Identification of collaborative CAD modelling patterns in product development projects

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Introduction

New developments to computer-aided design (CAD) software transform a once solitary modelling task into a collaborative one. To identify the advantages and disadvantages of the new way of working, it is crucial to follow the modelling process in this context. This research project proposes a methodology that, based on non-invasive work monitoring, enables the study of collaborative modelling in a CAD environment, and thus the identification of patterns.

Methodology

Within the methodology, classification of CAD actions is proposed, which serves as a basis for analysis by enabling the **conduction of the analysis on multiple levels of granularity**.
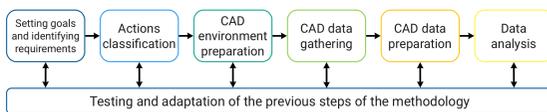
To support the methodology, computer code has been developed that **categorizes and analyzes identified CAD actions**. The methodology was validated by conducting a case study that included 14 development teams, which performed 91877 CAD actions within the development project.

Case study

The objective of the development project was to design a functional 3D CAD model of different types of baby strollers using *Onshape*.

User actions were then gathered using *Onshape Analytics* in the form of an audit trail.

| Time	Document	Tab	User	Description
08.12.2021 12:46	Sklop mehanizam	N/A	fc214567@stud.fsb.hr	Cancel Operation
08.12.2021 12:45	Sklop mehanizam	Assembly 1	fc214567@stud.fsb.hr	Insert feature : Fastened 8
08.12.2021 12:45	Sklop mehanizam	Assembly 1	fc214567@stud.fsb.hr	Add assembly feature
08.12.2021 12:44	Sklop mehanizam	Assembly 1	fc214567@stud.fsb.hr	Add assembly feature
08.12.2021 12:44	Sklop mehanizam	Assembly 1	fc214567@stud.fsb.hr	Insert feature : Fastened 7
08.12.2021 12:44	Sklop mehanizam	Assembly 1	fc214567@stud.fsb.hr	Insert feature : Mate connector 5
08.12.2021 12:44	Sklop mehanizam	Assembly 1	fc214567@stud.fsb.hr	Add assembly feature
08.12.2021 12:43	Sklop mehanizam	Assembly 1	fc214567@stud.fsb.hr	Add assembly feature
08.12.2021 12:43	Sklop mehanizam	Assembly 1	fc214567@stud.fsb.hr	Insert feature : Mate connector 4
08.12.2021 12:43	Sklop mehanizam	Assembly 1	fc214567@stud.fsb.hr	Insert feature : Mate connector 3
08.12.2021 12:43	Sklop mehanizam	Assembly 1	fc214567@stud.fsb.hr	Add assembly feature

Furthermore, CAD data was then read and filtered in order to conduct a data analysis.
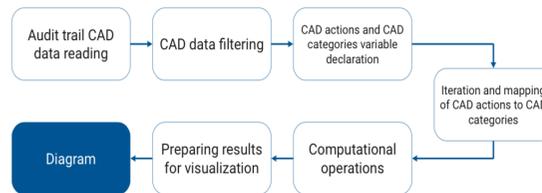
Results

The results show the following:
- Teams with less CAD activity generate CAD models of poorer **quality** compared to teams with more activity performed.
- Teams that generated better quality CAD models recorded a higher **ratio of CAD modification and deletion actions**.
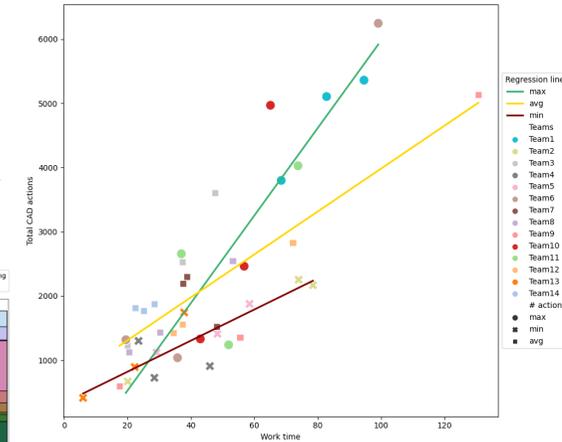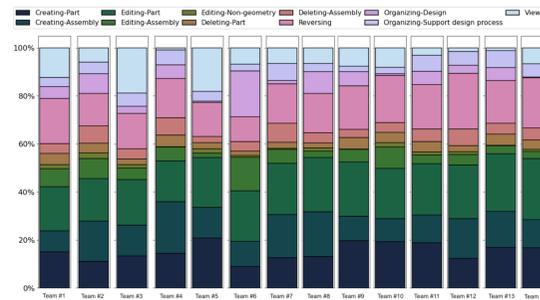
- During modelling, teams decrease the number of CAD creation and modification actions at the **component level**, while increasing the activity at the **assembly level**.
- In the context of **team efficiency**, it was found that teams that generated better quality CAD models performed **more CAD actions** in a **shorter time frame** than teams with less CAD activity.
- However, some teams were not as coherent as others in terms of **workload distribution**. Namely, teams have shown differences in **individual contributions**.

- Finally, individuals which performed more CAD actions also tended to use a **wider range of CAD actions**. In addition, it was registered that they used **advanced CAD actions** (*branching, versioning and editing in context*) offered by *Onshape* exclusively.

Conclusion

The presented results allow development teams to better understand collaborative CAD modelling while the validated methodology provides researchers with a basis for analyzing CAD actions to understand collaboration and approach modelling during development projects.

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