# Thesis Projects Spring 2017

Product Development Research Lab is the research lab within the Department of Mechanical Engineering[1].

Our vision is

> ***With practice and science we support innovation teams in product development through new work methods, tools and processes that will empower them to create and develop new product and services for the sustainable society.***

The research is applied and considers methods and tools that will support companies, and organisations, to enhance their capabilities to deliver value towards customers based on products. The goal is to support companies and organisations both in being more efficient in their development (i.e. incremental improvements) and in finding totally new value adding solutions for the market (i.e. radical innovation). Our platform is the subject of Mechanical Engineering.

For the upcoming spring we're looking for some skilled students who want to join in a collaborative effort to support our ongoing research projects with Volvo Construction Equipment.

Preferably you are a thesis worker ready to do your final project.

1.1-1.3 contacts: Ryan Ruvald (rruvald@gmail.com) & Tobias Larsson (tlr@bth.se)
2.1-2.3 contacts: Alessandro Bertoni (alessandro.bertoni@bth.se) & Tobias Larsson (tlr@bth.se)

[1] http://www.productdevelopment.se/

# #1.1 - AR/VR interaction with machines

By use of augmented and/or virtual reality (Microsoft Hololens etc) provide the possibility to create a link with a machine. Three levels;

A. See machine data through AR/VR when looking at a machine
B. Interact with the displayed data
C. Interact with machine (and parameters)

Real World Example


Demo Site Scale Example

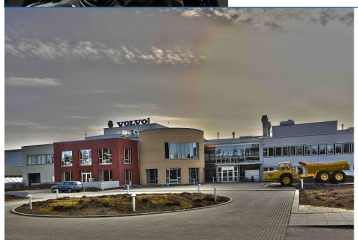
# #1.2 - Remote operation (through simulator or other rich interface)

Take over and run a machine remotely.

A. Universal driver interface
B. “Ride-along feature”; step into the machine on remote and ride-along as a needfinder
C. “Edu-teacher-mode”; ride-along and get educated on how to drive a machine.

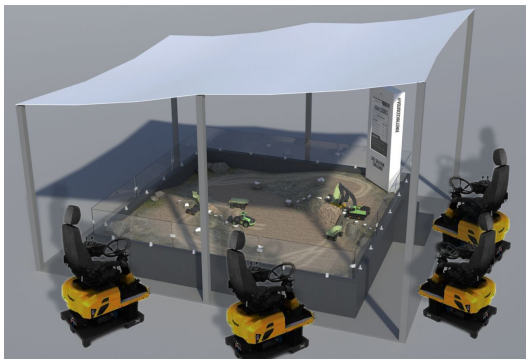
## Real World Roll Out

John at the Volvo facility is able to port into a vehicle in operation to assist, train or collect data through a VR connection at a universal vehicle simulation

Machine operator on the site has AR interface with John and receives haptic feedback or is allowed partial feature operation during instruction.

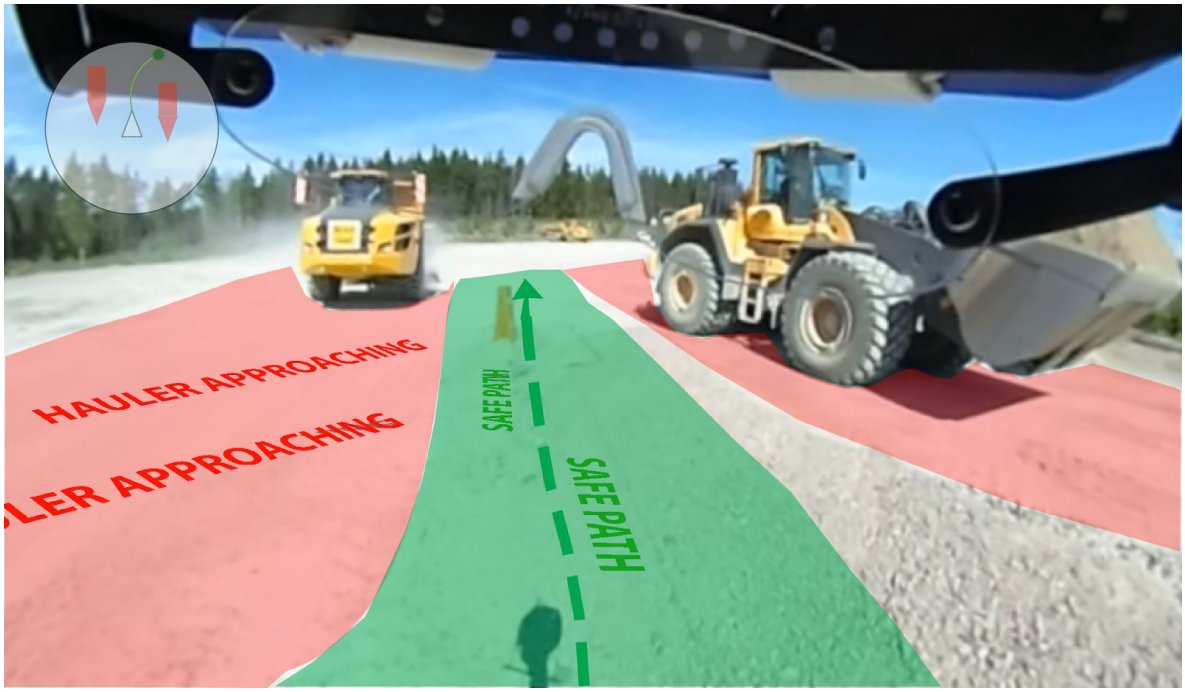
## Demo Site Case



# #1.3 - Safety in autonomous sites

Use AR/VR etc to provide safety in site operation when interacting with remote machines.

A. Dynamic safety paths on site through AR
B. “Do you see me?”; interaction to make sure an autonomous machine see a person on the site.



# 2. VALUE AND DATA-DRIVEN CONCEPTUAL DESIGN

The work will be based on the current research effort in the MD3S research profile[2]. The research challenge is to reduce the uncertainty of conceptual design value models by exploring the use of data mining technique to forecast the performance of a new product based on the real-time data collected from the current product. Read some of the background here in the "Let the machines talk"[3] article ( http://www.productdevelopment.se/?p=3844 )


Three master thesis are proposed for this topic addressing the following research questions:

1. What are the relevant data to be mined from real time usage of the product to be integrated in a value model?

2. What is the machine learning algorithm capable of best integrating with value models and rendering the most reliable results for the concept assessment?

[2] http://www.productdevelopment.se/?p=68
[3] http://www.productdevelopment.se/?p=3844

3. How can the information from machine learning algorithm be visualize in a traditional engineering design environment?

The parallel work on all the questions shall lead at the end to the development of a UNIQUE PROTOTYPE encompassing the collection of relevant data, the application of the machine learning algorithm, and the visualization of the results in a decision-making interface.

The students to be involved are potentially a project group of 3 people.

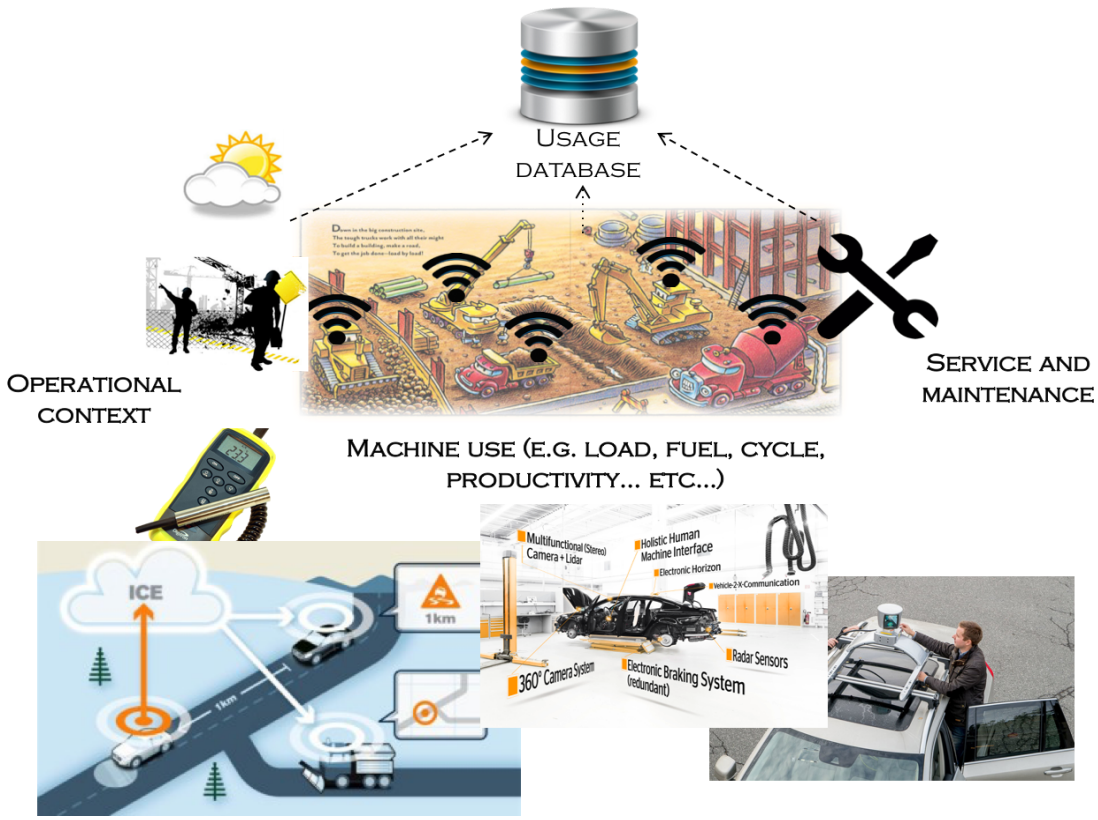
- 1 mechanical engineering student (having completed Value Innovation and Systems Engineering course)
- 1 mechanical engineering student (having completed the Knowledge Enabled Engineering course)
- 1 computer science student with interest, or existing skills, in machine learning/data mining

The following subsections describe in detail each of this questions.

## #2.1 - Data driven design sensors

Identify what data about an operating machine are relevant to be collected, and how to collect them. Focus on:

A. What use-data and environmental data are important in construction equipment.
B. What sensors shall be put on the machine or in the quarry to collect the data.



## #2.2 - Data driven design decisions

Use live data from the machine to design the next innovative machine. Focus on:

A. Which live data from the machine are relevant for a design engineer.
B. How to use live data to forecast the performance of the next innovative machine.
C. How live data can improve decision making.


## #2.3 - Data driven design visualization

Visualization of live data and value models for decision making. Focus on:

A. How to integrate live data visualization in traditional engineering tools.
B. How to condense heterogeneous data in a short and concise visualization.
C. Impact of different visualization techniques in group decision making.

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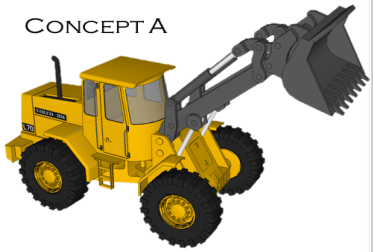
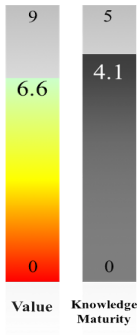
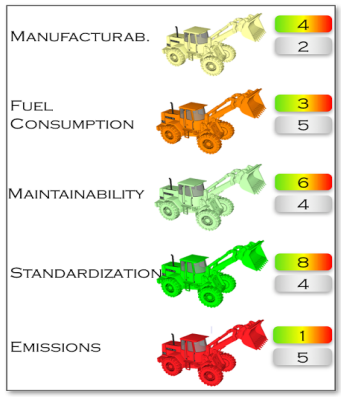
CONCEPT A

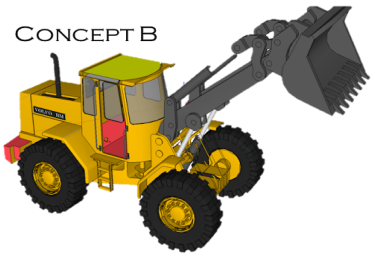


**TOTAL SCORE**
Weighted on VOC




CONCEPT B



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