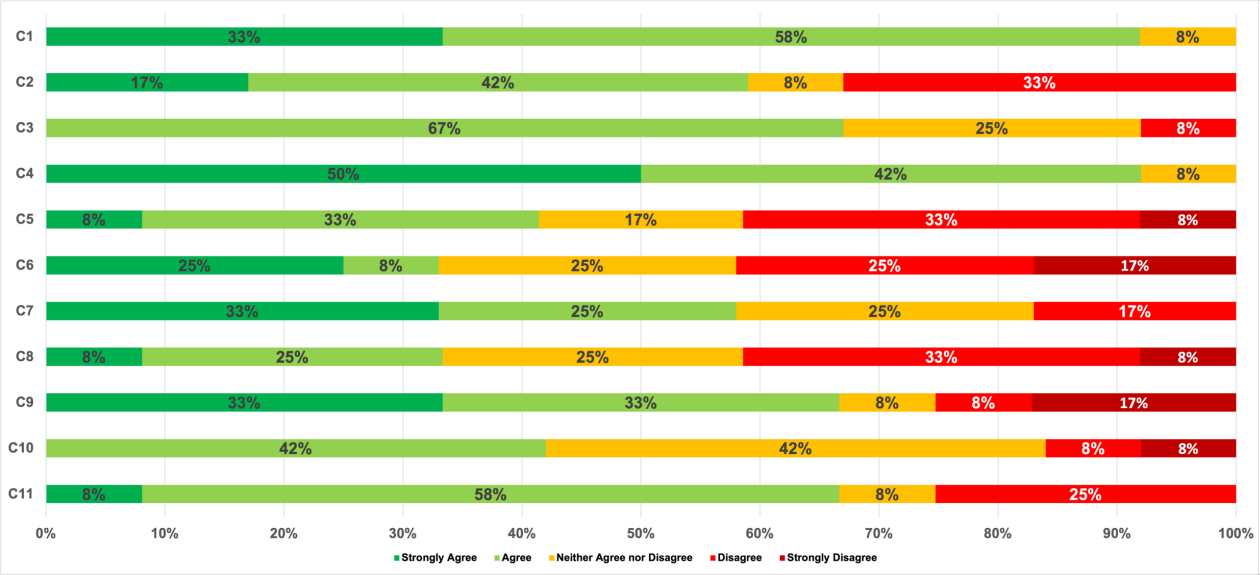
The artifact – set of challenges and mitigation propositions

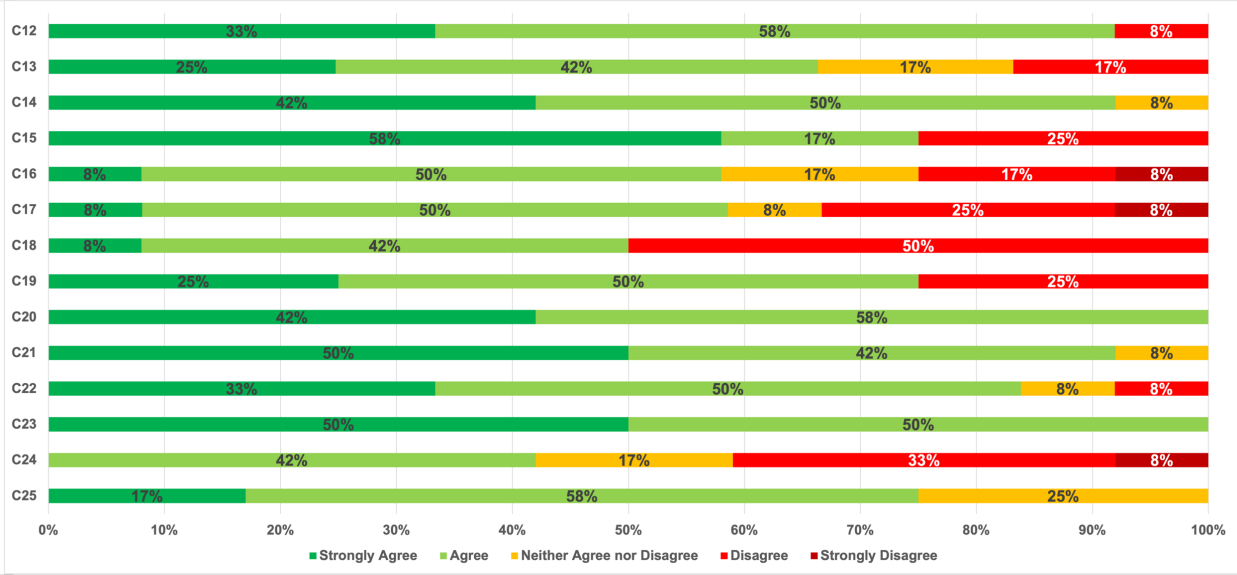
The artficat - set of challenges and mitigation propositions for effort estimation in large-scale agile development

Overview of the evaluation participants

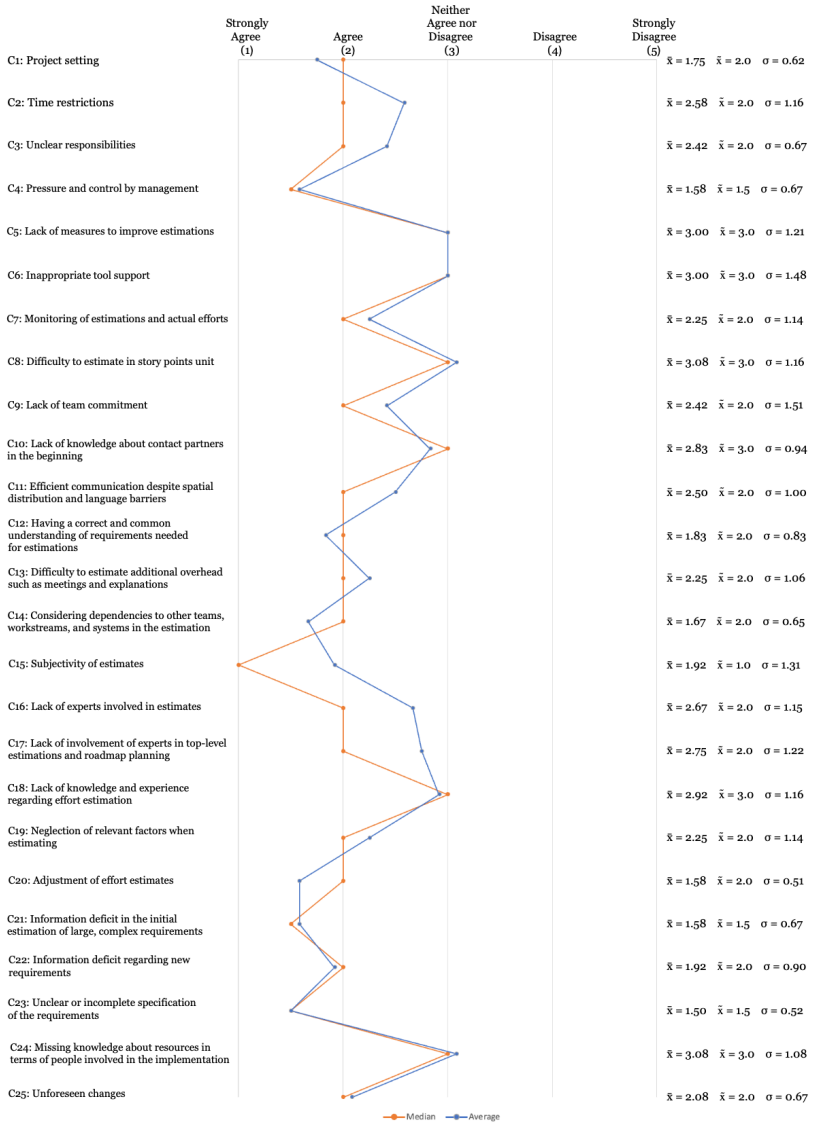
No.	Role	Alias	Experience in agile software development (years)	Interview (Duration h:m) \Online-Survey
1	Project Manager	PJM1	6 - 10	Interview (0:58)
2	Solution Architect	SolAr1	3 - 5	Interview (0:51)
3	PMO	PMO1	6 - 10	Interview (0:36)
4	Scrum Master	SM1	6 - 10	Online Survey
5	Agile/Scrum Coach	AC1	6 - 10	Online Survey
6	Product Owner	PO1	3 - 5	Online Survey
7	Product Owner	PO2	3 - 5	Online Survey
8	Solution Architect	SolAr2	3 - 5	Online Survey
9	Solution Architect	SolAr3	11 - 15	Online Survey
10	Product Owner	PO3	3 - 5	Online Survey
11	Product Manager	PM1	16 - 20	Online Survey
12	Agile/Scrum Coach	AC2	11 - 15	Online Survey

Evaluation – The challenges

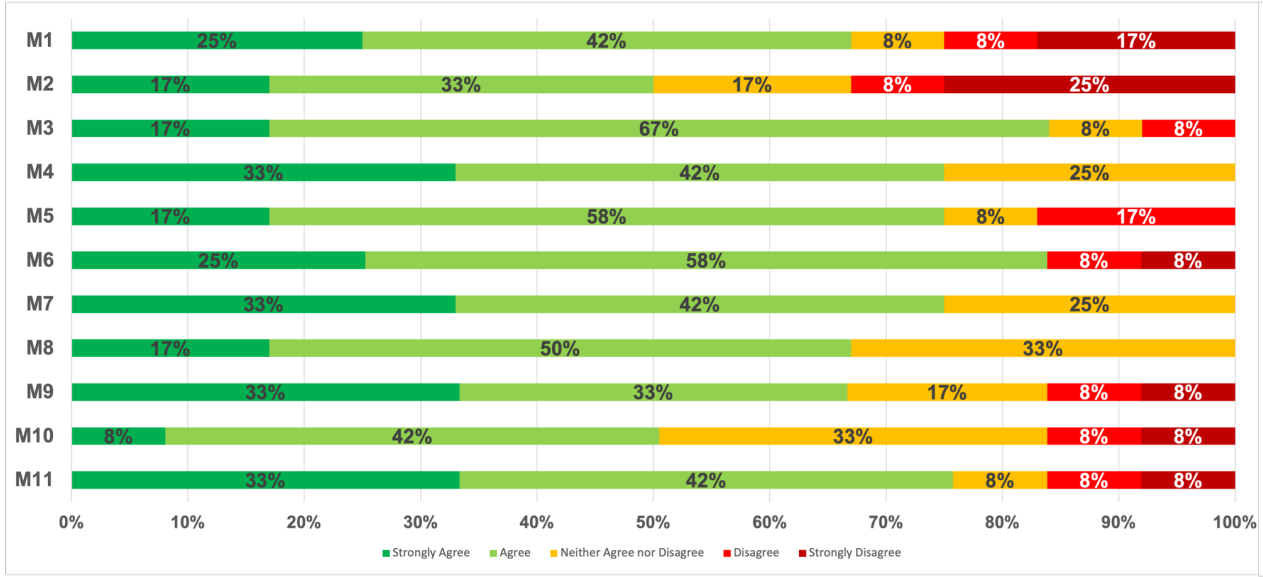


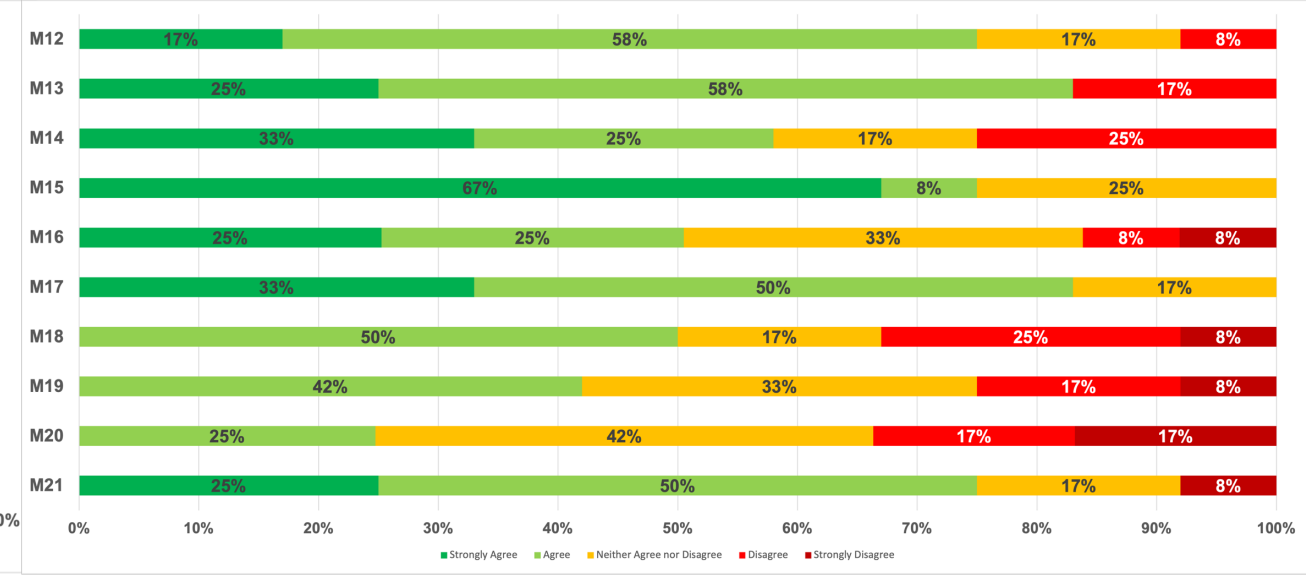


Evaluation – the challenges



Evaluation – the mitigation propositions





Evaluation – the mitigation propositions

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