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# Stadiums and Digitalization: An Exploratory Study of Digitalization in Sports Stadiums

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## ABSTRACT

While we have seen many technological innovations in the way most sports are administered or played, stadium interaction had been largely unchanged till recently. However, with increasing technological intervention in stadiums, it is natural to ask questions on the initiatives that spectators prefer. This paper attempts to create a comprehensive study of such technological initiatives in modern stadiums across different sports. We have collected data from stadiums, categorised them and analysed spectator willingness to pay for these initiatives. We find that age and frequency of stadium visits are the most important characteristics that define the willingness of spectators to pay for high technology initiatives in stadiums. Our study is one of the few in the domain that presents both spectator and stadium side issues in enhancing digital initiatives in stadiums. It would enable future managers of stadiums to better plan and target right initiatives.

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## KEYWORDS

Digitalisation; stadiums; survey; spectators

## Introduction

Sport and technology share the characteristic of connecting people and the stadium is where this is fostered. Stadiums are faced with unique challenges in today's competitive landscape because like many industries, the spread of smart devices and demand for instant gratification by millennials have created urgency for stadiums to adapt to the latest technology in order to meet the needs of their customers (Song et al., 2018; Tacon & Walters, 2016). This challenge is accelerated by the fact that most stadiums were built 35 + years ago (Van Heck, 2019), creating difficulties in implementing technology and making it fit for purpose. Second, stadiums now compete with home viewing options from sophisticated camera angles and media technology. Recent research in the field has advocated for study of digitalisation's impact on sport (Ströbel et al., 2021; Tang et al., 2017).

The changing demands also present opportunities in marketing to profile consumers with more accuracy than ever before (Graef et al., 2022; Jha & Shah, 2019) as well as analytics on the back-end to increase operational efficiency and quantify decision-making (Chang, 2019; Jayal et al., 2018; Zadeh, 2020). This study seeks to investigate the marketing, technological and logistical opportunities and challenges by exploring digitalisation technology in fan engagement and operational technology and how their presence

benefits various stakeholders. Whilst technology is a part of most research on the aforementioned topics, there is limited extant research specifically on digital initiatives in stadia, likely because it has only grown in popularity in the last 5 years.

The overall intention is to find out the relationship between spectator demographics (age group, gender, nationality), sports factors (with whom they spectate a match, favourite sport, frequency of attending match, stadium) and their awareness and demand for technology. We can formalise the research question in this study as:

*How does the application of digitalization in sporting venues and stadiums contribute to spectators' willingness to pay and engage?*

We conduct a quantitative study to analyse the spectators' response and their willingness to pay for different digitalisation initiatives in the stadia. The spectator-based quantitative study's findings support the extant literature in the field of spectator typology, fan engagement and technology adoption. The impact of this research is a delineation of how fans stand to gain from the digital stadium to be used as a tool for stadium marketing and technology officials in the industry and in further research.

## Background and literature review

Fan engagement generates an atmosphere that aims to prolong the period of time spent in the venue (consumers arrive earlier and leave later than the match) and therefore the spending more (Huettermann et al., 2019). Fan engagement and operational efficiency often determine whether fans will return to the stadium or not (Yun et al., 2020). Technology is particularly efficient in achieving best results under such circumstances (Vale & Fernandes, 2018). Extant research in these two strands form the basis of empirically tested hypotheses to determine which consumers are more aware and will both utilise and pay for digitalisation initiatives.

### Types of spectators

Giulianotti (2002) details the hyper-commodification over the past decade of soccer and the impact of this process on forms of spectator identification with football clubs. This study builds up on the work by Giulianotti (2002) to connect the spectator types to their affinity for technology in stadia. Giulianotti (2002, p. 1) describes four spectator classifications (*supporter, follower, fan and flâneurs*) on a matrix with two axes. The first axis measures the basis of the individual's investment in a specific club while the vertical axis measures the different degrees to which the club is central to the individual's project of self-formation. The nature of loyalty is quite unique in sports. In traditional businesses, customers might quite easily switch the provider, if they are treated below expectations (Yoshida & James, 2010). However, if a loyal fan is not satisfied with the experience, switching the favourite team is still very unlikely. For many fans, there is only one supplier in the market as they particularly follow a sport played by their favourite team and not the sport in general. It is argued that the demand for game tickets is inelastic, so the increase in ticket prices is not likely to diminish revenues (Da Silva & Las Casas, 2017, p. 38).

**H<sub>1</sub>:** *Technology will be most welcomed by **flâneurs** (measured by low frequency attending), implying they attend for the experience more than loyalty to the team.*

**H<sub>2</sub>:** *Die-hard supporters categorised as **supporters**, who are in attendance purely for the enjoyment of the match (measured by high frequency attending), will be indifferent to new technology.*

### **Fan engagement**

Fan engagement examples include fan apps, ordering food to a seat or engaging fans both on a match-day and non-match days through social media (Santos et al., 2019). When conducted through technology, fan engagement provides a competitive advantage to winning, gives ever-important data to segment and target customers, and puts the fan at the centre of activities, increasing transparency (Yim et al., 2020). In the fight to win consumers' leisure time, organisations that are properly equipped with tools allowing them to segment and target their customers on an individual basis are better placed to build customer loyalty and long-term relationships (FanThreesixty, 2019). Given that the younger age bracket is the most engaged fan community (Poushter et al., 2018), it is essential for stadia to understand social media as a channel to reach fans. The key to implementing measures to satisfy and excite fans is to know who the target market is and at what cost.

**H<sub>3</sub>:** *Spectators in younger age demographics will be more likely to pay a higher ticket price for technology and therefore represent a primary target market.*

### **Crowd management and operational efficiency**

Where some stadiums have implemented customer-facing technology, others have focused on the backend by making operations more streamlined or using analytics to cut costs. Examples include Croke Park (in Dublin, Ireland) using Microsoft's Azure IoT suite to take data into machine learning algorithms and analyse it for patterns to predict where to light the pitch with heat lamps at specific times of the day for optimal growth and real savings for the stadium owners (SmartDublin, 2016).

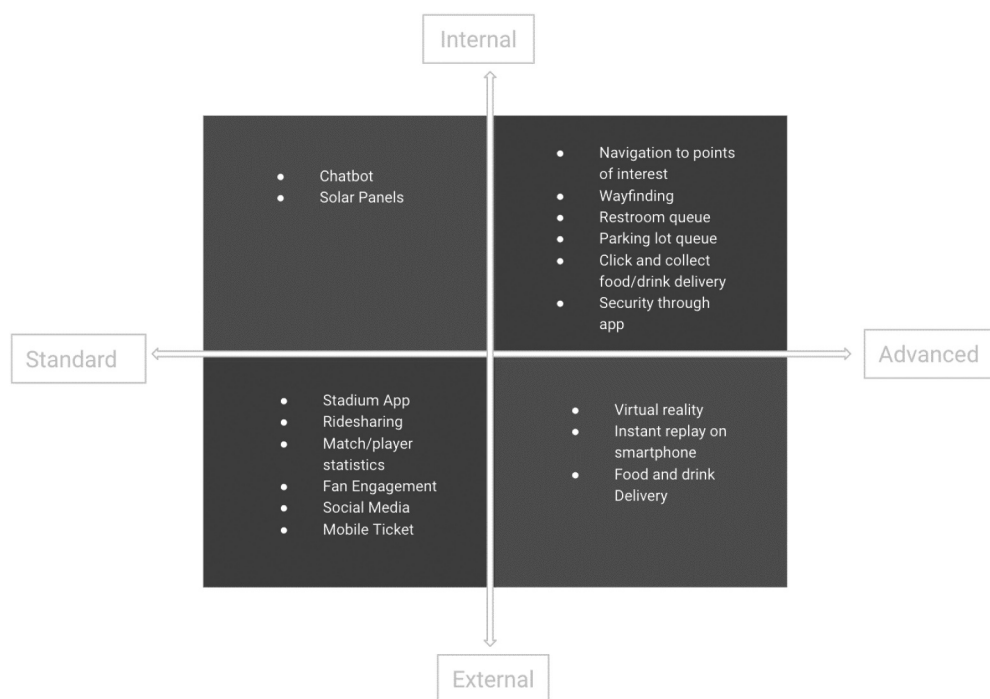
This builds into our attempt to find out whether fans demand internal or external initiatives. Wakefield et al. (1996) state that the physical environment of the stadium has a significant effect on the extent to which spectators desire to stay and return to the stadium, but with little mention of technology, which in today's day and age makes up a significant part of the physical environment, whether in the hands of the consumer, such as a stadium app, aforementioned fan engagement and social media use, or from the operational perspective, such as decreasing crowding or solving inventory problems before they arise. This brings us to the next hypothesis.

**H<sub>4</sub>:** *Fan-facing (external) initiatives will be more demanded and profitable to consumers than stadium-facing (internal) initiatives.*

## Data and method

We conducted a survey to measure how respondents' demographics and match day factors (variable: awareness) are related to each of the 17 noticed digital initiatives and in the stadium and their interest in availing of or likelihood to pay for initiatives (variable: profitability) that are not in the stadium they visit most. [Table A1](#) in appendix contains the brief description of the survey respondents. The initiatives were found by researching the most technologically advanced stadiums around the world (which formed an outline of companies from which qualitative interviewers were sourced) and listing them to analyse the demand and profitability of each variable. Delineating various initiatives provided identification of advanced vs. standard and internal vs. external initiatives. [Figure 1](#) lists the various initiatives from different stadiums chosen for the purpose.

The survey was conducted online over the course of 8 weeks through multiple choice, rating scale and open-ended questions. A purposive sample was taken because of the exploratory nature of the research and given that the aim is to develop an initial understanding of an under-researched population (Barratt et al., 2015; Sibona et al., 2020). To get the required respondents, we contacted the fans of major football clubs in UK/Ireland and the USA. The survey was floated to the fans on their fan groups, Facebook pages, etc. It was designed to reach the fans who regularly attended the events in these stadia. The non-probability sampling involves the inherent risk of being somewhat biased but the sample size (120) mostly counters this.



**Figure 1.** Digital initiative classification matrix.

Survey results were cleansed, searching for blanks or multiple answers, removing them, and highlighting outliers. Some variables were grouped into categories, for example, there were 23 sports chosen but six sports were recurring and an 'other' category was made for the remainder. The question 'in what town or city do you live?' gave largely varied answers so this was simplified by country. Because the data is categorical, dummy variables were applied in order to perform the analysis. Digital initiatives were categorised into standard and advanced initiatives (Figure 1) based on research of several stadia. Standard initiatives were those recurring in stadia while advanced initiatives were less common and often in new stadiums or those with high capital investment in technology. To test H4, data was divided into stadium facing and operational<sup>1</sup> initiatives (internal) and fan facing initiatives (external).

Figure 1 represents the digital initiatives arranged by the level, i.e. standard and advanced as well as their focus, i.e. internal vs. external facing initiatives. These classifications were created based on the analysis of data collected from the stadium managers and team executives.

## Results and analysis

Figures 2 and 3 show the respondents' awareness and attitude towards the digital initiatives. We find that awareness is consistently lower than usage (Figure 2). This was later divided into standard digital initiatives (on left of the vertical line) that are commonly seen compared to advanced technology solutions in place only in leading stadiums. The survey validated the categorisation with high previous usage of

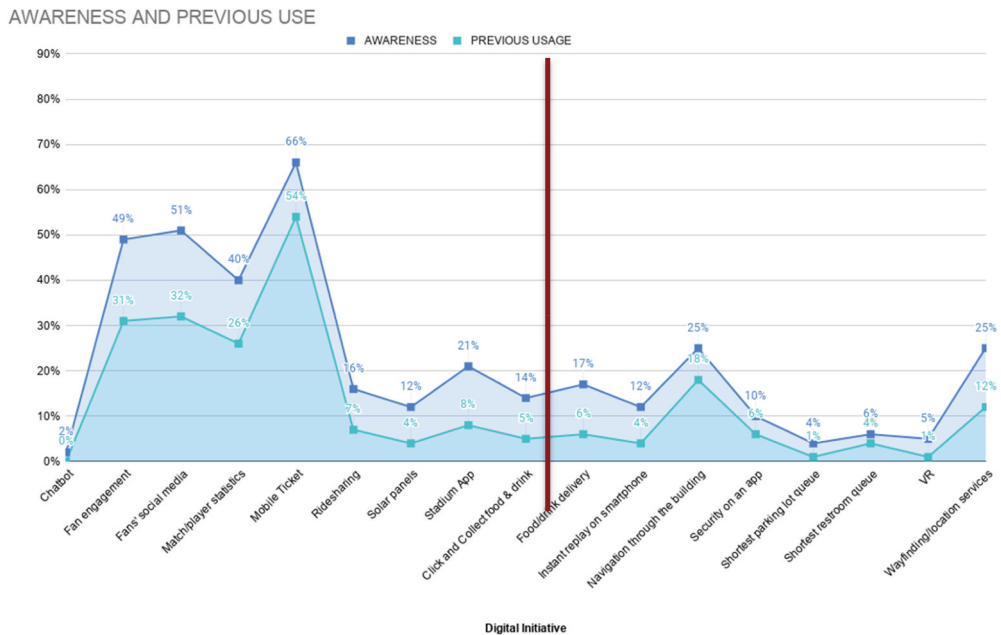
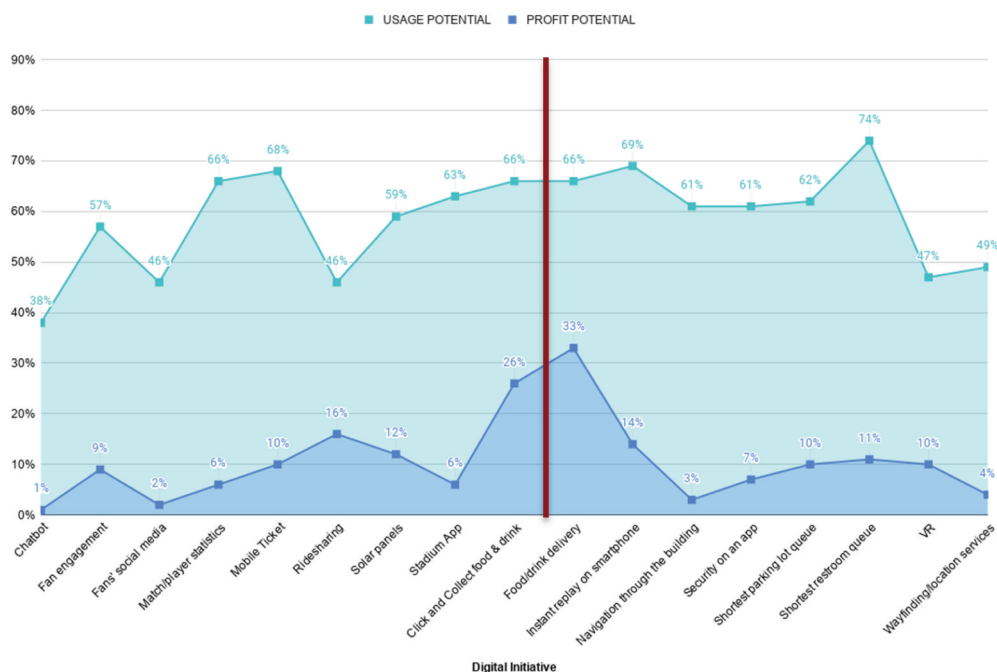


Figure 2. Knowledge of digital initiatives.

## USAGE AND PROFIT POTENTIAL



**Figure 3.** Profitability potential of digital initiatives.

initiatives such as mobile tickets, fan engagement, and social media use, although respondents had more experience with digital navigation through the building than anticipated.

Figure 3 maps the percentage of respondents who indicated they would avail of the digital initiative as well as those who said they would pay 1–15% of the ticket price. The highest potential for use is methods to find the shortest restroom queue remotely, instant replays from a smartphone, mobile ticketing, click and collect and delivery of concessions, and match/player statistics on a smartphone.

The first set of hypotheses that we analyse relate to the type of spectators that stadiums interact with. Table 1 shows multiple models that were used to test these hypotheses. We find that all initiatives' profitability (respondents indicating their willingness to pay 0%, 1–9%, 10–14%, and 15+% of their ticket price) was significantly ( $p < 0.05$ ) impacted by the frequency of respondents' visit to the stadia. It can be concluded that as frequency of attending a match decreases, profitability of digital initiative increases. When initiatives were further divided into standard and advanced measures (model 2 and model 3 respectively), regression of standard measures' profitability with frequency of attending turns insignificant ( $p > 0.1$ ), signalling little statistical difference in means, so there is not a definitive group that are more likely to deem standard technologies profitable. However, the regression of advanced initiatives showed strong statistical significance ( $p < 0.1$ ) implying less frequent attendees particularly favour the sophisticated technologies.  $H_1$  and  $H_2$  are therefore supported.

**Table 1.** Results of mode analysis

|                            | Model 1                                             | Model 2                                                  | Model 3                                                  | Model 4                                         |
|----------------------------|-----------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|-------------------------------------------------|
|                            | DV: Avg profitability of all technology initiatives | DV: Avg profitability of standard technology initiatives | DV: Avg profitability of advanced technology initiatives | DV: Avg awareness of all technology initiatives |
| Gender                     | 0.147*<br>(0.08)                                    | 0.134*<br>(0.09)                                         | 0.216**<br>(0.061)                                       | 0.324**<br>(0.112)                              |
| Age                        | -0.065**<br>(0.033)                                 | -0.038<br>(0.029)                                        | 0.011***<br>(0.008)                                      | 0.043***<br>(0.007)                             |
| Location                   | 0.007<br>(.127)                                     | 0.021<br>(0.142)                                         | 0.005<br>(0.224)                                         | 0.036<br>(0.218)                                |
| Most Favourite sport       | 0.431<br>(0.378)                                    | 0.317<br>(0.441)                                         | 0.654*<br>(0.464)                                        | 0.496<br>(0.502)                                |
| Co-spectator               | 0.006<br>(0.112)                                    | 0.002<br>(0.183)                                         | 0.008<br>(0.216)                                         | 0.016<br>(0.209)                                |
| Frequency of stadium visit | 0.093**<br>(0.046)                                  | 0.059<br>(0.048)                                         | 0.098*<br>(0.051)                                        | 0.081**<br>(0.032)                              |
| Adjusted r-squared         | 0.046                                               | 0.035                                                    | 0.12                                                     | 0.17                                            |
| F-value                    | 3.42***                                             | 3.10***                                                  | 4.365***                                                 | 3.118***                                        |

Numbers in brackets represent standard errors, \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

H<sub>3</sub> is predicated on the notion that social media and smartphone presence (young consumers/millennials) are the cause for the new age empowered fan and therefore demand digital fan engagement. Model 1 shows the results for all digital initiatives. These were later divided into standard and advanced initiatives with results contained in model 2 and 3, respectively. Age measured against profitability resulted in a statistically significant p-value indicating that H<sub>3</sub> is valid and the negative correlation coefficient confirms the hypothesised direction.

To test H<sub>4</sub>, an ANOVA was conducted between means of fan-facing and stadium-facing profitability (Table 2). It was expected that the mean would be higher for fan engagement initiatives as they are consumer facing. As seen by the p-value ( $p > 0.1$ ), there was no consistent trend to indicate this, meaning there is no statistical significance to suggest the primary beneficiary of the initiative (fan or stadium) determines its profitability. Interestingly, while not statistically significant, the mean of internal facing initiatives was greater than that of external facing initiatives (contrary to the hypothesis).2021

**Table 2.** ANOVA analysis for H4

| Groups            | N                     | Average    | Variance  |
|-------------------|-----------------------|------------|-----------|
| avg stadium-faced | 109                   | 2.59611184 | 0.4475196 |
| avg fan-faced     | 109                   | 2.57607034 | 0.4193837 |
| <b>ANOVA</b>      |                       |            |           |
| F-value           | 0.050 ( $p = 0.822$ ) |            |           |

## Limitations and conclusion

This research can be expanded upon with more specific demographic survey questions or the model of purposes quantified through further experimentation in future. Due to the importance of social media in the sporting industry discussed in the literature review, analysing spectator's satisfaction and profitability through social media by analysing sentiments using Twitter data could make for an interesting study to complement this one.

We find that fans benefit from increased operational efficiency that the new technologies introduce in the stadia. Technology entities provide means for fan engagement (Mártins et al., 2022), which benefit the spectator and increase customer retention and ticket sales, ultimately cyclical as the stadium and team can invest this to better themselves on a digital or other property. Technology entities are in an advantageous position, as the sports and technological boundaries are blurring and their services and increasingly demanded as stadium technology and experiential economy trends continue on an upwards trajectory. This paper provides an interesting mechanism to enable firms to make decisions about the type of technology to adopt in their stadia. Extant research has shown that there is a need to be innovative as well as maintain sustainable balance (Sinha et al., 2022). This paper provides a mechanism for such stadium managers to make the optimal decisions to maximise fans experience, without the need for investment in non-relevant innovations.

## Notes

1. Internal, stadium-facing, and crowd managements are used close to interchangeably because with the exception of chatbots and solar panels, all initiatives deemed stadium-facing are to mitigate crowding and disperse spectators equally through the stadium.

## Disclosure statement

No potential conflict of interest was reported by the authors.

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## Appendix

**Table A1:** Description of survey respondents.

| Attendance frequency          |     | Categorical variable coding | Favourite sport:            | 1st | 2nd | Categorical variable coding |
|-------------------------------|-----|-----------------------------|-----------------------------|-----|-----|-----------------------------|
| Weekly                        | 26% | 1                           | GAA                         | 49% | 30% | 1                           |
| Monthly                       | 23% | 2                           | Rugby                       | 27% | 21% | 2                           |
| Every 2–3 months              | 18% | 3                           | Soccer                      | 13% | 17% | 3                           |
| 1–3 times per year            | 33% | 4                           | American football           | 4%  | 1%  | 4                           |
|                               |     |                             | Basketball                  | 1%  | 5%  | 5                           |
|                               |     |                             | Tennis                      | 1%  | 9%  | 6                           |
|                               |     |                             | Other                       | 5%  | 17% | 7                           |
| <b>Age group</b>              |     |                             | <b>Stadium/sports venue</b> |     |     |                             |
| Under 18                      | 0%  | 1                           | CROKE PARK                  | 37% |     | 1                           |
| 18–22                         | 29% | 2                           | AVIVA STADIUM               | 21% |     | 2                           |
| 23–26                         | 9%  | 3                           | All Dublin stadiums         | 4%  |     | 3                           |
| 27–30                         | 5%  | 4                           | Other Irish stadiums        | 17% |     | 4                           |
| 31–34                         | 2%  | 5                           | UK stadiums                 | 9%  |     | 5                           |
| 35+                           | 57% | 6                           | US stadiums                 | 7%  |     | 6                           |
|                               |     |                             | Other countries' stadiums   | 5%  |     | 7                           |
| <b>Gender</b>                 |     |                             | <b>Nationality</b>          |     |     |                             |
| Male                          | 62% | 1                           | Ireland                     | 77% |     | 1                           |
| Female                        | 38% | 2                           | USA                         | 9%  |     | 2                           |
|                               |     |                             | UK                          | 10% |     | 3                           |
|                               |     |                             | Other                       | 4%  |     | 4                           |
| <b>Fellow spectator group</b> |     |                             |                             |     |     |                             |
| Alone                         | 3%  | 1                           |                             |     |     |                             |
| Spouse/family                 | 56% | 2                           |                             |     |     |                             |
| Friends                       | 41% | 3                           |                             |     |     |                             |