

Conceptual Design Report of a Firefighting Very-Large-Air Tanker “Material Girl”

(Technical Paper)

The Data Analytics Controversy in European Soccer

(STS Paper)

A Thesis Prospectus Submitted to the
Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia
In Partial Fulfillment of the Requirements of the Degree
Bachelor of Science, School of Engineering

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Fall, 2021

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Prospectus

Undergraduate Thesis Prospectus

Designing A Responsive Aerial Fire Fighting Aircraft

(technical research project in Aerospace Engineering)

The Data Analytics Controversy in European Soccer

(sociotechnical research project)

by

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November 1, 2021

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General Research Problem

How have companies applied data analytics to improve their products?

Digital methods have vast and diverse applications in problems of optimization, including, for example, aircraft design and professional sports management. Through high-speed processing of vast datasets, such methods can yield results that surpass those achievable through older techniques. Yet when CAD, data analytics, or other digital methods do not merely supplement the judgment of experienced experts, but displace it, such techniques can yield deficient results (Petroski, 1985). Digital methods' extraordinary capacities can inspire undue confidence, which in turn can tempt managers or others in positions of responsibility to forego the financial and time costs of expert human judgment (Scherz, 2019). Such economies are hazardous, because digital methods depend upon data that require selection, interpretation, and weighting, and each of these steps occasions opportunities for error (Allen, 2001; Rainie & Anderson, 2017). Hence digital methods are best applied as supplements to expert human judgment, whether the problem at hand is specialized aircraft design, sports management, or any other data-intensive human problem.

A Conceptual Design of a Firefighting Aircraft

How can firefighters fight wildfires at less risk to ground crews?

The Technical Research Project within the aerospace department is a two-semester capstone project. The technical advisor is Jesse R. Quinlan, PhD. This project is split into teams of eight students.

As the effects of climate change grow, the increase of frequent devastating forest fires grows with it. Yearly, the amount of damage caused by wildfires has risen through direct

property damage and loss of large areas of woodlands. The fires are causing devastating effects on the surrounding ecosystems and communities. In 2019 wildfires caused 4.5 billion dollars' worth of property loss and damages in Alaska and California alone. The fires are more dangerous now and in 2019, "Eighteen firefighters experienced fatal injuries" occurred (U.S. Fire, 2020). As risks grow, this necessitates finding safe tools to protect ground crews. The main tool used for this are firefighting aircraft.

**Table 1
General Requirements for Aircraft**

Technical Description	Objectives	Requirements
Entry into Service Fire Retardant Capacity	N/A 8000 gallons	2030 4000 gallons Multi-drop capable (2000 gal per drop) Fire retardant \geq 500 gal/min
Payload Drop	Drop Speed \leq 120 kts	Drop Speed \leq 150 kts Drop Altitude \leq 300 ft AGL
Design Radius (payload)	400 nautical miles	200 nautical miles
Design Ferry Range (no payload)	4000 nautical miles	2000 nautical miles
Dash Speed	400 kts	300 kts
Field Requirements	Balanced Field length \leq 5000 ft @ 5000 ft MSL elevation	Balanced Field length \leq 8000 ft @ 5000 ft MSL elevation
Certifications	Provide systems for possible autonomous flight control	Autopilot mode Meets certification in FAA 14 Capable flight in icing conditions

Table 1: Describes the goals for the aircraft design process through the objectives. The requirements section contains the notable constraints on the design. Overall cost must be kept low in order that the aircraft will be purchased by known firefighting institutions.

Currently, there is only one aircraft deploying that is specifically designed for aerial firefighting. All other aircraft are repurposed commercial or military aircraft. The Canadair 415 “Super Scooper” is the state of art firefighting aircraft built for combating flames. This plane has the ability to attack the fire up to five times more frequently than any other aircraft. Considering that there is only one aircraft designed to fight fires the need for newly designed planes is increasing. Within the design process the group will be using software such as OpenVSP, Matlab, and Gasturb. These programs help calculate various flight characteristics and computation fluid analysis of the design. At the end of the capstone the team will have successfully created a conceptually designed aircraft. The design will be submitted in a competition against other schools.

The Data Analytics Controversy in European Soccer

In European soccer, how have defenders and critics of data analytics in the sport advanced their agendas?

In professional soccer, winning earns teams millions of dollars. Each game can change the direction of a club for years to come. To succeed teams must utilize every advantage they can find. In soccer, observational data has been collected since the 1950s; data analysis was introduced in 1999. Charles Reep was the first to lead observational data collection. He was hired and helped a struggling team avoid, “relegation after winning 13 out of 14 matches and doubling their goals scored” (Luzum & Model, 2021). Teams witnessing the success began employing their own data collectors. As data collection needs increased, collectors began to form businesses around the growing market. These businesses began using more complex and automated methods for data collection and paved the way for modern analytics. What started out

as observational player analysis has expanded into all corners of the game. Some, however, contend that analytics has gone too far, and that many human judgments cannot be automated.

Researchers have studied analytics in soccer. The research ranges from refereeing to the effectiveness of analytics used in the sport. The main point of contention with analytics is the Video Assistant Refereeing (VAR) usage. Tamir and Bar-eli (2021) observe that “despite fierce objections and extensive criticism, VAR represents an important revision in modern professional soccer.” Research indicates that VAR improves referees’ accuracy and diminishes bias. The issues left unsettled are the biases of the technology utilized and the time between an incident and a final ruling. In player recruitment, analytics attempts to unearth gems. According to Kalenderoglu (2019), analytics “guides the technical and managerial staff through more data driven recruitment processes to attract the best talents.” However, “valuing an action is hard since goals happen rarely and it is not clear that which action is the most crucial one in scoring a goal” (Kalenderoglu, 2019). This data difficulty initially limited analytics, causing many to believe that it had no use in soccer. Despite the difficulty, the study discusses new strategies and bettering existing analytics trends. However, the study does discuss the controversies of seeing athletes as just numbers. Bojanova (2014) found that data lets fans interact more in the sport. For example, “The official FIFA World Cup app,” is “advertised as a virtual ticket to the global stadium” and “the best way to #joinin with the biggest conversation on the planet.” Since 2014 FIFA has continued to use a World Cup app to increase fan participation. FIFA wants to give fans more information into stats and decisions made in the tournaments.

Participants range from fans to analytics companies. Data analytics firms market their services to soccer leagues. Oracle presents “Research shows that fans are interested in the integration of match data and analysis ... providing fans with a data-rich experience” (Austin

2021). Oracle also promises that “In teaming with Oracle, the Premier League will increase the excitement” around the sport (Austin 2021). These companies believe promoting their product promotes the league as well.

The Referees Association favors analytics. Referees administer the tool, and according to the association: “Referees are happy to trust in the advice of a video assistant” (Gardner 2019). The association believes that, “the introduction of VAR will improve the accuracy of Key Match Incidents to 87 per cent” while also protecting refereeing decisions (Premier League, 2019). This contributes to a fairer match with less bias from referees.

Clubs have started to incorporate analytics into strategy as well. Some clubs, such as Chelsea, use analytics to offer fans services: “We bring you extra detail and analysis from yesterday’s victory ... in the form of all the key stats” (Cech, 2020). Chelsea’s goal is to bring fans closer to the action of the game. Others also use the data in recruitment and management. This allows them an advantage over their opponents on and off the pitch.

Governing bodies of the sport have had to create laws protecting players from the effects of analytics. In these laws UEFA have had to identify how data applies to player stats and how collection groups can use the data. UEFA, the Union of European Football Associations, protects players from aggressive data collections stating, “we ensure adequate security measures are taken to offer equivalent protection as within Switzerland and the EEA and in compliance with applicable data protection laws” (UEFA.com, 2020).

Fans Against VAR is a social media forum. Its members are petitioning the sport’s governing bodies to end analytics in officiating, claiming: “VAR has stolen the heart and soul from football” (Willmott, 2019). VAR is Video Assistant Referee, incorporated in the 2019-2020 season across Europe. This tool allows referees to retract or make calls using video in real time.

This group advocates that the VAR process is too precise forcing referees to hesitate in making decisions.

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