DATA-DRIVEN DECISION SUPPORT SYSTEMS FOR PRODUCT DEVELOPMENT – A DATA EXPLORATION STUDY USING MACHINE LEARNING

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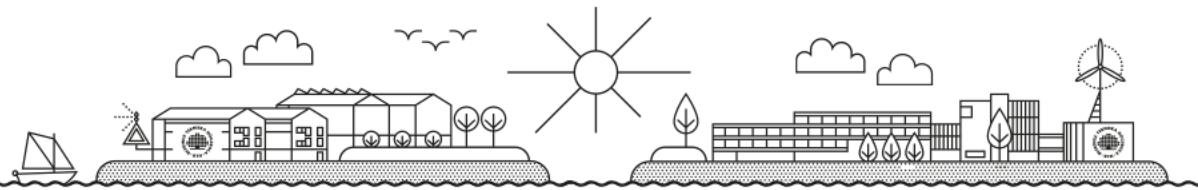
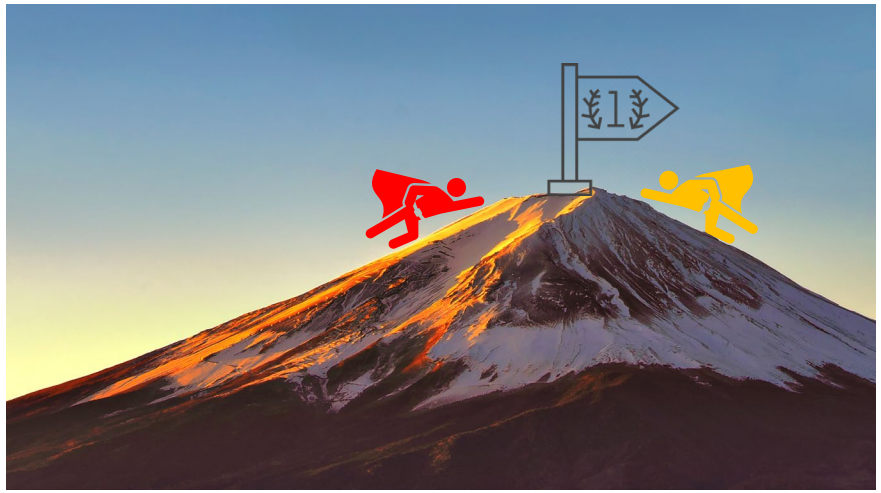
PRODUCT DEVELOPMENT
RESEARCH LAB

CONTEXT

Background Concepts



COMPLEX SYSTEMS



Mechanical

Product-Service System

Sensors

Mechatronics

PRODUCT DEVELOPMENT

- Transforming data into information for commercial production.

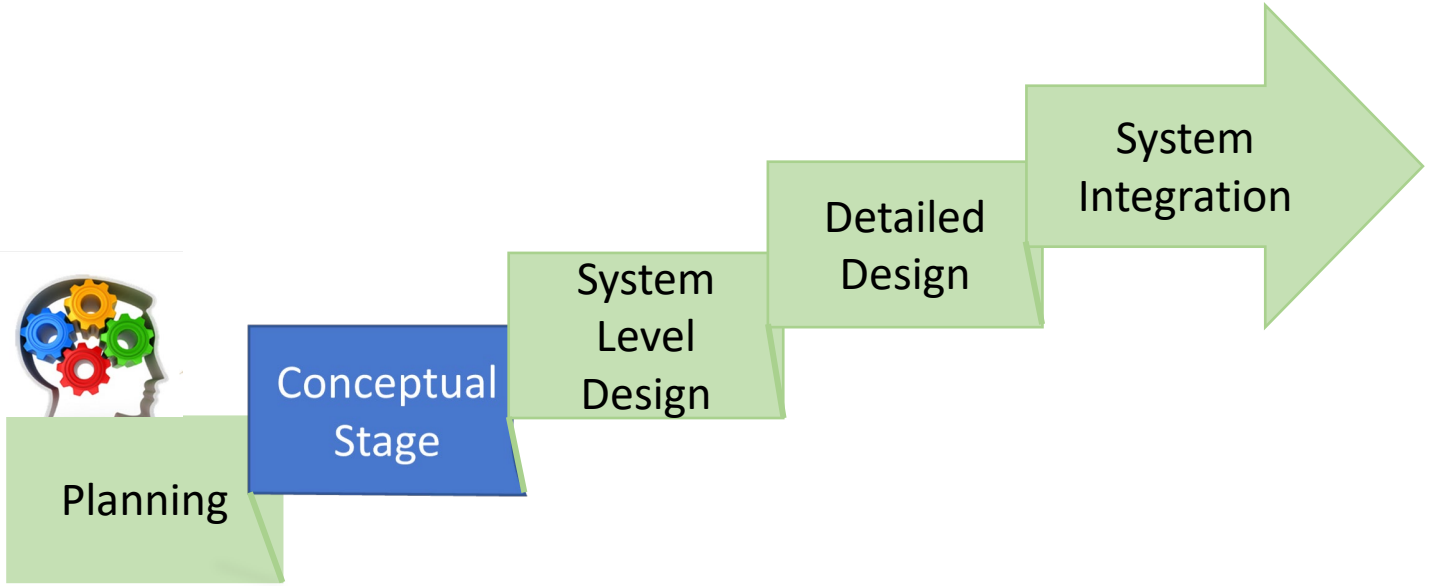


Figure 1. Product Development Process, adopted from (Ulrich and Eppinger, 2004)

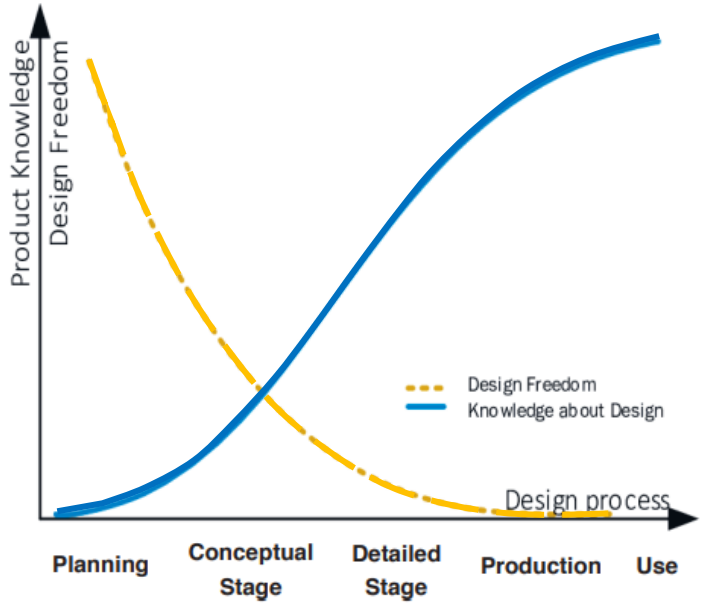
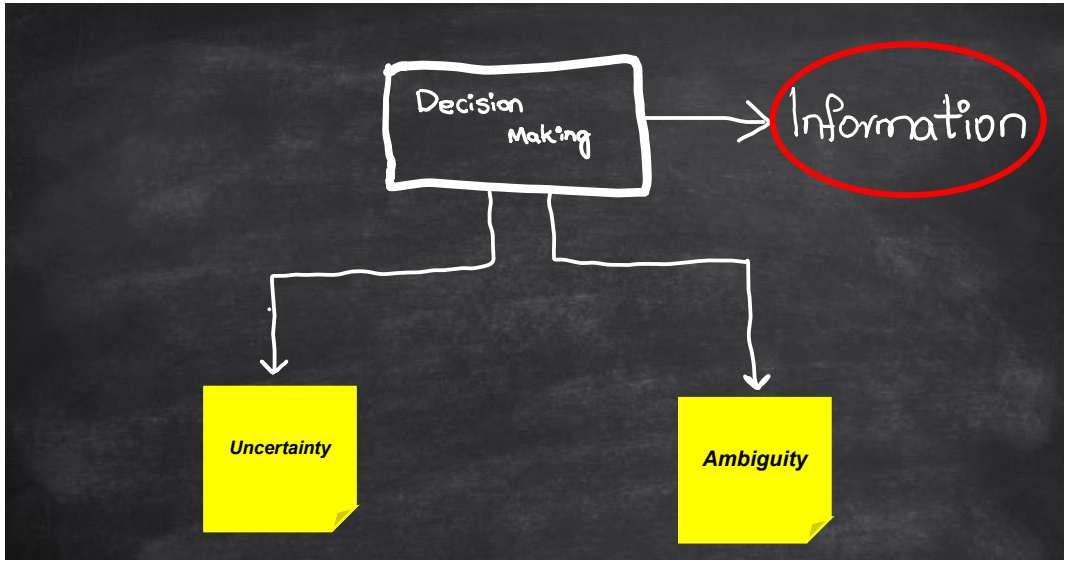


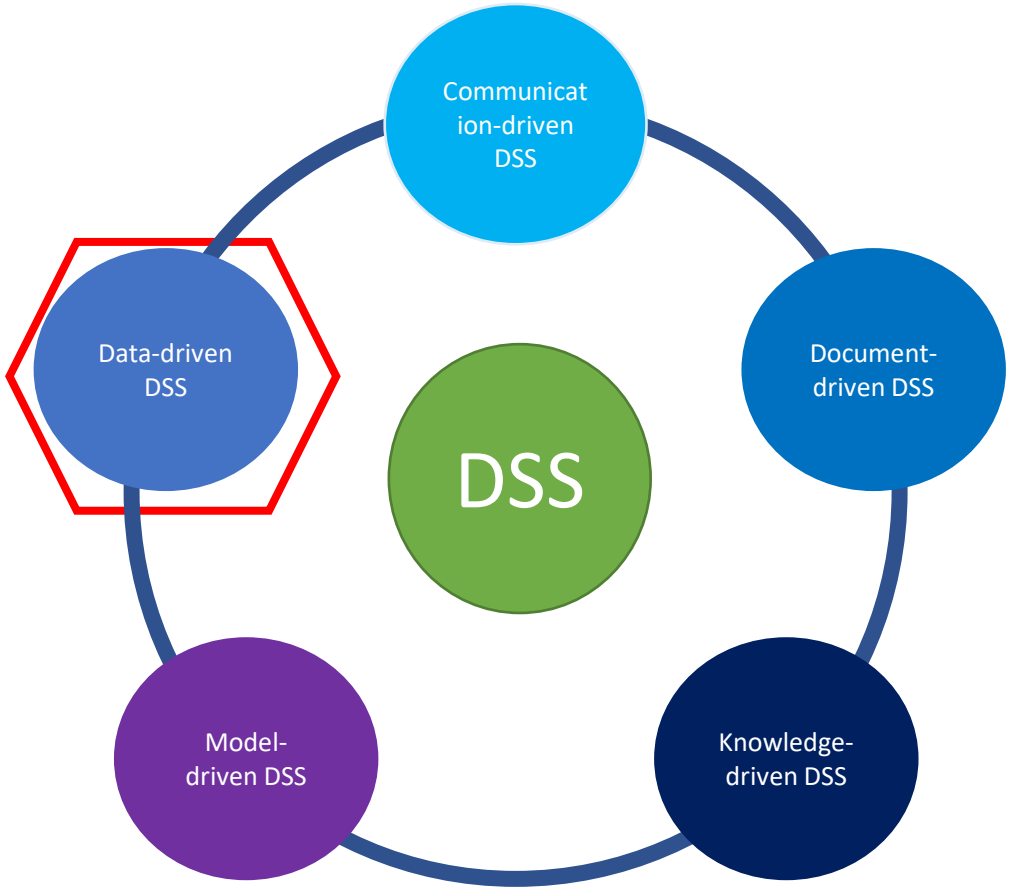
Figure 2. The design process paradox, adopted from Ullman (2018)

DECISION-MAKING

- Iterative decision-making process.

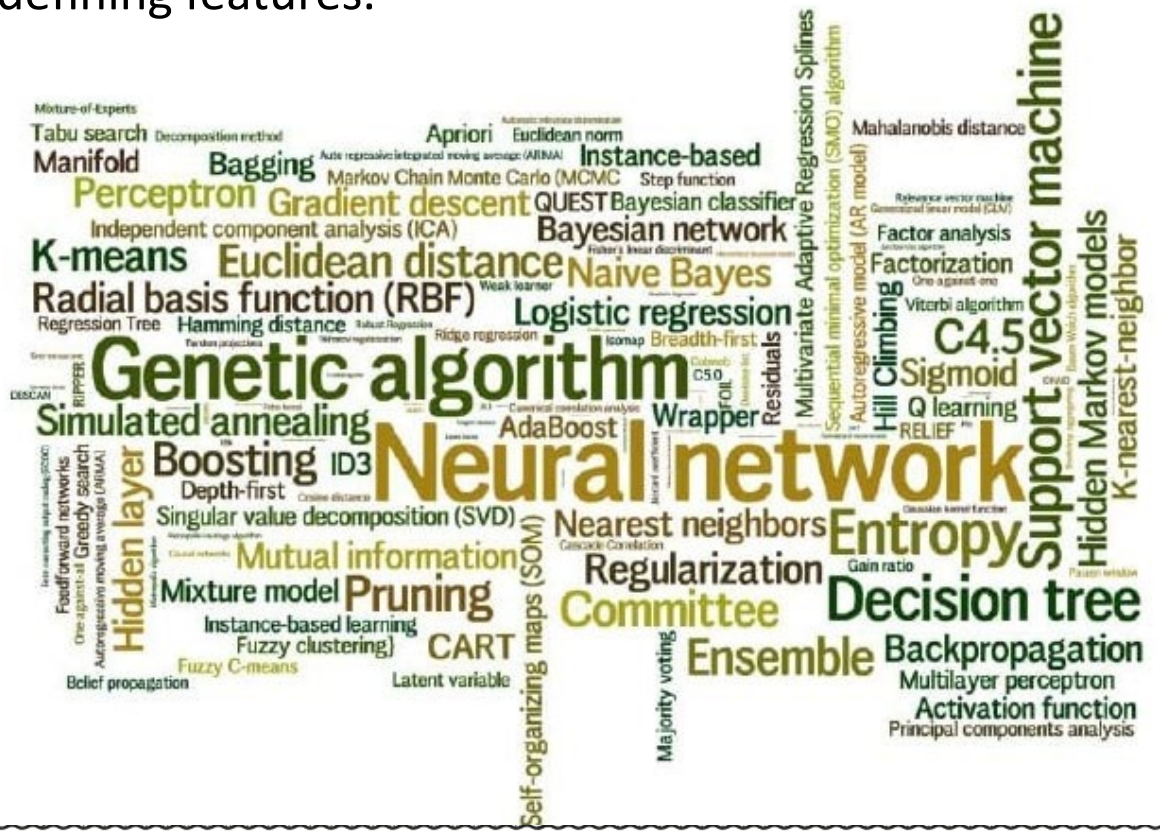


DECISION SUPPORT SYSTEM



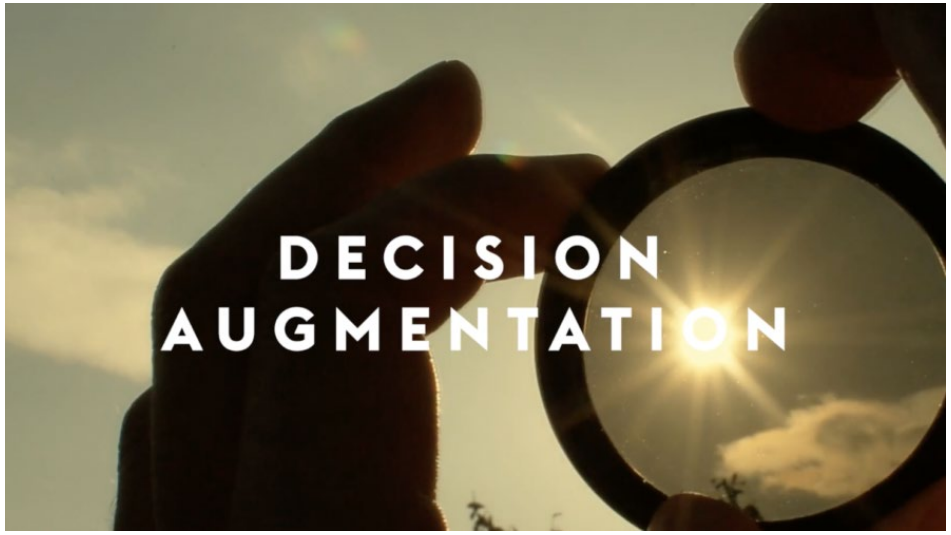
MACHINE LEARNING

- Parsing data to make predictions.
- Teach and train computers by feeding them data and defining features.
- Regression.
- Artificial neural networks.
- Natural language processing.



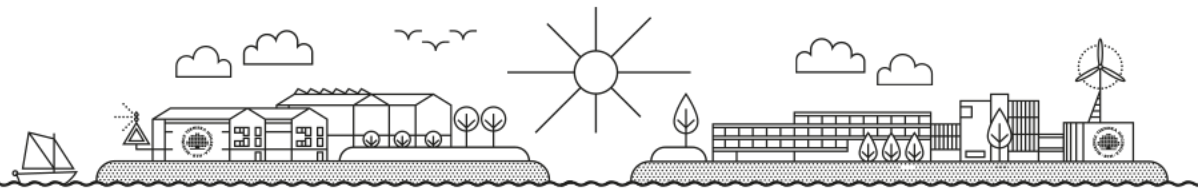
RESEARCH QUESTION

- How can machine learning techniques augment the decision-making capability in the conceptual stage of product development?



RESULTS

Working Approach



RESEARCH CASE

Figure 3. Heavy Construction Machine

Figure 4. E-Dent

RESEARCH CASE

Case Study - I

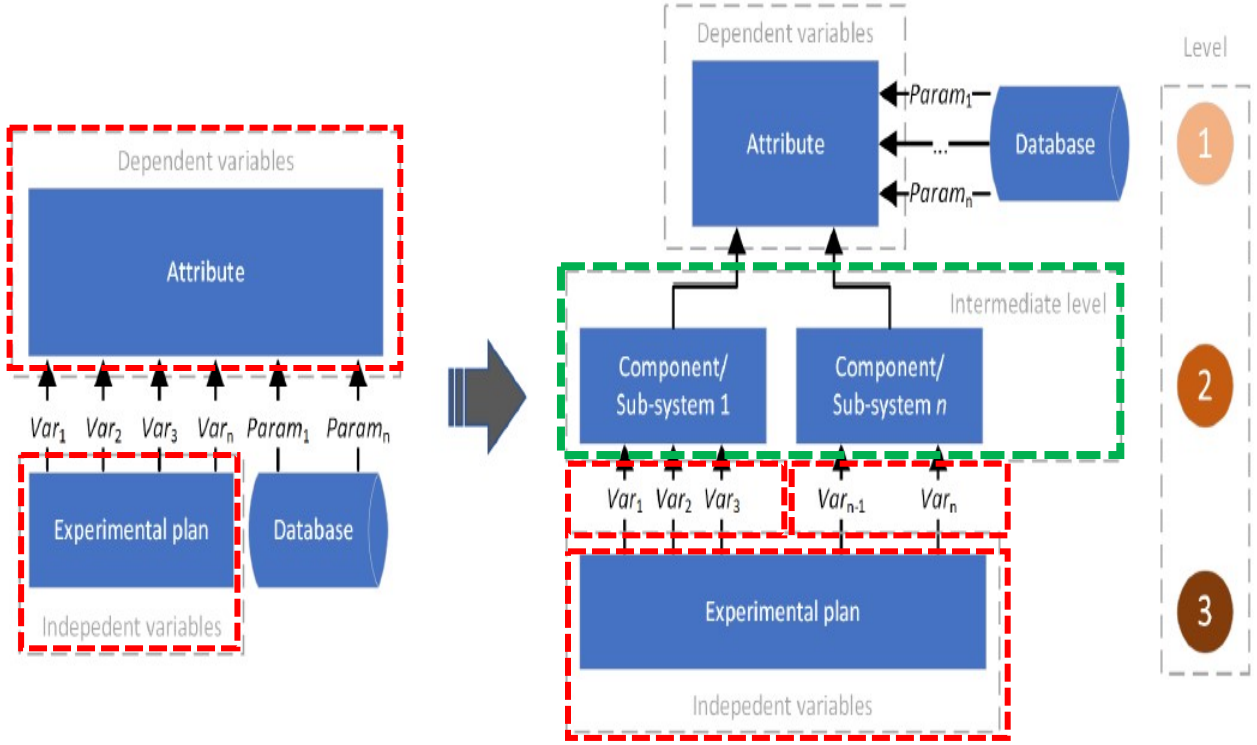
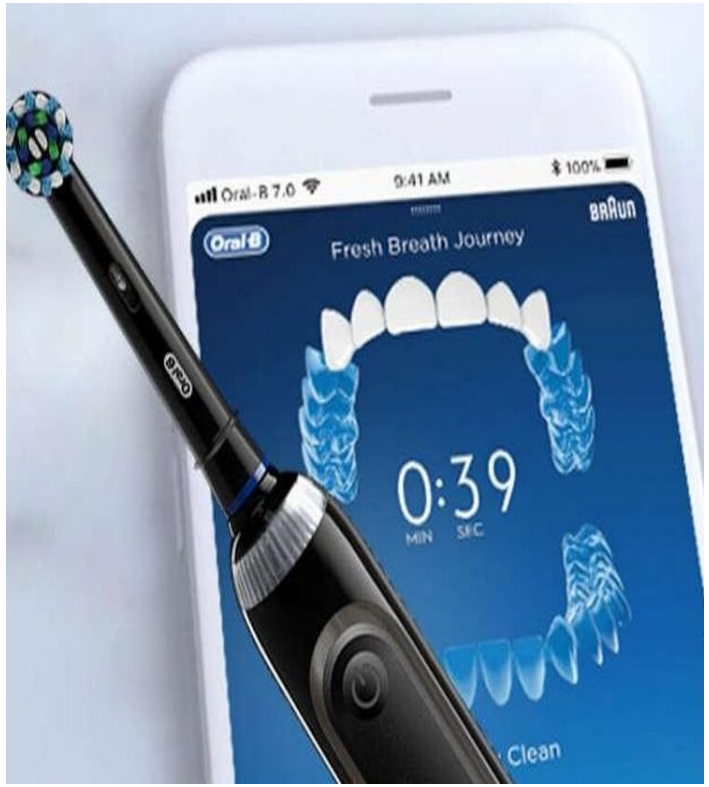
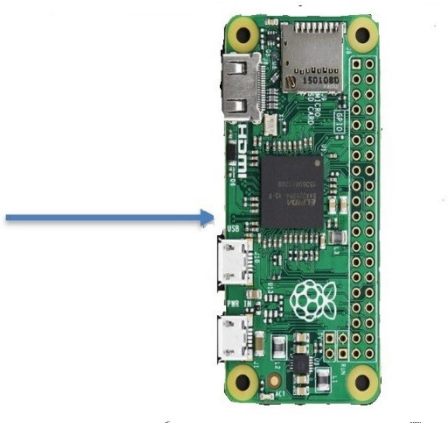


Figure 5. Variable hierarchy

RESEARCH CASE

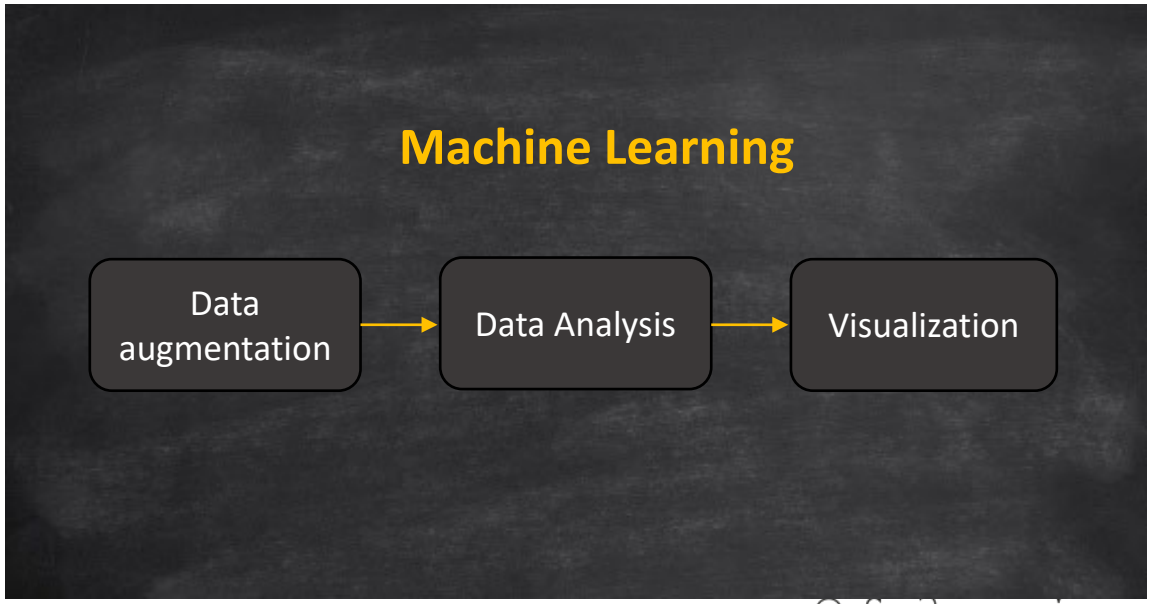
Case Study - II





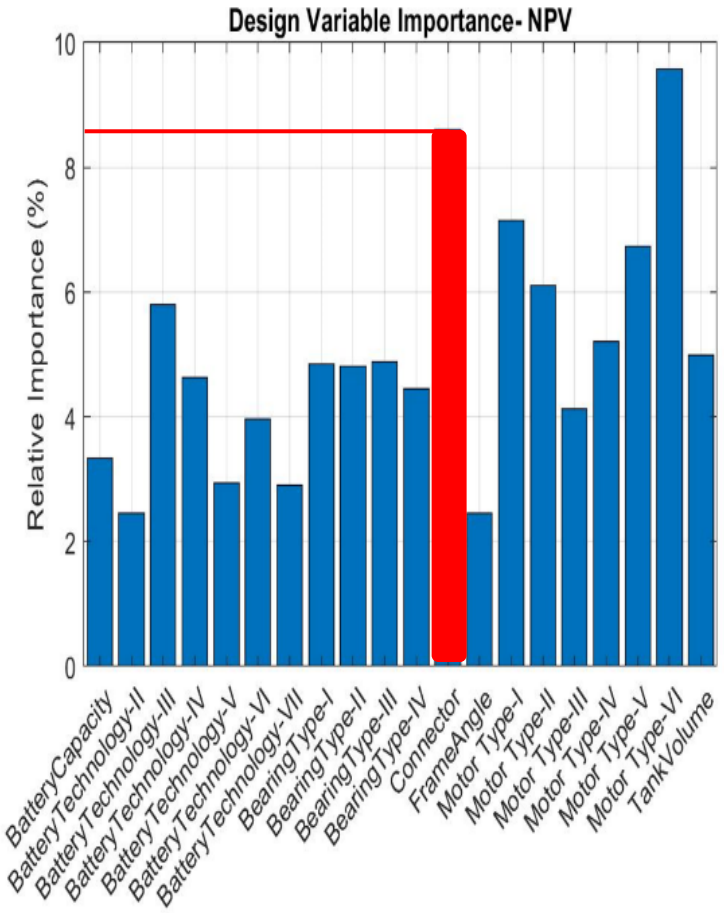
RESULTS

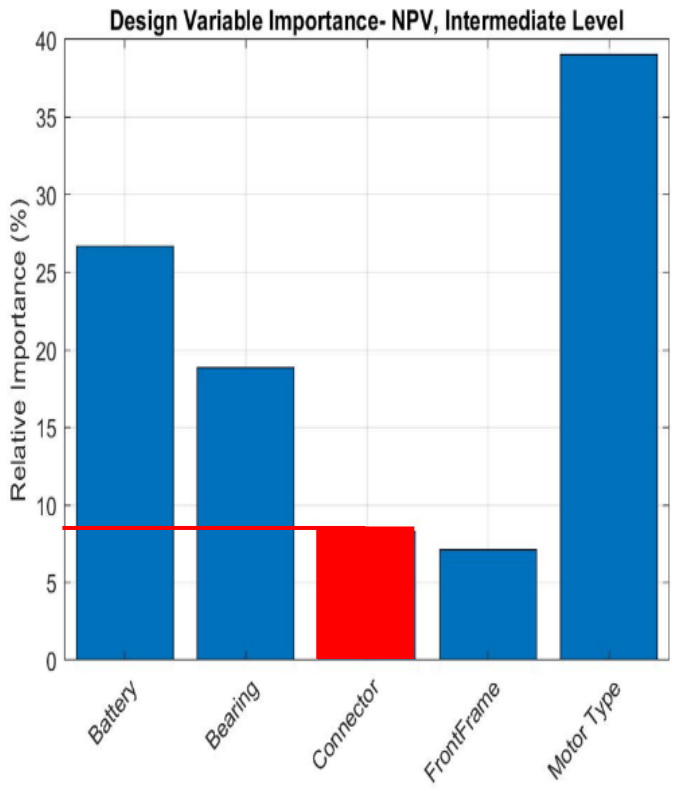
- Use of machine learning techniques in order to support the decision-making process in the conceptual stage of the product development.
- Three aspects of machine learning: data augmentation, data analysis, and visualization.



DATA AUGMENTATION

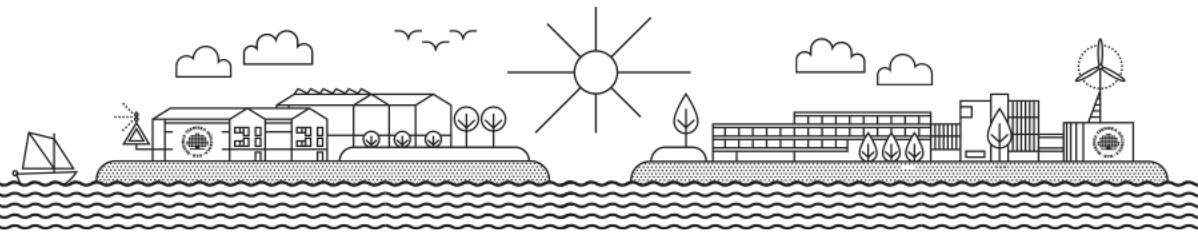
- Data Augmentation
  - Synthesis of Data
  - Provides additional data, guiding the decision-making process.





DATA ANALYSIS

- Data Analysis:
  - Cause-and-effect relationships.
  - Building of trust.
  - Analysing the design choices.



VISUALIZATION

- Data accessible and interpretable for decision-makers.

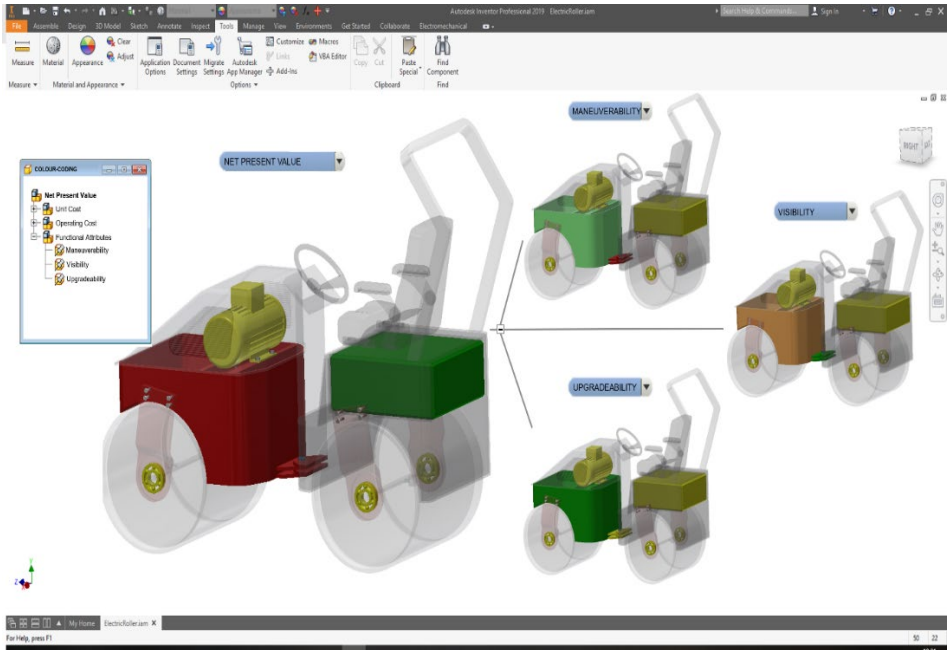


Figure 5. Color-coded CAD model visualization from a structured input

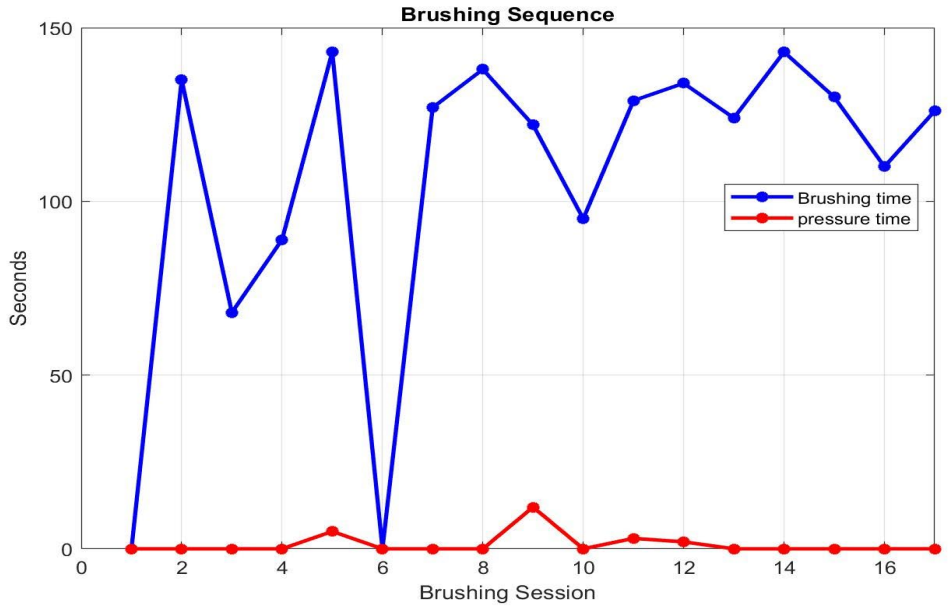
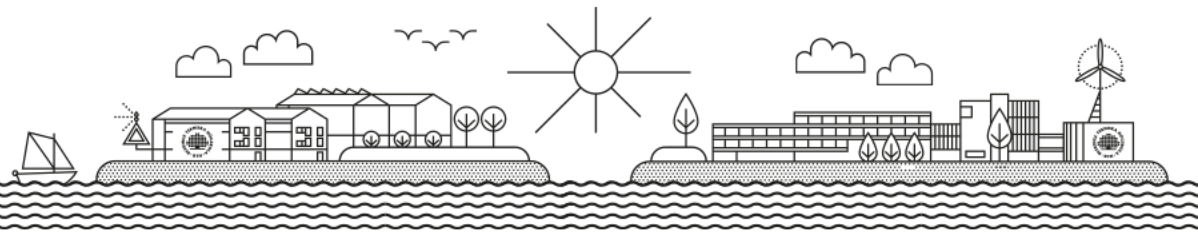


Figure 6. Brushing sequence per day of a participant

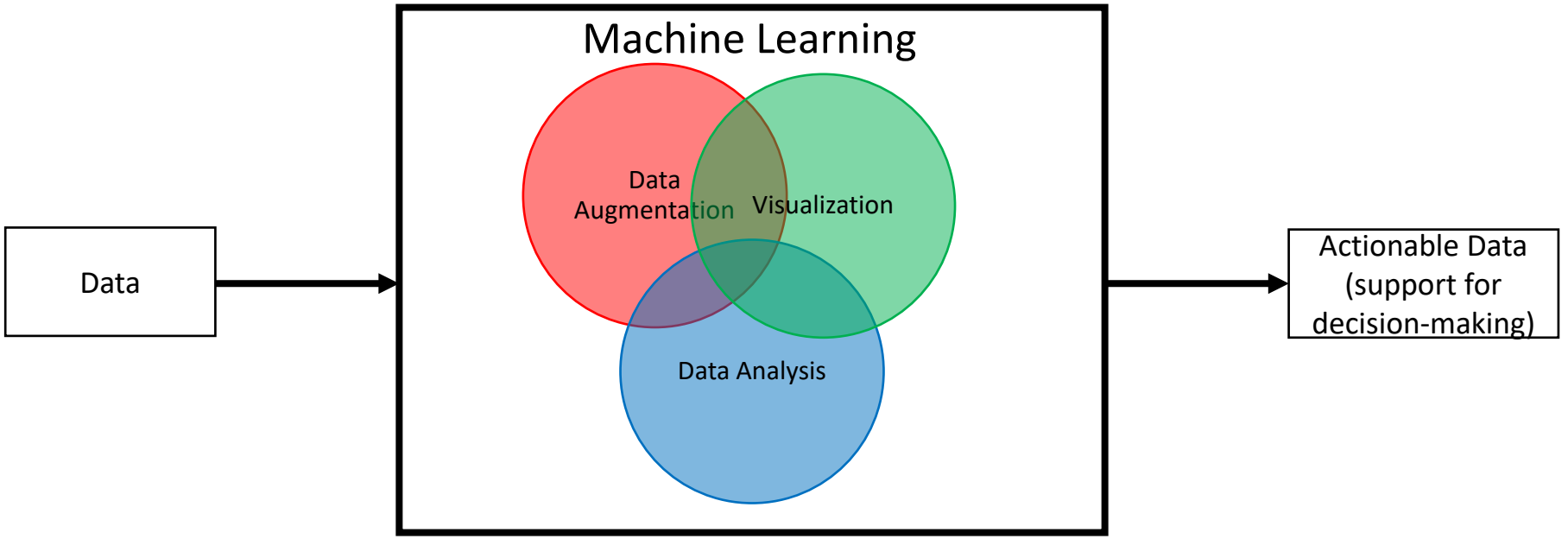
RESULTS

- Data analysis and visualization: DSS.
- Extracting and Associating data for sharing information.
- Increase of efficiency and effectiveness.
- Supporting the cross-functional teams.



SUMMARY

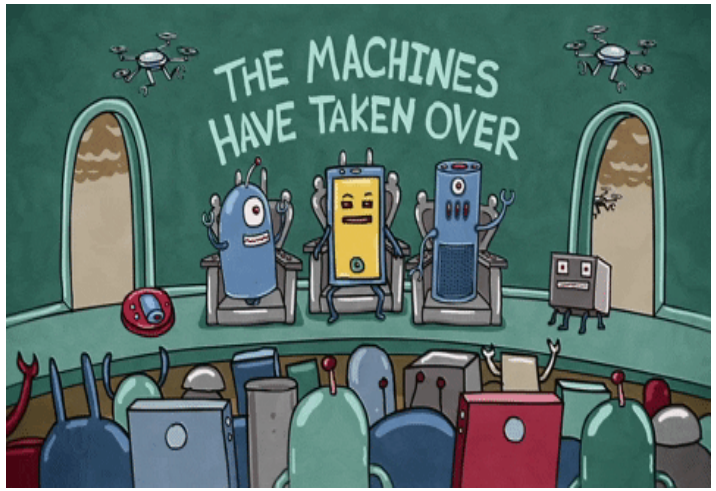
DSS



Paper A	Paper B	Paper C
Regression model for cause-and-effect relationship with visualization	Artificial neural networks method for cause-and-effect relationship	Natural language processing for data augmentation, data analysis and visualization.

CONCLUSIONS

- Machine learning approach for decision-making.
- Actionable information and knowledge, augmenting the decision-making process.
- Capability for Decision-support system.
- **Future works**
  - Diving deeper into machine learning model for smart decision support systems.



ACKNOWLEDGEMENT

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THANK
YOU


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