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Abstract

The purpose of this research is to explore and define the digital maturity of events using the Industry 4.0 model (I4.0), to create a definition for Events 4.0 (E4.0) and to place various relevant technologies on a scale of digital maturity.

In a mixed methods approach, we carried out a qualitative social media analysis and a quantitative survey of tourism and events academics. These surveys and the thorough literature review that preceded them allowed us to map the digital technologies used in events to levels of a digital maturity model.

We found that engagement with technology at events and delegate knowledge satisfactorily coexists for and across a number of different experiential levels. However, relative to I4.0, event research and the events industry appear to be digitally immature. At the top of the digital maturity scale, E4.0 might be defined as an event that: is digitally managed; frequently upgrading its digital technology; fully integrates its communication systems; and optimizes digital operations and communication for event delivery, marketing, and customer experience. We expect E4.0 to drive further engagement with digital technologies and develop further research.

This study has responded to calls from the academic literature to provide a greater understanding of the digital maturity of events and how events engage with digital technology. Furthermore, the research is the first to introduce the concept of E4.0 into the academic literature. This work also provides insights for events practitioners which include: the better understanding of the digital maturity of events, and the widespread use of digital technology in event delivery.

Recognizing Events 4.0: The digital maturity of events

Introduction

Events are in the midst of rapid social and technological change. With a growing variety of technological means, the industry is fast-paced and increasingly delivered to a discerning consumer market while finding ways to connect with consumers through technology (Lockstone-Binney *et al.*, 2013; Mitchell *et al.*, 2016; Silvers *et al.*, 2005; C. M. Van Winkle *et al.*, 2016). The triple revolution of increased smartphone ownership, social media and faster Internet speeds continues to create a more networked and connected experience for people and organisations (Poushter, 2016; Rainie and Wellman, 2012). Digital technology is the thread of the fabric of organisations (Li et al., 2018). It is an increasingly important part of how they engage with their customers.

Despite some resistance, digital technology continues to permeate festivals and events around the world (C.M. Van Winkle *et al.*, 2018). Contemporary events can be compared to the great exhibitions of the 19th century, at which nations would exhibit the latest technological advances to the rest of the world (Paxman, 2009). Therefore, there is an implicit expectation that events should demonstrate the very latest in digital technology. Furthermore, events are complicated supply chains and digital maturity in events may offer competitive advantages. For example, the ability to digitally access data can improve festivals, conferences, and exhibitions by providing superfast communication with external partners. Moreover, engagement with events as fans, spectators, delegates or organisers, can be augmented with digital technology by improving access and sociability capabilities, refining the personalisation of events, and thereby creating enhanced experiences.

As we advance into what many in business and academia consider to be a fourth industrial revolution, the capacity to control and exchange data electronically has extended our ability to create, edit, maintain, transmit and retrieve information. To this end, the modern event organiser is able to develop the event participant – event – event

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organiser relationship through digital communication technology and insight through data (Krishna and Mauri, 2016; Krzysztof, 2015).

Industry 4.0 (I4.0) is a metaphor for the digitisation of industry. Industry as a whole is becoming more and more driven by Internet connected digital systems and data, which in turn means that real and virtual worlds become 'smart' and grow together (BMBF, 2018). Oesterreich and Teuteberg (2016) noted that I4.0 can be described as the digitisation and automation of the manufacturing environment. It also creates digital value chains to enable the communication between products, their environment, and business partners. Digital applications have impacted the tourism sector too giving rise to 'Tourism 4.0' (Boes *et al.*, 2016; Korže, 2019). This is based on leveraging big data processing from travellers and technologies such as artificial intelligence, mobile internet, robotics, Internet of Things, and cloud computing to deliver an enhanced travel service (Papathanassis, 2017). The concept of being smart characterises everything that is embedded or enhanced by Information and Communication Technologies. It is said to signify resource optimization through the use of advanced technologies (Gretzel *et al.*, 2015).

Smartness emphasises how interoperable systems can integrate functions that have the ability to manage big data and generate value (Boes *et al.*, 2016; Gretzel, 2018). The events industry is an ideal environment to benefit from the implementation of a widespread digitised approach with numerous organisations empowering managers and improving the overall event experience with the integration of extensive ICT practices and systems. However, a gap exists between industry and education as there is little research that assesses the different levels of digital technology in use in events and whether different levels of technology impacts upon the event experience. This paper seeks to bridge this gap between academic theory and event practitioners.

Neuhofer *et al.* (2013, p. p340) observed "while literature has recognized the recent impact of technology on experiences, its empirical exploration remains scarce". Whilst there have been further empirical and theoretical studies since (Flavián *et al.*, 2019; Pallud, 2017), the problem remains. Mair and Weber (2019 p209) reinforce this by observing "the rapid growth of the events/festival industry in the past few decades has not always been matched with the level of research devoted to investigating it". Theory development relating to the different digital maturity levels within events remains

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unfilled. Therefore, we seek to drive understanding and research of the digital maturity of events by developing an Events 4.0 (E4.0) model based on the I4.0 metaphor. Henceforth, our study is likely to be of interest to a wide-ranging section of academics and practitioners who have an interest in developing work and research in this area.

With the more widespread adoption of digitalization in event delivery and as the supply chains of all events become intertwined with technology, we can learn how the digital maturity of events in the 21st century is shaping event management and event control. Then, we can seek to describe what a mature digital event is, and to define E4.0. In so doing, there is the opportunity to mimic I4.0 and to express the digital maturity of the events industry as E4.0. In order to achieve this, a benchmark for digital maturity of events needs to be established, with each of the levels of digital maturity requiring a description.

The purpose of this research is therefore to explore literature on digital maturity in events and define the different levels of digital maturity of events using the Industry 4.0 model (I4.0), to create a definition for Events 4.0 (E4.0) by placing various relevant technologies against levels of a digital maturity model.

Our research used a mixed methods approach. First of all, we conducted a qualitative social media analysis of a LinkedIn group devoted to events and technology populated by events professionals from around the world. To complete our exploration, we secondly conducted a survey of events academics in order to quantify perceptions of events technologies against levels of knowledge and understanding.

The research team is multi-disciplinary with expertise in digital transformation, event management and social media analysis. Multi-disciplinary teams bring a multi-view perspective, which many authors claim is a good thing (Dawson, 2019; Goodman, 2013; Tredinnick, 2006; C.M. Van Winkle *et al.*, 2018). The combination of expert knowledge from a variety of knowledge backgrounds is a key driver for this research.

The team set out to answer the following research questions

RQ1: Can digital maturity in events be defined? If so,

RQ2: How should the levels of digital maturity of events be classified?

RQ3: How does the digital maturity of the events industry affect the development of event management theory?

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Literature review

The various levels of digital maturity in events cover a wide range of principles. For example, the success of recurring events in the 21st Century is achieved by engaging a number of continuous evaluation procedures that are digitally integrated throughout the lifetime of an event (Rani, 2018; Tokosch, 2016). Successful events are no longer measured by simply achieving a respectable attendance. A great deal more engagement is manifest through digital technologies. Moreover, the days of passive consumers who were largely dependent on the success of companies reaching them for engagement have gone (Hudson and Hudson, 2013). Bustard *et al.* (2019) considers it pertinent to measure engagement with an event by how individuals and groups are exploring meaning across a myriad of touch points with consideration for the cognitive, conative, and affective realms of that experience.

Evaluation of events has become just as important as a means of engagement even before the event occurs. It is no longer enough to use evaluation for reflective or post-assessment purposes (Getz, 2018). Successful events require organisers to create something that is considered by those who attend as a valuable and memorable experience (Pizam, 2010; Tung, 2011). Creating memorable event experiences can be described as being dependent on a number of factors including, creating regular attendee engagement, providing appropriate activities, relevant subject matter, topical and contemporary focus and targeted to a sizable receptive audience. There remains a lot to discover about the event and festival experience (Jackson, 2014) as well as how event organisers can best attain this knowledge to provide memorable experiences. With ongoing developments in technology, data can be and to a large extent are being provided by the delegates themselves in real time during the event as their movements and engagement is collected as data. Digital maturity is allowing events to fine-tune each stage of the delivery process.

From a broader business perspective, various authors (Colli, 2018; Glass *et al.*, 2018) believe that the digital maturity process itself involves multi-disciplinary activities with technological factors being one of the most important areas of demand for companies along with the implementation of I4.0. SMEs (Small to medium enterprises) are [lagging] behind in developing strategies to implement new solutions. Glass *et al.* (2018) suggests that to confront this shortage companies, governments, and education

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facilities should increase their efforts to offer interdisciplinary apprenticeships and degree courses in the subject. Colli (2018) on the other hand considered a number of existing digital maturity models and proposed six sequential digital maturity stages of digitalization to understand the strategic focus, goals and perspectives of a company.

Using a similar approach, Gill and Van Boskirk (2016) created a self-assessment digital maturity model to help companies assess their overall digital readiness. By attributing responses to four dimensions, (business culture, technology use, organisation support, and data insights), businesses were able to assess their digital maturity against global best practices. These consisted of level one: sceptics, level two: adopters, level three: collaborators, and level four: differentiators. The results created a bell curve of business types ranging from Public Sector at level one, B2B Healthcare and Utilities at level two. Manufacturing, and Multichannel Retail at level three, and Online Retail businesses at level four.

The development of digital maturity in events can be compared to smart tourism, which Gretzel *et al.* (2015) expressed as a logical progression from traditional activities. Smart tourism is characterised by an ability to transform large amounts of data into enhanced tourist experiences and increased destination competitiveness thanks to the interconnection of the different stakeholders through latest ICT advancements (Buhalis and Amaranggana, 2014; Femenia-Serra, 2018). Digital technology is transforming the focus of business processes from physical products to data-driven services (Pflaum and Golzer, 2018). This is evident even in the delivery of events as a mix of virtual and live action through computer graphics and virtual reality to create a more immersive experience and a better brand connection (Colston, 2017). As the components of I4.0 become more prevalent in the events industry, much value can be obtained from understanding how businesses are adopting new levels of digital engagement in order to engage their audiences (Heinze, 2016).

As technology and digital technologies circle every aspect of an event organisations activities, it is prudent to suggest that survival and future success of events can depend upon digital maturity and transformation (Li *et al.*, 2018). Bustard *et al.* (2019) considers the adoption of digital technologies as an emerging era of ubiquity in computing intelligence that provides the potential of the interconnectedness of experience through multiple stakeholders. However, dealing with digital maturity requires careful attention as Neuhofer

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(2016) urges caution advising that applied technology solutions have proven to have the ability to create or destruct the value of the experience.

It was the German Government who initially discussed competitiveness in industry and signalled I4.0 as a new era in manufacturing as the fourth industrial revolution (BMBF, 2018). Since its first expression in 2011, I4.0 has galvanised all industries into understanding how to maximise the benefits of automation and data exchange. Today, the 4.0 suffix is the principle buzzword in the lexicon of cutting-edge organisations. Substantially though, Gilchrist (2016), while suggesting that I4.0 claims to be many things and hard to define, describes characteristics of I4.0 that are relevant to E4.0, including:

1. The merging of the Operational Technology (OT) with Information Technology (IT) to provide a new level of organisation and control over the entire value chain of the lifecycle of products
2. Global networks to connect machinery, factories, and warehousing facilities as cyber-physical systems
3. Flexibility to cater to last-minute design changes geared towards increasingly individualized customer requirements
4. Bring new ways to create value, business models, and downstream services for SME (small medium enterprises)

The global future potential of I4.0 is reflected in financial commitment. Industrial sectors are planning to commit US$907 billion per annum to Industry 4.0 – around 5% of revenue (Geissbauer *et al.*, 2016). Generating, analysing, and communicating data seamlessly underpins the gains promised by I4.0 (Columbus, 2016). More specifically, I4.0 refers to the emergence and diffusion of a range of new digital industrial technologies (Gerbert, 2015), whereas in previous eras (Industry 1.0, 2.0, and 3.0) are characterised by mechanisation, mass production and electronics, and IT. What is different about I4.0 is that all the benefits of previous revolutions in industry came about after the fact, whereas with the forth revolution there is the chance to proactively guide the way it transforms our world (Gilchrist, 2016). I4.0 therefore acknowledges the impact of connected computers with the key constituents being cyber-physical systems, the Internet of Things, cloud computing and cognitive computing (Woliński, 2018).

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Various authors, (Kozinets, 2015; Krishna and Mauri, 2016; Rainie and Wellman, 2012), have highlighted that the use of communication networks globally has risen dramatically and become ubiquitous due to the rise of smartphone ownership. This has been fuelled by social media, apps, and faster broadband speeds to create a networked society (Ilya, 2015). This culture shift creates a change in behaviour, which in turn creates large volumes of data. These datasets in the 4.0 networked era can be harnessed to monitor and evaluate events. Ultimately, our smartphones, (when used in conjunction with event apps) and wearable devices (such as delegate smart badges and smart buttons), are able to collect live data through Internet of Things, analyse them, and even make decisions based upon them using Artificial Intelligence decreasing processing errors and generating easier access (Sirius, 2013). By combining the Internet of Things data and big data, (extremely large data sets that may be analysed computationally to reveal patterns, trends, and associations, especially relating to human behaviour and interactions), event managers are able to create a competitive advantage.

Until recently, most business decisions have drawn upon data from a limited range of traditional sources such as production records, internal accounts and market research reports (Strange and Zucchella, 2017). However, since the Internet of Things, website analytics, Big Data, and social media data, events can provide their audience with much more personalised and tailored experiences. As event companies develop new and innovative ways to connect, the events themselves are absorbing aspects of I4.0 at every stage of the process; pushing the boundaries of event experiences far beyond the physical world (Ryan, In press). For example, Internet based technologies such as social media play an increasingly important role in the promotion and meta-narrative of events (Taylor, 2013). They are used to promote events before, during and after delivery and are used to gather data and inform decision making. Generating responses from an event can be achieved using a number of methods and through both qualitative and quantitative data. This can vary from simply counting the number attendees to conducting complex data analyses that provides data on their movement during the event and their actual engagement with other attendees and traders (DoubleDutch, 2018). These data can then be amplified with online questionnaires and a variety of website and social media data. If collected, visualised and used appropriately, the data can be of immense value and can serve to assist in real-time evaluation and the future direction and content of upcoming events (eventmobi, 2017).

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With the advent of big data and analytics, new sources of valuable data are available to guide decision-making processes in a more informed manner. Businesses were once looking at historical data but advances in database technology and system processes has led to near real-time data collection and analytics (Madarasz, 2018). Many events businesses are yet to realize the power of digital technology and the potential value it may bring to their events. Failure to adopt aspects of digital technology does not necessarily suggest a poor experience or the end for those businesses less digitally mature; not every events business relies on this kind of data support to survive. Instead, this research provides an opportunity to better understand where event businesses do engage and more importantly, how communication between non-digital and fully integrated individuals/businesses can be improved.

So far, research around the subject of events management and I4.0 in academic books and journals is very limited. This is not to suggest research into events and digital technology is limited, for which a body of research exists. However, (and if somewhat surprisingly), I4.0 has been overlooked and is yet to be broadly adopted into events research. Instead, previous research has focused directly on topics such as the rapid development of new technologies (Andrews, 2013), ICT and communications (Evans, 2015), digital communication channels, 'smart' business and social network analysis (Jarman, 2016; Theodoraki, 2014), and technology adoption at events (S. Lee, Boshnakova, D., Goldblatt, J., 2017; Robertson *et al.*, 2015; C.M. Van Winkle *et al.*, 2018). Digital maturity and transformation today differs from previous periods as it not only provides the change in the main business processes but also reveals the concepts of smart and connected products through service-driven business models (Li *et al.*, 2018; Onar and Ustundag, 2018). Information from social media data analysed through techniques such as netnography (Kozinets, 2015), Big Data Analysis and social network analysis become undoubtedly relevant in the pursuit of understanding both intra- and inter-festival relationships (Richards and Palmer, 2010).

Methodology

This critical evaluation of the literature has established that at present little has been done to empirically assess or measure the maturity of digital technology used in events and whether digital technology is impacting upon event experience. Therefore, given that

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we seek to understand these matters through academic study, the research questions remain. To answer the research questions, a description of the two research instruments is provided justifying their use in detail positioning these particular methods within the universe of methods.

To answer RQ1, data were initially captured from a LinkedIn group made up primarily of events professionals and academics. More specifically, analysis of the data informed our outline of the E4.0 concept. For RQ2, a survey was distributed to a forum made up of academic members of the international tourism and event research and education community. To answer RQ3, we compared data from the literature review and data from RQ2 to understand what research already exists and how this links to digital maturity research.

The research essentially adopts a constructivist approach as the overarching philosophy. It includes quantitative and qualitative components which are embedded into an interpretative phenomenological analysis to explore the role of digital technology in the delivery and experience of events (Halinen, 2005; Ormston, 2003; Scott and Morrison, 2007). As the research also engages with social media, consideration must be given to trust from the contributing members. In these circumstances, trust is perceived as an outcome of repeated interactions in which relationships are gradually developed between network members over a period of time (Luo, 2005; Rousseau *et al.*, 1998). From an ethical perspective, all names were anonymised and permission was sought from social media group owners and participants.

The research is also considered interpretivist rather than a positivist mixed methods approach with two analyses being conducted sequentially. The qualitative phase of social media analysis was conducted in its entirety, closely followed by the quantitative survey. In terms of emphasis, each had equal status as they were designed to answer a specific research question. The qualitative phase was conducted through LinkedIn between April and September 2018 followed by the survey in November 2018.

Adopting this design provided both quantitative and qualitative data of digital technologies and applications to inform RQ2, and the different digital maturity levels (see figure 2 below), and to further the understanding of the digital maturity of events. The additional triangulated empirical data presented allows for improved perceptions into the current state of digital-technology adoption and digital maturity in the events industries in a time of continued digital development. It is also important to emphasize

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the value of the data collected considering the approach adopted. It is appreciated that usually large data collection is generally more reliable and precise (Veal, 2011). However, once a qualitative approach towards the research has been included, (Travers, 2001) suggests there are no benefits in working with large data sets, since these encourage a positivist mentality towards analysis. What was most important to this research was engaging with a sufficiently informed sample of the English-speaking events academics and industry population.

Our analysis begins with an attempt to uncover the potential challenges, ongoing developments and various strategies that will provide the events industry and academics with a forward-facing approach to the growth of technology within events. By including industry professionals and academics, the research contributes to bridging the gap between practise and academia. Our research approach aims to create further understanding of events and their digital maturity and how digital connectivity in particular impacts on the event experience and management.

From a theoretical perspective, creating a better understanding of E4.0 bridges an important gap in the literature that assists in teaching event students contemporary problems in events and digital maturity. The research also responds to calls from industry and academics who seek for further research in this area (EN, 2017; Gold, 2019; Neuhofer, 2016; Neuhofer *et al.*, 2013; C. M. Van Winkle *et al.*, 2016; Wood, 2018). Because the research and empirical data collection includes industry perspectives, we believe this research will provide value to event managers, marketers and practitioners around the world who wish to understand more about the digital maturity of events.

The research communicated directly with event professionals and academics through the following approach:

1. Social media analysis of an events-professionals LinkedIn group for events and technology
2. A survey delivered to tourism and events academics to quantify the levels of our developing E4.0 model of the digital maturity of events

After conducting the social media analysis, it became evident that the discussions appeared to be around topics that utilise digital technology rather than the technology itself. Therefore, a survey was designed for an academic audience in order to improve the levels of relevant responses. The findings are presented below.

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Qualitative analysis of events-professionals LinkedIn group

In order to answer the research questions generally and to begin to understand the concept of E4.0 (RQ1), online analysis of a group of events professionals on LinkedIn was used. The research team contacted the 'Social Media and Event Technology for Event Planners and Meeting Planners' group on LinkedIn. This group is composed of over 25,000 events professionals with a shared interest in events and technology. It is a closed group. The group gave permission to use their data. For brevity in the remainder of this paper, we refer to this study instrument as the "social media analysis".

The group represented the largest and most active group on LinkedIn for the topic of events and technology. Data were collected manually from the LinkedIn Group by copying and pasting posts from the start of the group (June 2017) to the time of analysis (June 2019). While the group may not be representative of events-professional as a whole, we argue that posts from individuals in this group, by virtue of their engagement with this social media platform, are most appropriate for developing an understanding of E4.0.

The dataset comprised of 21,656 words in 234 posts from 98 individuals. We did not include the comments on the posts in the analysis because we wanted to focus on the posts that had initiated discussion. In this way, we argue that the data are representative of topics rather than representative of debate about topics. Analysing comments would also have been technically very difficult due to the sheer volume of information.

We did not have detailed information about the precise characteristics of the individuals who contributed to the dataset of posts. However, to an extent, their roles listed in LinkedIn were informative. These included events consultants, social media managers, marketing professionals, EventTech managers, CEOs at tech companies, and events students.

The posts were brought into the qualitative analysis software Nvivo, a qualitative data analysis computer software package. The data were interpreted thematically by the research team, focusing specifically upon different types of technologies mentioned. The purpose was to understand the technologies most important to events professionals within the time period under study. This provided a snapshot of this shifting landscape. In this analysis, 65 categories were created by the research team for different types of technologies mentioned in these professional posts. These themes are presented in the discussion below.

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Survey of academics

In order to qualify the levels of digital maturity, some targeted quantitative data would be required. To achieve this, a Qualtrics questionnaire was distributed to 3,092 academics who belonged to an email list that connects members of the international tourism and event research and education community. The response rate was 1.7% (52 responses). It was not possible to extract any analytics on the profile of the respondents or the members of the list.

Although this response rate of 52 academics may be considered low, this did allow for the creation of the initial insights into the E4.0 concept and crucially it provides a starting point to better understand the levels of the developing digital maturity model. Moreover, given that a purposive sample was used, purposefully choosing participants on the basis that those selected are knowledgeable of the subject is more likely to provide relevant data, the findings can therefore be considered more generalisable (Basit, 2010; Kuma, 2014). The survey results also created an additional foundation for further studies and triangulation with the findings from the other methods in this study.

Findings

Findings from social media analysis

The posts of the group were read and analysed thematically. The themes were then used for further qualitative analysis of the posts and to inform the definition of E4.0. Each post was carefully reviewed and coded in Nvivo, generating 65 themes in total. The most referenced themes were social media, marketing, apps, GDPR and mobile. The top 14 themes are shown in figure 1 below.

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Name	References
Social Media	30
marketing	18
apps	16
GDPR	11
mobile	8
Data	5
interaction	5
planning	5
interactive	4
ROI	4
AR	3
brand	3
Fundraising	3
Influencer	3

Figure 1: Results of the thematic analysis of the social media data

The results of the thematic analysis reveal the most pertinent events and technology topics in this group in the time period specified. The most common topics were social media and marketing. Marketing appeared alongside other topics as a verb, a noun, and an adjective. This certainly influenced its prominence. It is clear therefore that social media engagement is of key importance to events and delegates. However, it is important to highlight that conversations on LinkedIn are usually posted with an image that is a link to a much more detailed discussion. The more important data might have existed in the image or the link.

From the qualitative analysis of the comments, it was evident that the members of the group appear positive towards the use and future development of technology. Event Professional 'A' stated:

> "Social media and event technology are here to stay. Social media offers unprecedented opportunities to add value up & down the event planning & management chain."

This statement reinforces the knowledge and general use of social media during events. Similarly, mobile and event apps can be considered as recognised. In another statement Event Professional 'B' observed: "The world of event technology, software and "apps" is exploding" while Event Professional 'C' commented that business and events "are increasingly adapting to the changing trends of mobile technology". With all of this social

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media and app technology however, there also comes issues around data and its use and protection.

The timing of the research coincided with a major change in the General Data Protection Regulation (GDPR) provision, which is the new regulation in EU law on data protection and privacy, which came into force in May 2018. This would have influenced the prominence of GDPR in the analysis. GDPR represents a significant part of the discussion in this period. Event Professional 'D' commented:

> "Data integration can help your events with GDPR compliance. With GDPR just around the corner, there's never been a better time to integrate your event data with business systems like your customer relationship management (CRM)"

The topics discussed in the social media analysis and how these fit with various systems and processes at events provided the first level of data. The results of this analysis are indicative of some aspects of E4.0 that may be important and make a partial step towards answering RQ1. It was therefore possible to provide an initial definition for E4.0: events that are frequently iterating, digitally managed and fully integrated with social media marketing, CRM and other data and digital systems, with communication optimised at all levels, through mobile devices and apps, in order to inform other sections of the delivery operation, to maximise marketing opportunities and to enhance the experience of attendees.

Findings from the analysis of the survey of academics

Event organisers invest heavily on social media engagement and expect a great deal in return through social media retweets, tagging and sharing of images. However, it is just as important to understand if delegates consider technology at events that important. With this in mind, we asked our expert respondents to rate their knowledge, views and understanding of various events technologies. We then mapped these to the levels of our developing model of the digital maturity for events.

In order to understand the importance of digital technology at events, the survey opened with some general observation questions. Our expert respondents were asked if they considered the events industry to be at the cutting edge of technology. Responses were largely supportive of the suggestion that it is. 64% agree, 22% neither agree nor disagree and 14%

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disagree. This was followed with a question on how important academics considered the use of technology/digital applications when attending conferences/events. Only 2% considered its use not important at all. 24% considered it extremely important, 39% very important and 29% moderately important.

The survey then transitioned from respondents' perceptions of the event industry to ask about the respondents' own use of technology at events. Thus, our expert respondents were asked about their general method of engagement when attending an event or conference (email, text, Facebook, Twitter, etc.). These provided something of a description of the respondents rather than informing us about the digital maturity of events.

Moving to knowledge of more advanced areas of technology, the survey sought data on aspects of digital engagement at conferences and events. These included:

1. Online registration/digital booking
2. Use of website and social media analytics data for insight
3. social network analysis tools to map out networks and influencers
4. Use of event Apps for smartphones
5. Use of wearable technologies for events staff and delegates
6. Social media and search engine paid advertising
7. Use of Client relationship management systems
8. Use of website content and search engine optimisation

Optional answers included: Extremely familiar, Very familiar, Moderately familiar, Slightly familiar, and Not familiar at all.

All of these digital technologies would have been experienced by our expert respondents when attending events in the 21st Century. However, the survey sought to discover how familiar the respondents were with these technologies and if the actual term for the technology was more or less well known. The survey deliberately did not offer any explanation or definition of the technology as this may have influenced the answer.

Similar to the previous question, a lot of the resulting data was expected. Online registration/digital booking was very familiar with 65% 'extremely familiar' with the technology. Overall the remaining seven varied evenly between very familiar and slightly familiar with only social network analysis tools to map out networks and influencers receiving the lowest 'not familiar at all' response rate of 7%.

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The survey also collected a selection of qualitative data as respondents were asked to if there were any specific examples of connected/digital technology considered to be essential to the delivery of an event that had not been discussed in the survey. 23% answered no to this question. However, the following answers below in Figure 2 detail the most important examples of digital technology that delegates engage with or expect to during the lifespan of an event with number of times referenced.

Rate of response	Answer
6	wifi
5	Email
4	Apps for conference session registration
4	Voting systems
3	mobile responsive website
3	online streaming
3	opportunity to engage with others who are not attending physically
3	presentation materials
3	Scanners of barcodes
3	Video conferencing
2	Online video Skype
2	Real time streaming
2	social media checkin
1	Active microhones
1	Artifical Intelligence
1	bots
1	chatbots
1	crowd sourcing, polling etc
1	Electronic program and books of abstracts
1	event hashtags
1	Gamification
1	geolocation tagging
1	iBeacon, location mapping, augmented reality
1	paperless proceedings
1	RFID
1	security

Figure 2: Results of the survey: frequency of use of digital technologies when attending conferences/events.

It became evident, during the course of the research, that delegates experience different types of digital technology either before, at, or immediately after registration. Indeed, a question asked about delegates experience of digital technology on arrival or during the early stages of arrival where a great deal of technology is used. Figure 3 below shows delegate familiarity with a large selection of digital technology used at events.

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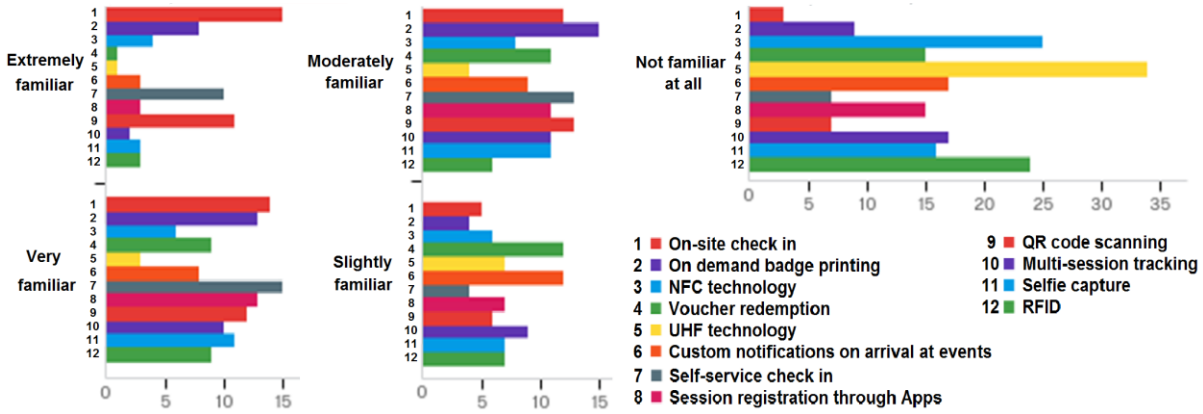

Figure 3: Results of the survey: experience of digital controls at conferences/events.

In order to link the theory of E4.0 to aspects of I4.0, a question was designed to include the key constituents of I4.0 - cyber-physical systems, Internet of Things, cloud computing and cognitive computing. These were included with a broader selection of more advanced forms of technology that are used at or through the delivery of events. Many of the forms of technology are used to analyse and market the event, while others can be part of the event experience. The different types of technology included in the list were sourced from three leading event management software companies who provide solutions to the set-up look, feel, and functionality of events in mobile apps. Figure 4 below highlights respondent engagement and knowledge of these terms.

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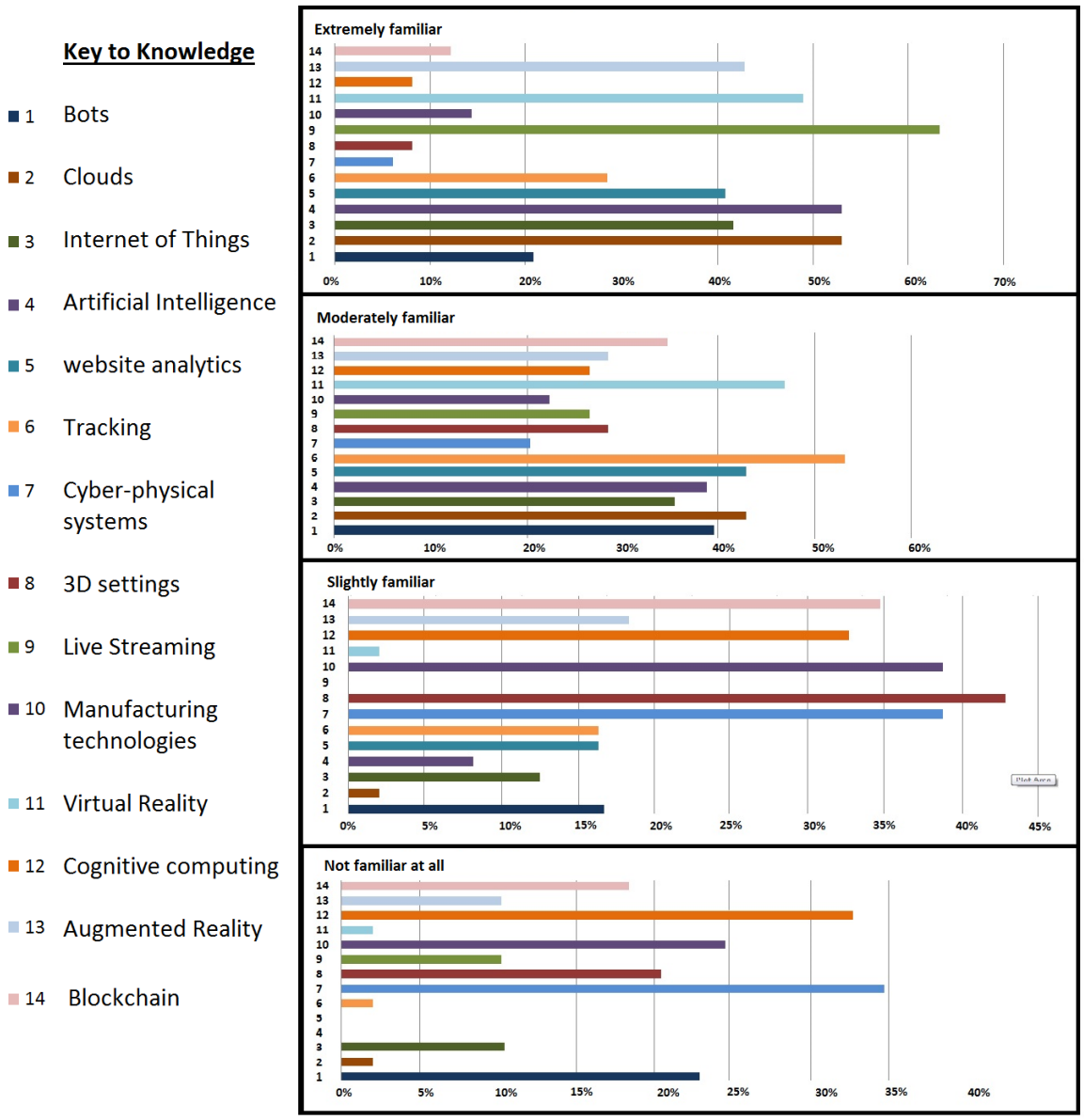

Figure 4: Results of the survey: digital technologies mapped against levels of knowledge.

Discussion

Having studied digital technology at events on three levels, a literature review, a qualitative analysis of topics of interest, and a survey of engagement, a greater understanding has been achieved. This study is the first to consider the different levels of engagement with digital technology and to explore the topic empirically. The findings from the research have found that digital-technology engagement exists on a number of levels.

With regard to RQ3 and the digital maturity of the events industry affecting the development of event management theory, the literature review indicates that academics are

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making contributions to theory and a broad understanding of digital technology exists. However, relative to I4.0, from the social media analysis and the survey, the perception is that the events industry appears not to be digitally mature. Also, our findings suggest that relative to I4.0 not all events are digitally mature. Therefore, the 'digital immaturity' of the events industry may be having some effect on event management theory, so that theorists (like us) are arguing for greater digital maturity across the events industry. In addition to this, it was notable to observe the link between event technology and I4.0 was absent from current event research.

This research provides a new starting point on which to build further data on academic engagement with technology at events. Considering the industry's engagement and ongoing drive towards even greater technological integration, academia should place even greater emphasis on the need for understanding technology and its different levels at events.

It became evident from the survey that many respondents suggested they were not familiar with technology that they would all have experienced. Digital technology at events is fundamental to the future of event experiences; whether it is knowingly experienced or not. For example, RFID (radio frequency identification), NFC (near field communication) and UHF (ultrahigh frequency) all employ radio signals for all sorts of tagging and tracking purposes often integrated into a smart badge at registration for conferences or ticketing at events. It is most likely that our respondents would have experienced the different technologies, but have not linked their experience with the terms.

At the other end of the scale, we sought to understand respondent knowledge of the main aspects of I4.0. In order to gauge this, we asked for respondent knowledge of a number of the I4.0 terms. Overall there is widespread knowledge of more than just the elements of I4.0; most of the suggested technologies scored highly in the knowledge of and understanding sections.

The results from the survey suggest that widespread academic understanding of technology at events is extensive. Some digital technology is considered routine, while other comprehensively used technology appears to be unfamiliar to the end user. The survey questions were designed to inform what technologies contribute to the various levels of digital maturity at events in figure 5 below. These ranged from engagement with email, text, websites, social media and Wi-Fi, to the actual components of I4.0, cyber-physical systems, the Internet of things, cloud computing and cognitive computing.

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Currently, there is an emergent desire to engage and understand more about the capabilities of technology within events (S. Lee and Goldblatt, 2012; Mair and Weber, 2019; PRNewswire, 2018; Sell, 2007; Van Niekerk, 2017; Yeoman, 2013). This is manifest through the popularity of event technology groups on LinkedIn and the use of hashtags for social media discussion. The growing digital maturity levels form the foundation for E4.0 and will contribute to what Gerbert (2015) described as greater efficiencies and changing traditional relationships among suppliers, producers, and customers. For conferences and events, these advancements provide the organisers with real data that can assist in the decision making process and provide critical information to assist in developing greater communication.

The connectivity event organisers seek to achieve through social media is well documented as a primary means of two-way communication. These organisers use Twitter extensively to communicate with visitors, and to keep them informed of latest developments (Hudson and Hudson, 2013). However, the lack of value our expert respondents placed on this form of social media is highlighted in the results that suggest this platform is minimally utilized.

The qualitative responses in figure 2 not only highlight perception of the depth of digital technology being used at events, it also highlights the fact that many delegates are satisfied with a less digital level of engagement. Event Professional 'E' suggested:

> Technology is a hygiene factor. [It is] Not really important at all for a good conference. Also, the nature of most conference venues is such that technology is a struggle; e.g. difficulties in getting PowerPoints to work, microphones that don't work.

Taking these comments a stage further, Event Professional 'F' stated, "I don't really think about it [technology] much. I'm there to network and meet people, so don't worry too much about technology". This event professional will be engaging with the technology to achieve their objective, but not realizing the importance it brings to achieving this. Therefore, satisfaction from the event comes down to providing delegates with the right communication levels they need to complete their individual objectives. This can range from the most basic social engagement to the gathering or observation of big data. Events are evidently a melting pot of experiences and goals and not all of them demand the highest levels of technology to complete.

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Figure 4 suggests that cyber-physical systems, 3D settings, manufacturing technologies and cognitive computing should be considered aspects of E4.0 while technologies such as cloud computing, artificial intelligence and live streaming are evidently established in terms of knowledge and their incorporation into events. Therefore, by linking a digitally mature event (E4.0) to the available I4.0 capabilities listed above, the integration of these would appear to be some way below the potential optimum level. Consequently, more research is required to both understand why this is and to further these potential capabilities. Artificial intelligence has the ability to provide events with endless systems that sense, learn, and decide throughout the delivery process; though many gaps exist. Future research examples might include, monitoring live data on the movements of an audience to reduce crowd management issues or benefit security with directional guidance, increasing the individualised nature of events to meet attendee requirements through audience profiles that provide specific data such as gender or accessibility needs, or providing last-minute communication with downstream services from suppliers to improve waste management. Further research efforts should be allocated to the many possibilities that can be drawn from these initial suggestions.

The data also indicates that there is good knowledge across all types of digital technology. This is reassuring for the development of education as the events industry embraces digitalisation (Phillips, 2015). Maintaining pace with the capabilities of advances in digital technology will remain a key objective for events and event management education in the coming years.

Our research has gone beyond recording awareness of technology. It provides a realistic lens to further understand the digital experience, (knowingly or not), on various digital levels. It considers event experiences in order to evaluate the levels of digital maturity. From the findings, different levels of engagement can be drawn in order to suggest the differing levels of digital-technology engagement from E1.0 ‘basic’ to E4.0 ‘integrated’. This means that attending or delivering events in the 21st century is experienced on a number of levels. That is, most events and delegates use a website, social media, apps and other systems to promote, engage, and enhance their events. However, as more value is placed on the use of digital technology and events mature through greater access to technology, we see the emergence of an E4.0 era.

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Therefore, by integrating our understanding of the literature with the previous research of Neuhofer *et al.* (2013) and (Colli, 2018), and informed by the social media analysis and the survey we carried out, we developed a model that captures the current state of digital maturity in events (Figure 5). This model provides answers to RQ1 and RQ2. For the former, it defines the different levels of digital maturity through digital-technology engagement. For the latter, it presents implicit classes of maturity, E1 to E4.

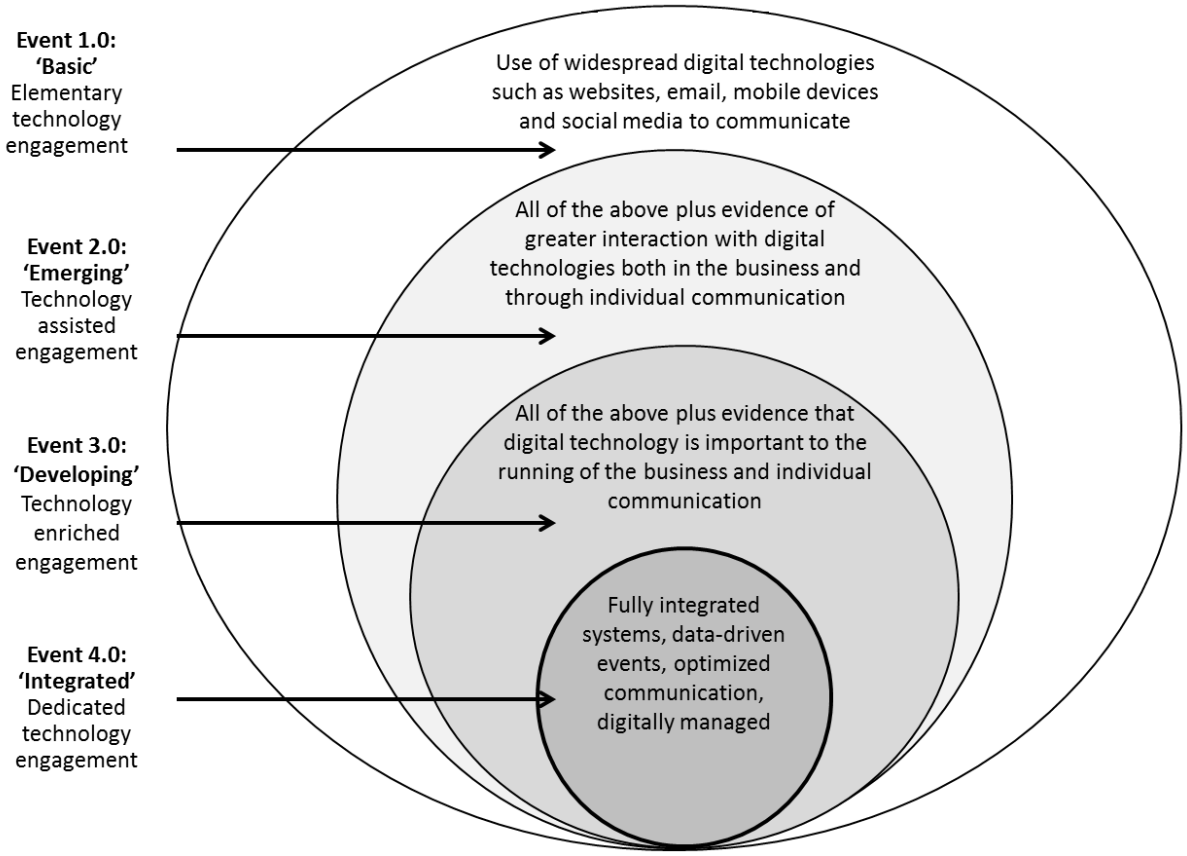

Figure 5: Different levels of digital maturity in events. (Adapted from Neuhofer et al. 2013 and Colli et at 2018)

Thus, this model anticipates that events will grow in their digital maturity to level E3 and E4. Thus, digital technologies may become sufficiently embedded so that data related to one element of an event will be used to inform other elements of an event in real time (E4). This will be led by greater adoption of Internet of Things. Furthermore, while the model of E4.0 indicates that the current trend of digital maturity is towards data-exchange in events, the ability to fully engage much less digitally coexists at a level

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that can be considered E1.0. This is indicated by the nested classes in Figure 5. Thus, E4.0 includes the integration of social media, Internet of Things, virtual technologies and the use of mobile devices, while E1.0 engages in a more organic experience. Online registration and wearable technologies such as delegate smart badges are superficial digital experiences and only considered as a process rather than as a fully perceived digital experience. The enhanced digital maturity of events and connection of technologies may enable better informed data for the organisers, but the less digitally aware delegates are oblivious to the technology. Nevertheless, small changes in attitude are generated through greater exposure. This leads to substantial effects on organisations and individuals and their digital maturity.

Our findings indicate that digital communications have enabled a shift in the content of events, marketing and the use of social media as a communication tool before, during and after the event. At the same time, we suggest that organisations and individuals can successfully interact, compete and engage across the four levels of digital maturity. Social media conversations provide qualitative and quantitative data that should be mapped out in order to provide further insight into specific events and types of event. That is, each event that uses social media can be analysed and a much wider landscape can be evaluated.

On the limitations of our research, one might argue that engagement with technology, or indeed lack of it, does not provide evidence of the immaturity of digital technology in events. However, the digital maturity model that we propose is principally informed by the literature on digital technology and events. The social media analysis and the survey rather inform the perspective of engagement that the proposed model adopts. Developments of the model, in further research, might take a technology or solutions-type perspective. Other types of surveys or questions would be needed to explore such developments. Finally, throughout, we do not discuss explicitly the demerits of new technology. A comparative analysis of technologies is beyond the scope of this paper.

Conclusion

This paper set out to define E4.0 to increase our understanding of how event businesses and individuals engage with different technologies. We analysed qualitative and quantitative data relating to perceptions of events and technology and mapped out the

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related social media networks. This fills a gap in the literature relating to events and digital maturity, which is an important topic for future academic and practitioner research.

This research has provided a revealing perspective on the use of digital technology in events. It has built on theory that has been previously developed in this and similar subjects of research, such as business and tourism. From this, the research can claim a number of contributions. It (i) provides an empirical investigation into how event businesses and individuals engage with digitally technology at events, and (ii) it provides a definition of E4.0 and other preceding levels that contribute to digital maturity.

While the different forms of digital technology at events can help us understand the levels of engagement, the findings also suggest that much of the technology at events does not need to be fully understood by participants. Participants may use a technology without understanding it.

The key to I4.0 and our understanding to whether E4.0 is already in existence is the 'self-optimization, self-cognition, and self-customization' of the industry. Our research has shown that event delegates are aware of the ability to communicate in a reciprocal process with technology rather than through a linear/top down process. This in itself is evidence of E4.0. Furthermore, this research highlights how industry is continually striving to optimise the delegate/event relationship through apps and other technology. The industry's on going mission to create deeply flexible communication opportunities is eliminating the possibility of gaps in the communication process in order to optimise delegate engagement at events.

Our ongoing research will continue to analyse the relationship between events and technology and the development of E4.0 in even broader areas. It is hoped that in presenting this first empirical exploration, further research is stimulated to take the concepts discussed much further. For example, the perceptions and requirements of individual engagement differ considerably from business, and our initial findings could be augmented and expanded upon. A broader discussion on potential issues such as IT & data security, skill-sets, expensive production costs and outages; these are significant problems within internet and cloud-based technology. Furthermore, the emerging topic of E4.0 itself requires both conceptual and empirical development. Extensive

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opportunities exist for new studies that further develop the digital maturity model of events and the definition of E4.0, using other methods and data sources.

This paper responds to the various calls for further research into the use of technology at events and the authors will continue to build upon the findings presented. This research has shown that there remains a great deal to discover about the use of technology at events and many opportunities exist for further research from academics and practitioners working together to provide mutual benefits for both industry and education.

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