

Thesis Project Portfolio

Data Pipeline for Digitizing Perioperative Flowsheets from Low Middle Income Countries
(Technical Report)

How Data Analytics is Changing the Sport of Football
(STS Research Paper)

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Table of Contents

Sociotechnical Synthesis

Data Pipeline for Digitizing Perioperative Flowsheets from Low Middle Income Countries

How Data Analytics is Changing the Sport of Football

Prospectus

Technological and cultural advancements have allowed data analytics to become a more prominent part of the world in many ways. While surgical flowsheet digitization and the sport of football do not appear to have much, if anything in common, they both can be improved with the implementation of data analytics. Data analytics is used in the medical field to provide analysis to primary healthcare providers with respect to the risk of the patient as well as the necessary actions to take in order to provide the best possible care. In football, data analytics is used to reduce injuries and increase player health and safety, to make in-game decisions on any given play, and to gather insight into prospects and players in order to manage personnel in the best way possible. This portfolio documents the methodology and results of two distinctly different research topics bound together by a commonality. The technical research topic details the digitization of perioperative surgical flowsheets through an application that utilizes relational databases, encrypted data, and individual patient identifiers. The final deliverable for the technical research topic is a functional application that allows for medical professionals to upload a picture of a perioperative flowsheet and receive analysis of the patient based on the data written on the flowsheet. The final deliverable for the STS research topic is a paper that discusses whether the implementation and continued usage of data analytics is enough to save the sport of football.

In Rwanda and many low-and-middle-income countries (LMIC), surgical, critical care, and anesthesia flowsheets are handwritten by medical professionals due to the lack of digital infrastructure necessary to support digitization systems. Therefore, many LMIC lack macro-level health data that can be utilized to quantify and improve existing healthcare outcomes. Literature has championed post-operative mortality rate (POMR) as a key indicator for institutional and national surgical safety. Many surgical operations deemed as “low-risk” in high income countries (HIC) have a surgical mortality rate in LMIC more than ten times that of HIC. Striving

to lower POMR in LMIC, the University of Virginia (UVA) is partnering with the University Teaching Hospital of Kigali in Rwanda (CHUK) to digitize anesthesia and intraoperative paper health records. Over the past two years, UVA student capstone teams have contributed in establishing a consistent and reliable system to scan and obtain the surgical flowsheets. The focus of 2021-2022 is to design and implement a data pipeline system that enables Rwandan medical professionals at CHUK to digitize paper surgical flowsheets via a mobile application and receive rapid risk-based notifications. The application enables medical professionals to quickly engage with pertinent perioperative data relevant for improving patient outcomes while also ensuring secure storage of the data, which in turn enables macro-level research for Rwanda's healthcare system. The design presented in this paper enables the user to rapidly upload anesthesia records and receive an email notification regarding hypotension risk data in, on average, 37 seconds. Leveraging AWS storage enables 1000 GB per month and demand-based scaling, dwarfing previous storage capabilities. Compared to the previous system, the average upload time decreased 81.7% from 40 seconds to 7.34 seconds with the usage of the newly designed system. In addition, the new system does not lead to an increase in system failures, where the user is unable to proceed with the usage of the application, which remains at 0% in the newly designed version.

The subject of my research is the usage of data analytics in the sport of football. Many advancements have been made in football over its lifespan, but none more influential to the future than the introduction and implementation of data analytics. Because of this influence, my research question is: There are many aspects of the sport of football that have and will continue to improve through the usage of data analytics, including player health and safety, recruiting and

personnel management, and in-game decision making by coaches, but is the impact of these applied changes great enough to save the sport from being defunct?

I use the STS frameworks Technological Determinism and Paradigm Shift Theory to support my research question. Through my research, I expect to find that data analytics is enough to fix what most critics of football deem to be the issues that doom the sport moving forwards. This is significant because it provides solutions that can possibly be extrapolated to other sports and even other issues plaguing society. It provides precedence for the STS community that data analytics can be used as a tool to improve the areas that it is applied to.

This portfolio is an example of the possibilities that can be achieved through the usage of data analytics. While the medical patient care field and the sport of football do not have much in common, the way in which they are both drastically improved is a testament to the versatility of data analytics.