



**BRITISH ACADEMY
OF MANAGEMENT**

BAM
CONFERENCE

3RD-5TH SEPTEMBER

ASTON UNIVERSITY BIRMINGHAM UNITED KINGDOM

This paper is from the BAM2019 Conference Proceedings

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1. Introduction

Innovation adoption and investment strategy are perceived as an important necessity to capture value (Chesbrough, and Rosenbloom, 2002) and competitive advantage (Bobillo *et al*, 2006). Early adoption of VR Innovation by Google, Facebook, Sony, Samsung (Finnegan, 2016) and many have added to VR landscape generating \$13 billion with more than 234 firms investing in “Content generation and application development, VR content studio tools and platforms, reality capture tools, VR content distribution platforms, head-mounted displays, and user input hardware” (Takahashi, 2015).

2. Literature Review:

2.1 Virtual Reality

Virtual reality (VR) is perceived as an evolving technology that creates “computer simulated environment” (Lanier cited in Cawkell, 2003) that utilises a combination of computer software and hardware system made of head mounted displays, goggles, gloves and 3-dimensional computer images (Coates, 1992; Greenbaum, 1992; Krueger, 1991, p. xiii; Cited in Steuer, 1993). The immersive experiences witnessed by users are beyond real life experiences (Berg and Vance, 2017; Denga *et al*, in press). The VR environments let users to explore the artificial world with possibilities of interactions and feelings of realism. As Psotka (1995) forwarded “What distinguishes VR from all preceding technology is the sense of immediacy and control created by immersion: the feeling of "being there" or presence that comes from a changing visual display dependent on head and eye movements” (Solak and Erdem, 2015).

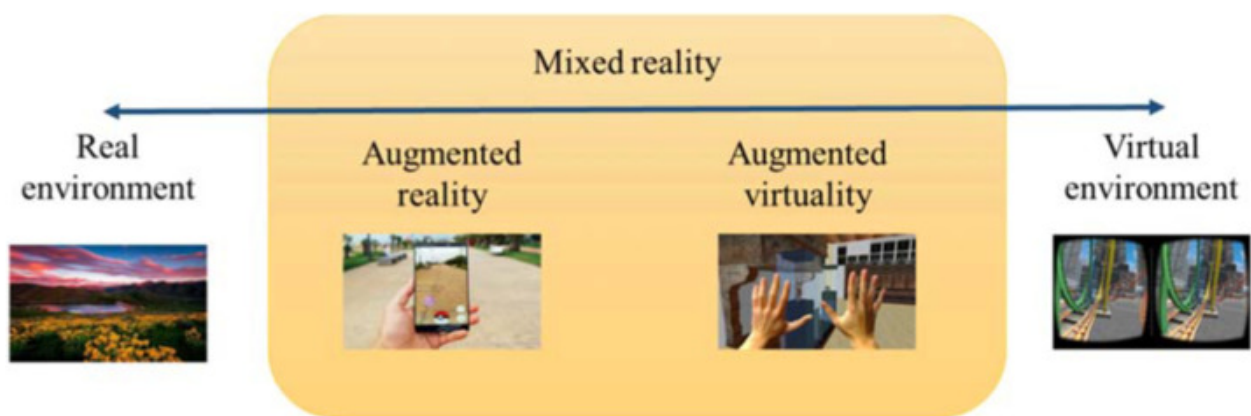


Figure 2. represents simple continuum between real environment and virtual environment (Milgram and Kishino,1994)

2.2 The business case of VR and AR

Industries were looking to use VR in training, product design, medicine and scientific development and various usages in many other sectors in 1990s (Patel and Cardinali, 1994). However, for many reasons VR did not catch enough attention until now. The factors responsible for slow growth of VR and obstacles it facing are discussed further in the next part (see 2.3). The era of Internet commercialization in mid 1990s saw VR as a developing technology that attracted attention of artists and users such as David Em, who applied VR to create fine arts project (Harrison, 2015, p. 225). Similarly, 3-Dimensional presentation of heritage site Dudley castle of England was brought the 1550 castle back to limelight (Graaf, 2015, p. 7). In spite of these beginnings and expected benefits and projected impact of VR (Shen and Eder, 2009, pp. 94-95), it did not progress fast enough to become a part of the business world on a larger scale until Facebook, Google and other Industry leaders made huge investment in year 2014 onwards that led to wider awareness and boost to development of virtual and augmented reality technology.

2.2.1 Consumer Level

Virtual reality was developed primarily in gaming and entertainment sector that targeted larger consumer base. Gaming giants such as Sony developed ‘Play Station VR’ and Microsoft created ‘HoloLens’ devices when connected with gaming consoles- Play station and Xbox respectively, offers vivid immersive experience to users utilising virtual and augmented platforms (Ripton and Prasuehsut, 2015). However, Integration of VR into gaming is not a newly developed concept. Nintendo introduced ‘Virtual boy’ a Head mounted Display (HMD) in 1990s, as well as Forte launched VFX1 HMD (McFerran, 2014).

2.2.2 Industry Level

Apart from gaming and entertainment, HMDs have created a path for industries to engage with customers using content and applications through the VR and AR technology. VR and AR both versions of immersive technologies are very useful in gaming and entertainment, watching movies and playing games utilising Head Mounted Displays such as Gear VR by Samsung, Oculus Rift, HTC Vive, Sony Play Station VR. In addition, VR is useful for marketing and content firm to create and deliver it. VR is becoming in tourism industry where virtual trips provide glimpses of location before actual travel to the location. Similarly, architecture and design industry is applying VR capabilities to aid CAD designing to provide better understanding of space and design as well as access to workers and staff located remotely. VR is in healthcare sector applies simulation of body anatomy and surgery procedure, that is taught to students. In business communication and marketing companies are using VR and AR to create virtual space and videoconferencing to conduct boardroom meetings and business communication with remotely based employees. In Spite of all these usefulness of VR, the emerging technology is facing many barriers to its adoption.

2.3 Inhibitors to adoption of VR

According to a VR report (Research and Markets, 2018) Inhibitors affecting VR and AR adoption are Fragmentation of Eco-system that contains operability challenges of technology and operating system challenges. In addition, lack of technology standardisation and software compatibility issue as well as lack of universal standards create data sharing and data privacy

challenges (PWC, 2017 and Research and Markets, 2018). Furthermore, lack of technology awareness inhibits access of VR to market (Finnegan, 2016 and PWC, 2017). Financial barriers are another hurdle in the mass adoption of VR and AR. Higher hardware cost and slow growth of sector have investment challenges are severely affecting the adoption of the technology (Perkins Coie, 2018).

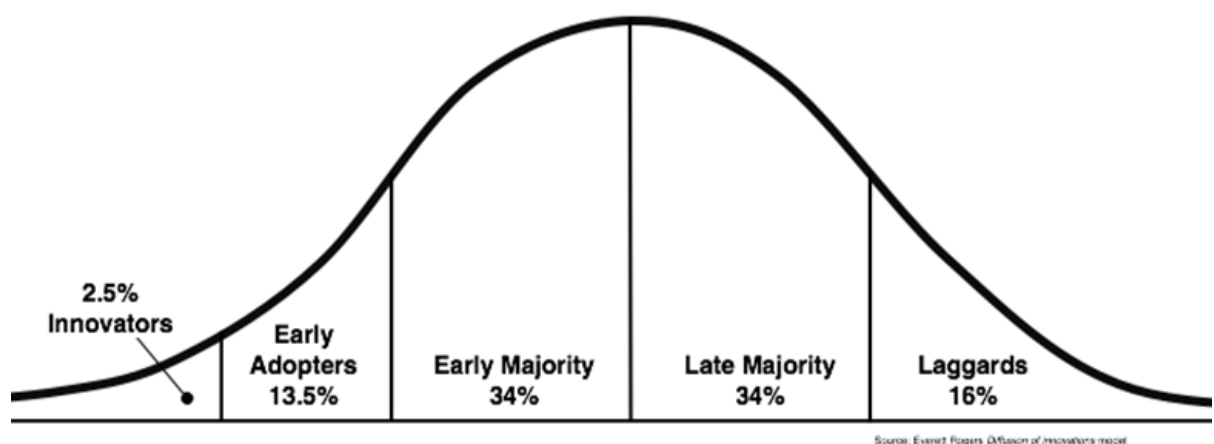
2.4 Accelerators to adoption of VR

VR Enablers such as improved functionality, enhanced user engagement and user satisfaction enhances VR diffusion, offer scope for better ways of value creation in the business model. In addition, VR capabilities of human interaction and communication (Deloitte report, 2015) are able to reduce risk and cost factors. These enablers encourage investment strategy towards VR technology adoption with an adaptable business model approach. Houliez (2010), emphasizes focus on productivity, citing innovation impact at various levels in a business model affecting cost, investment and other aspects- production, service and customers (Khare *et al*, 2017). The importance of innovation investment strategy and associated risks have been identified by many researches (Stainer *et al*, 1996; Voudouris *et al*, 2012; Virlics, 2013). However, performance measures are yet to be explored in context of virtual reality adoption. The UK being at forefront of innovation and technology, VR adoption research is important and VR usage requires long term planning (Amditis *et al*, 2007).

2.5 Strategies

2.5.1 USE and DIFFUSION of VR

Roger's (1962) diffusion of innovation theory suggests five types of adopters in the market (see Fig. below) that adopts or do not adopt an innovation. In the case of VR usage, improvements and advancements of VR and adopters are analysed.



2.5.2 BUSINESS model

It is important to investigate impact of adoption on business model, as it consists process and interconnected entities to create value. VR adoption can enhance the value creation of a firm by creating competitive advantage for the firm. It is essential to discuss various theories – Osterwalder's (2005) business model strategy, Amit and Zott's (2001) E-business model and Chesbrough's (2003) innovation strategy in business model; in order to integrate concepts of costs of adoption, competitive advantage and value creation in the business model.

2.5.3 ADOPTION STRATEGY

Most importantly, it is essential to assess the strategy for adoption by the firms. To investigate this, Mile's and Snow's (1978) organizational strategy theory is applied. The typologies divide firms by their strategic behaviour – defenders, prospectors, analysers and reactors. The theory is suitable in the context of this research to examine intention of firms to adopt VR and their business conducting strategy for growth and value creation.

2.5.4 Performance measurement and investment

Lastly, performance measurement of firms will be discussed to examine, if these firms have a performance measurement system in existence and its application before and after adoption of VR to determine the willingness of investment.

3. Research Question:

- Q1. What promotes and inhibits the adoption of virtual reality technology in UK businesses?
- Identify those industries adopting and utilising Virtual reality versus Augmented Reality technology?

3.1 Objectives:

1. To ascertain the use and diffusion of virtual reality technology in UK businesses today
2. To Identify the promoters and inhibitors on the adoption of innovative technology
3. To examine the strategies used by UK businesses to adopt new technology
4. To identify the performance measures used by UK businesses to determine investing in virtual reality.

4.Methodology

4.1 Research Design and approach

This research will be a sequential design employing mixed method as it will utilise both quantitative and qualitative methodology (Creswell, 2003) in two phases to obtain answer for the research problem. The planned research will follow pragmatic approach as it will utilise combination of quantitative (inductive) and qualitative (deductive) methodologies (Saunders *et al*, 2012). According to Tashakkori and Creswell *Et al*, (2007) epistemology for mixed methods generates a holistic view between positivism of quantitative approach and Interpretivism of qualitative approach.

4.2 Research Approach and Philosophy

The planned research will follow pragmatic approach as it will utilise combination of quantitative and qualitative methodologies (Saunders *et al*, 2012). Therefore, the epistemological stance will be both, objective for quantitative methodology and subjective for qualitative methodology. According to Tashakkori and Creswell *Et al*, (2007) epistemology for mixed methods generates a holistic view between positivism of quantitative approach and Interpretivism of qualitative approach. Explanatory in nature, this study will begin employing survey questionnaires and literature findings under deductive approach to test hypothesis. The quantitative outcome will be further examined with interviews utilising inductive approach of qualitative analysis.

4.3 Research Instruments

Secondary data available from VR blogs have been examined prior to employing survey method. A questionnaire has been designed comprising of carefully developed 6 point scales ranging from strongly agree to strongly disagree, excluding option for neutral answer to force selection of an answer on either side exploring the variable. Likert and scale approach is utilised to measure association of variables (Atkinson, 1996) including independent variables-barriers and enablers on the adoption of VR and dependent variable-impact on business and profitability. Close ended questions will also include responses for performance measures utilised to determine investment decision strategy.

The questionnaire will be piloted after validation from supervisors in order to ensure credibility and to exclude biasedness. It will be distributed online utilising “Qualtrics” and “GoogleDocs” and “surveymonkey” platforms as well as by emails to industry links with their consent of participation. The responses will be analysed utilising SPSS software.

In addition, qualitative approach will follow quantitative measurement to facilitate deeper insight of the study (Bryman and Bell, 2011). in depth interviews will be conducted with industry sources utilising open-ended semi-structured questions. It allows investigating follow-up questions for a deeper meaning and find relationship between views of VR adopters and challenges they faced during adoption as well as meaningful connections to analysis shown by questionnaire. Qualitative data will be assigned themes and codes to further analyse with NVIVO software.

4.4 Sampling

A random sampling will be used to target VR companies operating within UK. The sample size will be determined after preliminary research analysis. These stands to around 400 firms in the UK. First phase of sampling will target gaming, education, and architecture and healthcare industries initially. Although it is a wider sampling universe, it necessitates mapping out these industries to obtain sufficient samples. Within phase one of survey, questionnaire will be sent out to scan the VR landscape projecting availability of samples from the universe. Once identified, sample size will be determined utilising sample size method (Bartlett *et al*, 2001). In the second phase, key individuals and managers of firms will be approached for in-depth interviews. Availability of samples from phase one will determine number of samples required for phase two of interviews. In the absence of any positive response for interviews, a case study method will be employed to study an organisation's strategy for VR adoption.

4.5 Data Collection and analysis

Data collection will commence after research instruments- questionnaire and open-ended questions for semi-structured interviews gets approval from supervisors as well as all ethical aspects are verified and approved. The ethical aspects of data protection and confidentiality will be explained to selected adult participants. Data collection will begin with secondary data collected from VR blogs that will lead to first phase of primary data collection mapping out VR landscape once ethical consent is given. Statistical significance ($p \leq 0.05$) and correlation between variables will be identified utilising SPSS. In the second phase, semi-structured interviews will follow analysis of questionnaires' responses. Qualitative data of interviews will be coded with themes and also analysed through NCaputre of NVivo software. Both phases will be completed as stated in proposed plan of the work. However, it might take little longer depending on availability of samples.

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