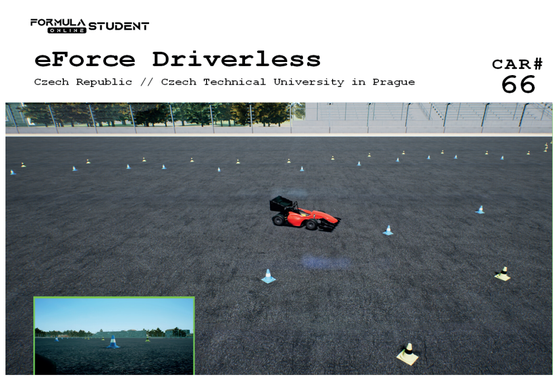
Masaryk Institute of Advanced Sciences, Czech Technical University; 2020
Diploma Thesis, Author: Marek Szeles
Field of Study: Innovation Management
Consultant: prof. Ing. Oldřich Starý, CSc.

Founding of a student research team developing an autonomous electric vehicle

Abstract
After existing for nine successful years, the eForce FEE Prague Formula Student team, active at the Faculty of Electrical Engineering CTU was looking for a new challenge for its tenth season. One of the options to move forward and expand activities was to initiate the development of a new autonomous racecar concept. This move would be revolutionary, as no Czech team had attempted this before. Apart from the opportunity, it also offered heavy risks – if the initiative were unsuccessful, the team could lose a financial investment it could not afford. Combined with a possible loss of support from sponsors and the University, as well as a loss of motivation of team members, this would mean a serious existential risk.

This thesis follows the story of eForce Driverless – the first Czech research project to develop a full-scale electric racecar. It documents the evaluation and planning that preceded the decision to go forward with the project, then the implementation stages, as well as its future outlook. As the author is a founding member of the new team, and served as its first captain, this thesis offers a unique outlook on how a complex and innovative interdisciplinary research team may be sustainably created and managed, from its inception to long-term operations.

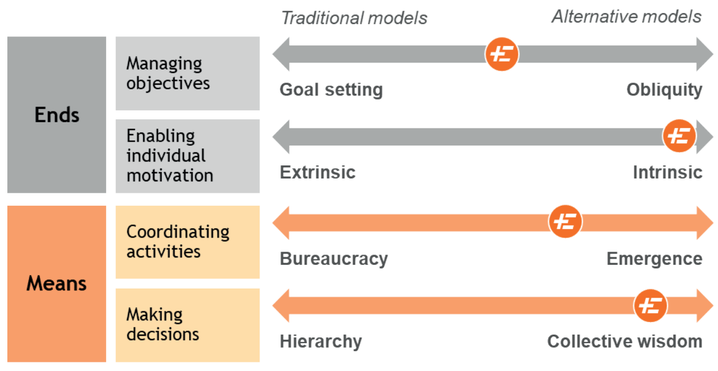
Keywords
Innovation Management, Engineering management, Leadership, Formula Student, Autonomous Driving



Screenshot from the simulator used for the FS Online Driverless event, including eForce Driverless sponsor frame

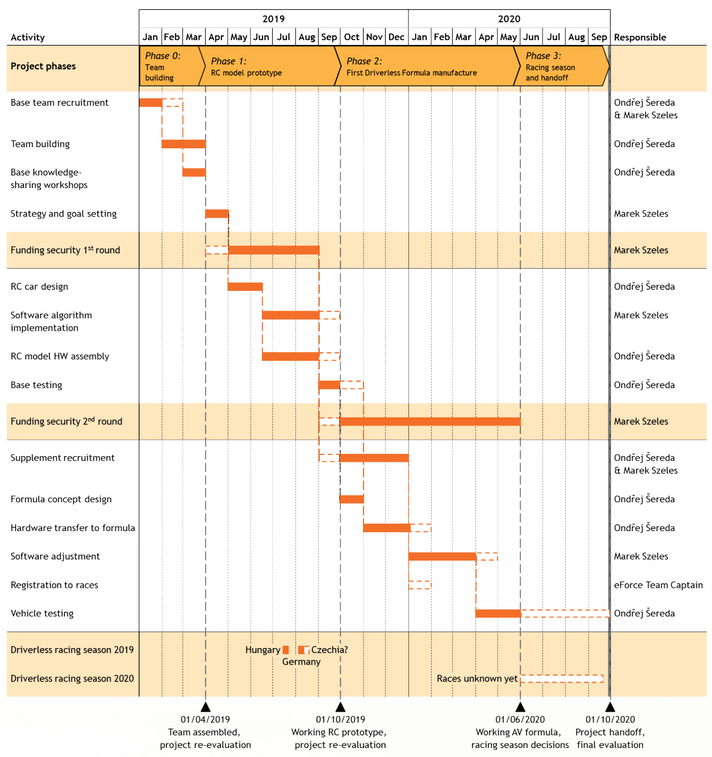
Introduction
Formula Student is one of the most respected and challenging student engineering competitions in the world. This competition is also one of the largest, being attended by participants the world over, and organized by experts from leading automotive, motorsport, aerospace and other technology firms. In 2018, eForce FEE Prague Formula, a team from CTU was considering entering the new Driverless category and develop an autonomous vehicle as the first team in the Czech Republic.

Methodology and current approaches
To further understand the functioning of the organisation after establishing its foundations, the latest publications on the topic of the Management of R&D Teams and its approaches are explored in detail. One of the most respected and specific frameworks was developed at London Business School and it lays out four axes on which the organisation's management models may be positioned. This methodology was applied on eForce to better understand its culture as seen on the following figure.



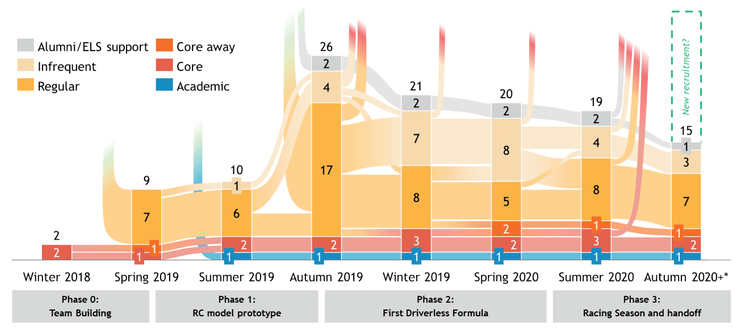
Approximate position of eForce management models in the London Business School framework as determined by the author

Feasibility Study
First, a feasibility study was done in early 2019 to help the team decide whether going forward with the project is feasible. As part of this analysis, the project was planned out and split into four phases as seen on the following figure.



Timeline chart of the planned implementation

Implementation
The bulk of the thesis describes how the eForce Driverless team was established and developed its first autonomous racing vehicle concept. Many deviations had to be made from the plan laid out in the feasibility study due to unexpected external and internal factors, the most significant of which was the COVID-19 pandemic, which prevented access to eForce workshop and effectively stopped progress for four months. Partly due to this fact, eForce Driverless had a high turnover of members as is seen on the following figure. Still, the plan remains to build and introduce the first autonomous vehicle prototype by the end of Summer 2020.



The flow of members across activity categories throughout the existence of eForce Driverless

At the time this thesis was being finished, eForce Driverless is only one of three driverless teams that managed to drive dynamic events at FS Online and it is therefore battling for podium finishes with a team from Karlsruhe Institut für Technologie (KIT) and a combined team of Technical University Delft and Massachusetts Institute of Technology (MIT), both already quite advanced teams.

Summary
It is always a gamble to establish a new project and dedicate resources to it without knowing whether it will become successful and the risk increases with its complexity. With a similar anxiousness, eForce Driverless was kicked off in late 2018 with the goal of establishing the first Czech research team building life sized autonomous racing vehicles. As it is described in this thesis, the gamble was worth it and a stable organisation full of talented individuals got established.

The Czech Technical University has gained another state of the art research team with a wide range of scientific interests. What is unique about eForce Driverless is its appeal primarily to younger, even undergraduate students, who can nonetheless contribute greatly even to this advanced project.