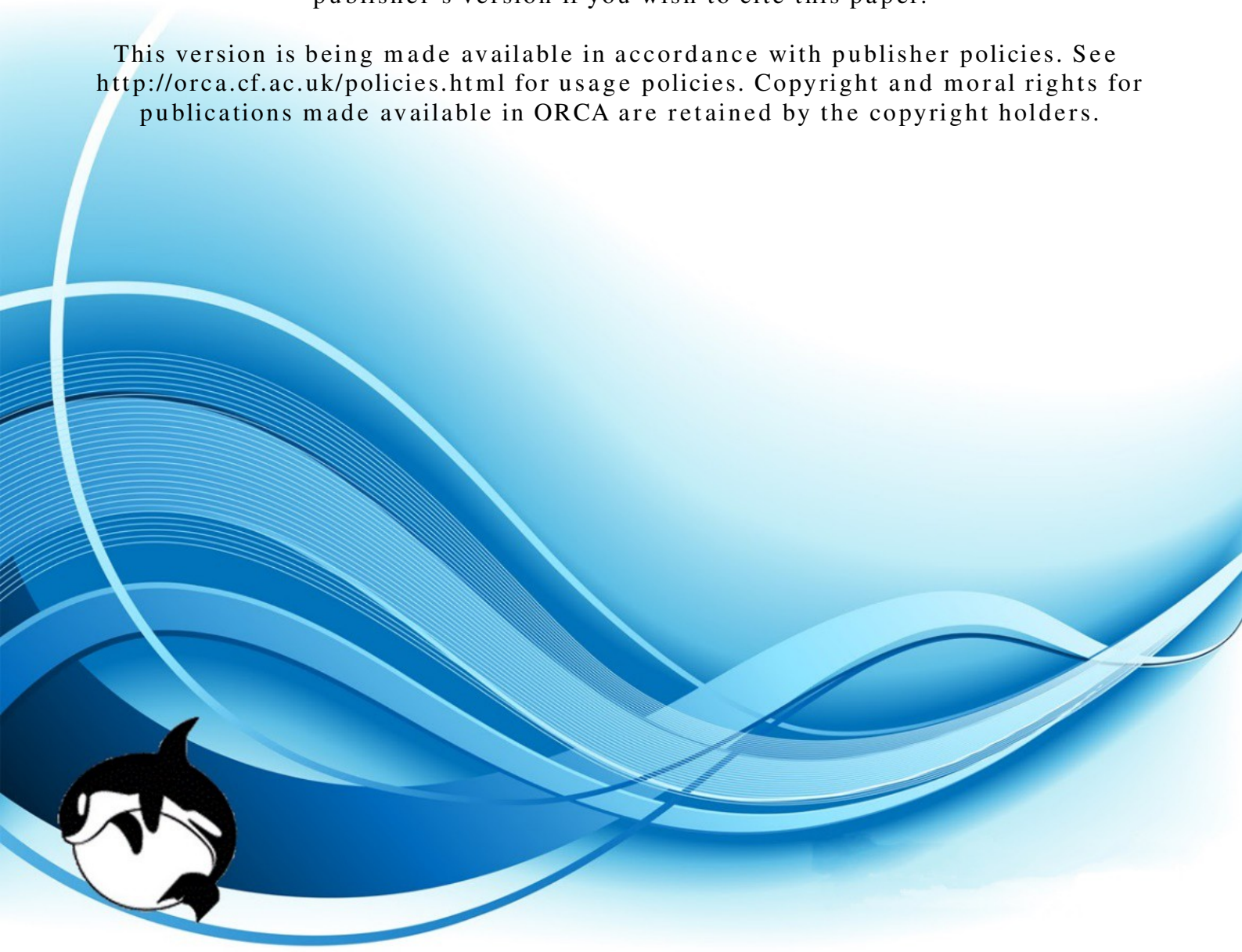

Programmatic Advertising: forewarning and avoiding hype-cycle failure

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Abstract

The emergence of new technologies has often been examined through their transition along the hype-cycle. While this has been a useful approach, recent research indicates that not all new technologies follow the pattern of the hype-cycle as originally envisaged by Gartner.

Programmatic Advertising (PA) is a multi-billion dollar business that uses web-based technologies to deliver highly personalised adverts to prospective consumers in real time. Despite its rapid growth it has received precious little scholarly attention. This study is therefore of interest to PA system developers and adopters since most have little understanding of its operation and limitations, and are poorly equipped to make informed decisions about its adoption and use.

Through the construction of a Concept Map of the system and the development of four future states of Programmatic Advertising development, consumer concerns over the ethical usage of data and the real return on investment are issues that are identified as requiring the immediate attention of platform developers in order to mitigate the deleterious effects of hype-cycle decline. The study proffers two alternative means by which the Programmatic Advertising hype-cycle may develop, and unpacks the socioeconomic mechanisms by which a loss of serendipity may occur in Programmatic Advertising systems.

Keywords: Programmatic Advertising, Hype-Cycle, Concept Map, Scenario Planning, Sociotechnical Systems

Declarations of interest: None.

INTRODUCTION

Information Technologies (IT), in their many different guises, have had considerable impact upon both business and society (Carlo, Gaski, Lytinnen and Rose, 2014; White, 2018). However, while they afford new and more efficient ways of working and interacting, their implementation is not straightforward and they may ultimately fail to meet expectations (Adner, 2002; White, Gardiner, Prabhakar and Abdrazak, 2007; Schmidt and Druehl, 2008; Chaffey and White, 2011; Mishra 2013; Thierer 2013; Sriram *et al*., 2015).

Programmatic Advertising (PA) is a relatively new implementation of IT that utilises large data sets to disseminate deeply personalised marketing materials to target audiences incorporating real-time pricing and bidding (Benady, 2015). Initially employed in web-based advertising, the technique is finding application within film, television, apps, games and loyalty schemes (Malthouse, Maslowska and Franks, 2018; Deng and Mela, 2018; Seitz and Zorn, 2016; Gertz and McGlashan, 2016). The growth of PA has been rapid, with the market estimated at being worth £960 million in the UK and almost $15 billion worldwide (Lambrecht and Tucker, 2013; Aguirre *et al.,* 2015; Benady, 2015; eMarketer, 2015). In 2015, almost half of all digital adverts were traded programmatically and this is expected to rise to over 80% in the near future (Benady, 2015). PA is said to provide organisations with a distinct competitive advantage particularly when integrated with Customer Relationship Management (CRM) systems (Lambrecht and Tucker, 2013; Benady, 2015; Hachen and Bardega, 2016; Seitz and Zorn, 2016).

Despite the rising and rapid adoption of PA, there is very little scholarly literature that examines this nascent phenomenon. The few extant studies are of value but tend to focus upon discrete aspects of PA, including consumer responses, ethics, fraudulent web traffic and PA's application in television, but neglect to examine the system as a whole (Aguirre *et al.*, 2015; Busch, 2016; Fulgoni, 2016; Martinez-Martinez, Aguado and Boeyken, 2017; Malthouse, Maslowska and Franks, 2018; Deng and Mela, 2018). This is troublesome since PA is a complex sociotechnical system (Baxter and Sommerville, 2011; Trist, 1981) and research is needed that studies its highly-interrelated elements (Benady, 2015; Seitz and Zorn, 2016; Brosche and Kumar, 2016; Gertz and McGlashan, 2016; Gangadharbatla *et al.,* 2017). Concerted effort is required, between practitioners and scholars, in order to define and theorize PA (Gangadharbatla *et al.,* 2017; Schwarz and Stensaker 2014). Since the approach spans consumer behaviour, advertising, marketing, information technology, big data and analytics,

research into its opportunities and challenges should draw upon a similarly ecelectic collection of disciplines and theoretical perspectives.

The ‘hype cycle’, developed by Gartner Inc., is an increasingly popular model that is used to help researchers to analyse and forecast the evolution and commercial progress of technologies (such as PA) in the marketplace (Dedehayir and Steinert, 2016; Jun, 2012a). Hype cycle modelling has been adopted in numerous studies to develop a shared understanding of a specific emerging technology and to determine consumer attraction and diffusion patterns that can help to inform specific performative action (Van Lente, Spitters and Peine, 2013). Seitz and Zorn (2016) argue that the significant hype generated by the PA industry and the press has been responsible for its widescale unconscious adoption. This has lead to the disruption of the traditional advertising industries eco-system which normally comprises non-personalised mechanisms of designing and placing advertisements through traditional media channels. In such cases target consumers are generically grouped according to the rules of marketing segmentation (demographics, behavioural, psycographic) and advertisments are designed around research that outlines how a particular product or service may meet the needs and wants of the targeted group (Kotler and Armstrong, 2015).

The popularity of PA, evidenced by its rapid adoption and profusion among web searches, indicates its importance as a subject of research. However, the recent emergence of criticisms of PA’s capabilities suggest that PA is balanced upon the initial peak of the hype-cycle and that rapid decline lies ahead. Seitz and Zorn (2016) concur and state that the PA industry is now facing a period of inhibiting uncertainty and this prompts the aim of this research which is to explore PA’s trajectory along the hype cycle.

This paper addresses the lack of research that examines the complexities of PA and proffers the first step toward an understanding of the system as a whole. A comprehensive Concept Map of the consituent elements of PA is constructed and used to instigate discussions with expert programmatic practitioners about the tensions that exist within the system. By uncovering the tensions that lie at the core of the PA system this paper moves beyond a singular case study of practice and positions PA’s innovative disruption on the hype cycle. In doing so, four future scenarios of PA development are generated comprising ‘Perfect Algorithms’, ‘Ethical Limits’, ‘Negative Cost Advantage’ and ‘Fewest Platforms’. Inspired by Dedehayir and Steinert’s (2016) analyses that challenge the accepted notion of the inexorable ‘rise-fall-rise’ pattern of the hype-cycle, the study proffers two alternative means by which the four future scenarios may manifest. This is a valuable critical interrogation that informs future directions for system

developers and technology adopters who may be guilty of 'blindly following the technological hype' of this system that is increasingly generating societal and economic concerns (Susi and Nicole, 2017). Its findings help PA platform developers mitigate PA's imminent descent into the hype cycle's 'trough of disillusionment' by identifying specific mechanisms by which PA's effectiveness may become eroded. While it may not be possible to entirely eliminate the relapse that typically follows the hype of new technology, attempting to ameliorate its effects so that the trough is neither as deep nor perhaps as long lasting, would be a desirable outcome for PA developers, adopters and users alike.

The paper is organized as follows: the next section reviews the concept of hype-cycles before presenting the extant PA literature. The method of development of the PA Concept Map is then detailed before its operation is discussed. The literature and the Concept Map are then used to inform an examination of the tensions that are inherent in the PA system before four future scenarios of its development are presented. These scenarios are then mapped onto the 'Typical' hype cycle and two variants, termed the 'Concurrent' hype cycle and the 'Sequential' hype cycle. The paper closes with concluding comments, statements of limitations and suggestions for future research.

LITERATURE

HYPE-CYCLES

The concept of technology hype cycles was first proposed by Gartner (1995). Since then, they have been studied in a range of contexts and across different technologies including fuel cells (Konrad, Markard, Ruef and Truffer, 2012), hybrid cars (Jun, 2012a), voice over internet protocol, gene therapy and superconductivity (Van Lente, Spitters and Peine, 2013), creative arts (Abbasi, Vassilopolou and Stegioulas, 2017), additive manufacturing (Gartner, Maresch and Fink, 2015), biomedical technologies (Boni, 2018), blockchain (Kewell and Ward, 2017) and Corporate Prediction Markets (Womfram, 2015). Hype cycles generally conform to five stages of expectation over time (Figure 1).

Stage 1: Innovation trigger: Awareness surrounding the novelty of new technology begins to spread amongst users influencing early adopters to purchase/use the technology. Organisations start to emerge with the hope of maximising the commercial advantage of being the first to market (Van Lente Spitters and Peine, 2013). However during this phase, while media attention could be high, some organisations experience a deficit in marketing resources and subsequently risk failing to commercialise the technology at the right time (Jun 2016).

Stage 2: Peak of inflated expectation: Inflated by the hype generated from a variety of media sources, this stage witnesses organisations investing and engaging in the technology without clear strategic aims or objectives (Dedehayir and Steinert 2016). This stage in the hype cycle is often associated with organisations and customers jumping on the 'bandwagon' (Dedehayir and Steinert, 2016) following the publication of 'numerous initial success stories' (Jun, 2016, 1414). Ultimately this leads to a peak in 'optimism and exaggerated expectations' regarding the technologies use and commercial viability (Van Lente Spitters and Peine, 2013, 1611).

Stage 3: Trough of disillusionment: This is a period of realisation and 'realistic re-adjustment' where the media becomes more prone to generating negative news regarding the failing application and/or commercial viability of the technology (Jun 2016, 1414). As Van Lente, Spitters and Peine (2013, 1616) explain this stage in the hype cycle represents a disappointment in the technology and is 'marked by an abrupt collapse of positive expectations'.

Stage 4: Slope of enlightenment: At this stage a more mature application and understanding of the technology emerges, resulting in it becoming socially acceptable and performing to a higher all-around standard (Gartner, 2018; Dedehayir and Steinert, 2016).

Stage 5: Plateau of productivity: This is the stage where commercial viability is proven and broader applications and markets become available to the technology (Gartner, 2018; Jun, 2012a)

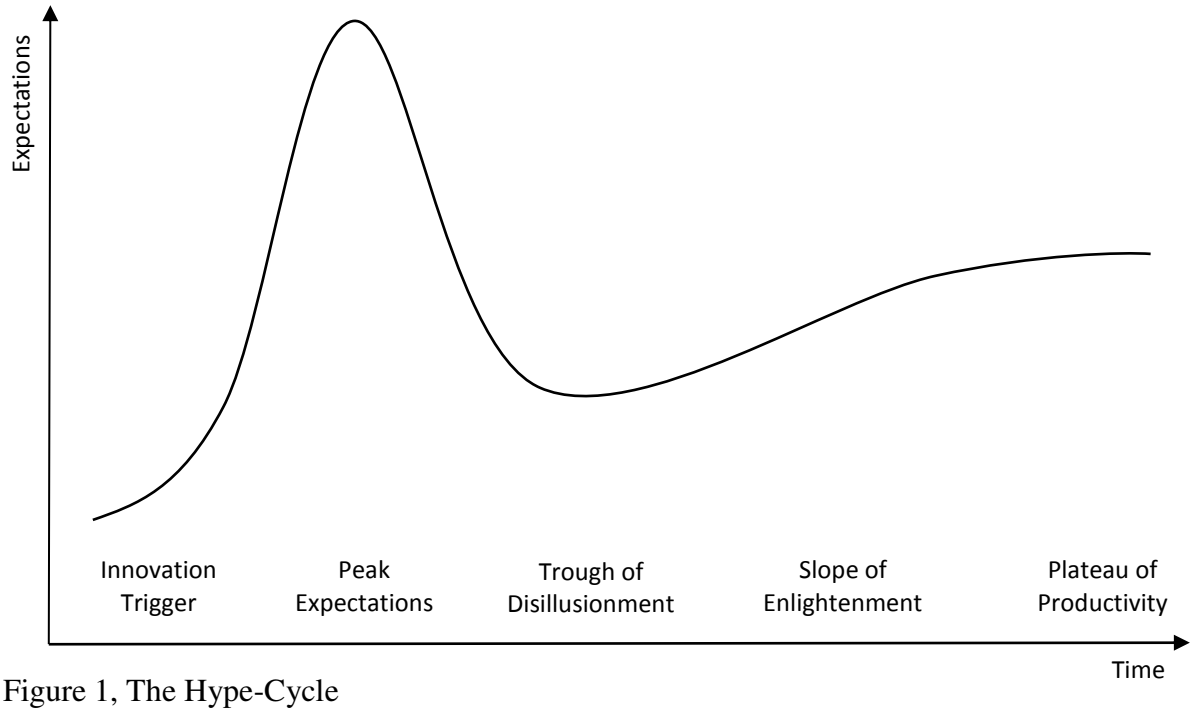

Figure 1, The Hype-Cycle

The majority of literature makes reference to hype-cycles in the context of information technologies, comprising discussions around ‘big data’ (Abbasi, Sarker and Chiang, 2016; Bosch, 2016; Chen, Chiang and Storey, 2010), mobile communication (Adamauskas and Krusinkas, 2017; Ozakazi and Barwise, 2011), e-business (Dainty, Leiringer, Fernie and Hartty, 2017; Cihanek, Haseman and Ramamurthy, 2014; Au and Kauffman, 2005), e-government (Bannister and Cnnolly, 2012), Web 2.0 (Bell and Loane, 2010), tabletop computing (Bruun, Jensen, Kristenses and Kjeldskov, 2017), cloud computing (Willett, 2014; Iyer, Krishnan, Sareen and Panda, 2013), online education (Mcpherson and Bacow, 2015), social media (Roberts and Candi, 2014; O’Leary, 2011), healthcare (Reddy and Sharma, 2016), and the Internet of Things (Urquhart and Rodden, 2017).

Despite the conceptual usefulness of hype-cycles, much of the literature fails to adopt them as a theoretical lens through which new technology adoption may be explored. For example, some literature acknowledges and uses Gartner’s hype-cycle model (Boni, 2018; Kewell and Ward, 2017; Bruun, Jensen, Kristenses and Kjeldskov, 2017; Urquhart and Rodden, 2017; Stratopoulos, 2017; Reddy and Sharma, 2016; Bosch, 2016; Womfram, 2015; Willett, 2014; O’Leary, 2011; Bell and Loane, 2010; Chen, Chiang and Storey, 2010; Wang, 2010; Swanson and Ramiller, 2004; Ramiller and Swanson, 2003), whereas other studies make only fleeting reference to hype-cycles (Adamauskas and Krusinkas, 2017; Dainty, Leiringer, Fernie and Hartty, 2017; Gartner, Maresch and Fink, 2015;McPherson and Bacow, 2015; Roberts and Candi, 2014; Xiatong, Kauffman, Yu and Zhang, 2014; Iyer, Krishnan, Sareen and Panda, 2013; Bannister and Connolly, 2012; Ozakazi and Barwise, 2011; Au and Koffman, 2005; Fichman, 2004), and both Ciganek, Haseman and Ramamurthy (2014) and Nielsen and Fjuk (2010) merely refer to the general ‘hype’ that surrounds information technology adoption.

Dedehayir and Steinert (2016) state that the hype cycle model has become popular model that researchers have been used to critically evaluate technologies during the key stages of their development. The model is praised for its ability to provide a useful framework to explain and plot the adoption of technological innovations and critically evaluate the users' expectations (Jun, 2012a). It is also suggested that it helps researchers take a more measured view of disruptive technology by concentrating on the procedural aspects of the technology whilst also considering the viewpoint of consumers and/or end users (Jun, 2012a). Hype cycle studies are used in the literature in order to better understand diffusion patterns, but they often follow a case study approach and are subsequently accused of being limited, only generating findings that are relevant to a single product or service (Van Lente, Spitters and Peine, 2013).

Much work has been done to theorise hype-cycles (Fenn and Reskino, 2009; Van Lente, Spitters and Peine, 2013; Dedehayir and Steinert, 2016) and while they form useful perspectives from which to view innovation processes and systems, they vary considerably between contexts (Van Lente, Spitters and Peine, 2013). Dedehayir and Steinert (2016) offer valuable critical insight into hype-cycles through their observation that while they may conform to the pattern indicated in Figure 1, they more frequently manifest as a series of peaks and troughs, and may even lack any form of recovery phase. They also add that the pattern of technology expectation that underpins the hype-cycle may be different for the different system actors.

PA Overview

A formal definition of PA is lacking due to a paucity of research and a great deal of misunderstanding of its functioning (Whitmer, 2018; Alaimo, Kallinkos and Sess-Sforze, 2017). Fundamentally, it is a data-driven system that facilitates the real-time bidding for advertising space to deliver personalized marketing materials to potential customers (Aguirre, Mahr, Grewal, Ruyter and Wetzel, 2015; Benady, 2015; Funk and Nabout, 2016; Li, Yuan, Zaho, Wang, 2017; Bush, 2016; Li. *et al*., 2017; Waesch, Rotberg and Renz, 2016; Gertz and McGlashan, 2016; Kosorin, 2016). PA has radically altered the way that advertising is undertaken (Li, Yuan, Zaho, Wang, 2017; Seitz and Zorn, 2016) and is capable of considerably reducing the cost and risk of advertising (Lambrecht and Tucker, 2013; Benady, 2015; Bleier and Eisenbeiss, 2015; Aguirre *et al*., 2015). For example, The Economist used PA to develop profiles of potentially suitable viewers by matching their reading preferences, subscription data, web cookies and mobile app data. This enabled the publishers to communicating real time messages that directly related to the specific individual interests (finance, politics, social justice etc.) of every target customer (Globalwebindex, 2019). This example outlines how PA enabled a fluid marketing communication campaign that was individually targeted in terms of to whom, where and when it would appear and personalised. Thus, via PA the Economist could take advantage of the use of ‘real time information’ and ‘opportunity creation’ to purchase and place the right advert in the right place at the right time at an optimum price (Busch, 2016; Benady, 2015).

In brief, the PA system comprises several ‘platforms’ and actors. Data Management Platforms (DMPs) profile customers from their browsing habits, purchase history and personal preferences, typically from data stored as ‘cookies’. Other data may also be used such as GPS

location, current activities and weather conditions. For example, hotels that are located near airports may use flight delay data to target stranded passengers with offers for accommodation via their mobile phones (Gertz and McGlashan, 2016). Supply Side Platforms (SSPs) manage the inventory of available advertising spaces – typically space on a webpage but this varies depending upon the channel. Demand Side Platforms (DSPs) utilize the DMP profiles to assess the 'fit' between the customer and the advertising materials of participating organisations, then calculate the 'value' of that webspace and carry out the auction-style bidding on behalf of participating organizations (Benady, 2015; Bush, 2016; Kosorin, 2016; Schafer and Weiss, 2016.

The extant literature comprises predominantly practitioner articles that describe the benefits of PA and predict its continued growth (Benady, 2015; Buch, 2016; Kosorin, 2016; Schafer and Weiss, 2016; Seitz and Zorn, 2016). Comparatively little of this examines its considerable complexity (Kosorin, 2016; Anderl, Schumannand and Kunz, 2016) and questions over its actual effectiveness are beginning to emerge. For example, the literature is punctuated with cautionary tales of costly mistakes (Benady, 2015; The Guardian, 2017; The Telegraph, 2017), malpractice (Innovation in Magazine Media, 2016), risks (Seitz and Zorn, 2014), creative challenges (Weisbrich and Owens, 2016), confusion (Krefetz, 2016), complexity (Benady, 2015; Anderl, Schumannand and Kunz, 2016), mistrust (Bleier and Eisenbeiss, 2015) and contradiction (Benady, 2015; Aguirre, Mahr, Grewal, Ruyter and Wetzels, 2015). In addition, technological advancements in web bots can produce fake page impressions that distort metrics of customer views. It is estimated that 25% of video impressions are in fact 'viewed' by bots and these fraudulent practices are costing US firms around $4.5 million per hour (Fulgoni, 2016; Innovation in Media Magazine, 2016). Adblocker technology is also developing rapidly and this adversely affects PA effectiveness (Shiller, Waldfogel and Ryan, 2018; Turner, Shah and Jain, 2018). To counteract this, organisations are employing methods of defeating the adblockers (Bashir, Arshad, Kirda, Robertson and Wilson, 2018) and consequently an 'arms race' of blocker versus antiblocker is escalating.

PA's automated capabilities lead to its apparent cost effectiveness but also remove human judgement from the process and this can result in improper advert placement (Benady, 2015; Campaign Live, 2018). There have for instance been several cases where organisations have withdrawn from PA platforms after their adverts had been displayed next to extremist materials (The Guardian, 2017; The Telegraph, 2017). This highlights the need for marketers to take greater care when utilizing PA platforms and not become seduced by the promises of cost

reductions (Schafer and Weiss, 2016). However, this may prove difficult because the sheer technical complexity of PA is often beyond their ability to understand (Benady, 2015; Seitz and Zorn, 2016; Gertz and McGlashan, 2016).

Organisations also need to be mindful of the loss of serendipity that may be encountered through dynamically targeting customers which locks them into an 'echo chamber' of exposure to repetitive adverts (Lambrecht and Tucker, 2013). Serendipitous experiences are valuable elements of human learning and discovery but the argument of whether they can be generated by information technologies remains moot (Andre, Teevan and Dumais, 2009; Makri *et al*., 2014; De Gemmis *et al*., 2015; McCay-Peet and Toms, 2015; Erdelez and Jahnke, 2018; Eirinaki, Gao, Varlarmis and Tserpes, 2018; Jain and Gupta, 2018; Kotkov, Zhao, Konstan and Veijalainen, 2018). In order to provide more personalised adverts that are relevant to the viewer's current location, circumstances and needs, increasingly large and personal data sets are required. However, this has the potential negative consequence of being perceived as overly intrusive by prospective customers (Aguirre, Mahr, Grewal, Ruyter and Wetzels, 2015; Van Doorn and Hoekstra, 2013). Data privacy is an increasingly sensitive moral and legal issue (BBC, 2018), as evidenced by recent allegations of impropriety in the US Presidential elections and Cambridge Analytics use of Facebook use data (Forbes, 2017; The Guardian, 2018) and data privacy laws are constantly being revised to cope. Thus, if organisations using PA continue to ignore the complexities of the system they may find themselves wasting considerable amounts of funds, negating timely promotional opportunities, isolating or scaring away existing and new consumers, devaluing their brand equity or at worse flaunting legal requirments around data protection laws.

The considerable volume of practitioner literature discussed in this section that promotes PA, coupled with a significant increase of the frequency of the term 'Programmatic Advertising' appearing in Google search results (see Figure 2), and its rapid and widespread adoption, mirror the early phase of a technological hype-cycle (Dedehayir and Steinert, 2016; Van Lente, Spitters and Peine, 2013). In addition, the recent appearance of articles that are critical of PA's actual efficacy (Funk and Nabout, 2016; Weisbrich and Owens 2016; Aguirre, Mahr, Grewal, Ruyter and Wetzels, 2015; Bleier and Eisenbeiss, 2015; Seitz and Zorn, 2014), and are summarized in Table 1, would suggest that the market has reached the point of 'peak expectation' and may well be faced with the 'trough of disillusionment' (Figure 2). Indeed, Seitz and Zorn (2016) concur and question whether PA's rapid uncontested 'hype cycle' of growth will result in the next .com crash (Seitz and Zorn, 2016).

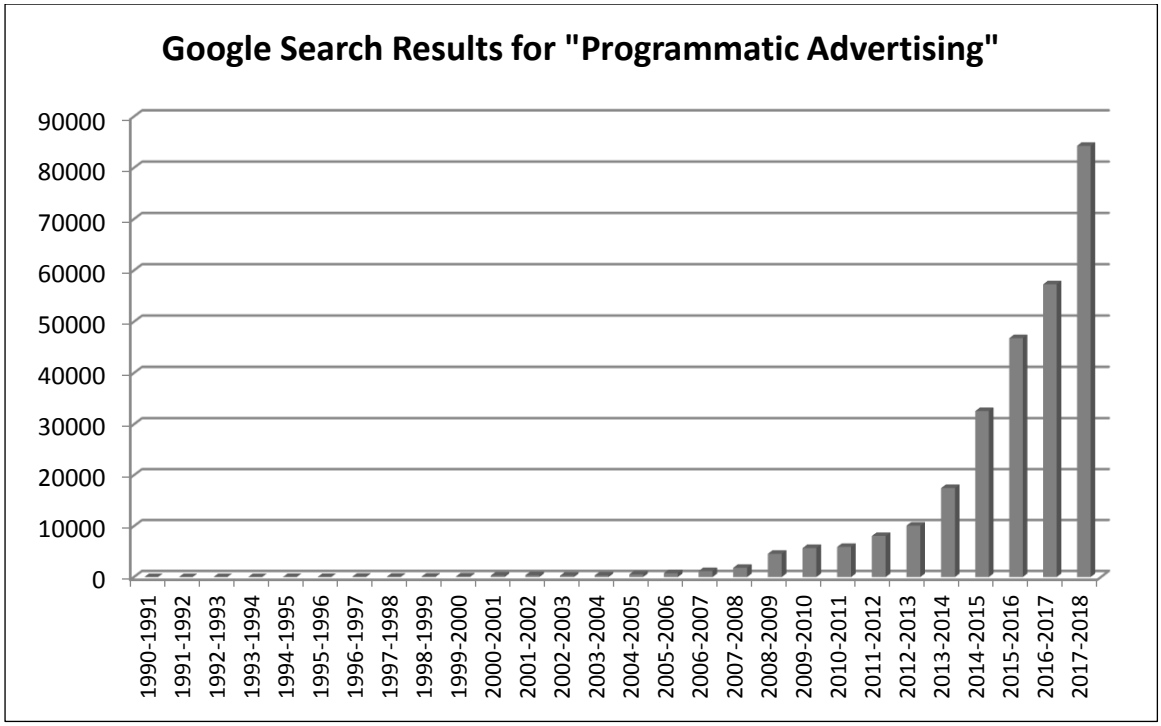

Figure 2, “Programmatic Advertising” Articles

Table 1, Critical Literature

Year	PA Challenge	Article
2014	Risks	Seitz and Zorn (2014)
2015	Expense	Benady (2015)
	Complexity	Benady (2015)
	Mistrust	Bleier and Eisenbeiss (2015)
	Contradiction	Benady (2015) Aguirre, Mahr, Grewal, Ruyter and Wetzels (2015)
	Improper Ad Placement	Benady (2015)
2016	Malpractice	Innovation in Media Magazine (2016)
	Creative Challenges	Weisbrich and Owens (2016)
	Confusion	Krefetz (2016)
	Complexity	Anderl, Schummannand and Kunz (2016) Seitz and Zorn (2016 Gertz and McGlashan (2016)
	Technological Fraud	Fulgoni (2016) Innovation in Media Magazine (2016)
2017	Improper Ad Placement	The Guardian (2017) The Telegraph (2018)
	Technological Fraud	Shiller, Waldfogel and Ryan (2018) Turner, Shah and Jain (2018)
2018	Improper Ad Placement	Campaign Live (2018)

Managing this transition is particularly challenging for PA due to its inherent complexity, the multiple stakeholders that are involved in its operation and the lack of contemporary research and understanding. In order to enable PA platform developers to consider the wider implications of technological decisions, and to enable existing and future adopters to make informed decisions about the technology, this paper proffers a system map of PA in the form of a Concept Map. This is used to identify the inherent tensions that exist within the system that conspire to imbue it with a considerable degree of sociotechnical complexity – a feature of other technologies that exhibit hype-cycles (Jun, 2012b). The tensions are used to compile four future scenarios of PA that may contribute to its decline into the 'trough of dissilusionment'.

METHODOLOGY

Systems Dynamics (SD) is an approach to understanding systems that considers them in terms of their elements and flows. Grounded in the field of Industrial Dynamics, Forrester (1961) developed SD in order to model industrial management problems. SD maps are popular tools for representing the dynamic nature of complex systems. Several types of mapping techniques have been developed that suit specific applications and includes causal loop diagrams, cognitive maps and concept maps, each of which could have been adopted for this investigation (Schaffernicht, 2017; Georgiadis, Vlachos and Lakovou, 2005; Safayeni, Derbentseva and Canas, 2005). This study uses Concept Mapping (CM) for its ability to display important information that cannot be included in other techniques (Schaffernicht, 2017), represent knowledge of subject matter (Novak and Canas, 2008) and highlight the dynamic relationships between events (Safayeni, Derbentseva and Canas, 2005) - see Safayeni *et al*. (2005) for a detailed review of the origins and development of CM. CM has been used in a variety of circumstances, most often education (see for example Horton, McConney, Gallo, Woods, Senn and Hamelin, 1993) but also in the investigation of social media (Moreno, Kota, Schoohs and Whitehill, 2013), consumers and marketing (Joiner, 1998), organizational culture (Kolb and Shepherd, 1997) and, apposite to this study, as a research instrument in its own right (Kinchin, Streatfield and Hay, 2010; Joiner, 1998).

The review of the PA practitioner and academic literature was used to inform the development of the concept map shown in Figure 2. In the corresponding description of the concept map the following conventions are used: activities or the outcome of events are indicated in the diagram by arrows and described in the text using the convention '*description*', the system variables are indicated in the diagram by boxes and in the discussion below by *Capitalised Phrases*. This

literature-derived concept map provided the basis upon which discussions of the operations of PA and of its inherent tensions were based that culminated in the generation of four future scenarios of PA development. In total, discusions of around 2 hours duration took place with five marketing scholars and five web-based marketing professionals (Denscombe, 2010; Fox, 2009). Each academic participant was a Senior Lecturer, Reader or Professor in their respective field and had held their post for a minimum of five years. Each of the expert practitioners had direct experience of developing and managing Programmatic Advertising systems or platforms. The identity of individuals and their respective institutions is not disclosed (Duclos, 2017; Babbie, 2009).

Conversations with the participants were initiated with the request to "Explain the Programmatic Advertising system". The subsequent discussions were unstructured in order to let the themes develop organbically (Fetterman, 2010), typically taking the form "What are the challenges within the Programmatic Advertising system?" and this data was used to inform the detailed development of the system map and the identification of its tensions. The elements and characteristics of the PA system were captured using instantaneously-sampled field notes (Paolisso and Hames, 2010) and included verbal descriptions and 'napkin sketches' that were drawn by the participants to explain elements of the PA system. The concept map was compiled using InsightMaker (https://insightmaker.com) and may be viewed or freely copied for further development (available at https://insightmaker.com/insight/60224/Programmatic-Marketing). The final concept map and the discussions of its operation were member validated by two PA technical staff (Sandelowski, 1993).

THE PA CONCEPT MAP

Beginning in the upper left quadrant of Figure 2 there is assumed to be a Consumer Demand for a product or service that results in a 'web search' being conducted that influences the number of Websites Visited. This in turn results in a number of different Adverts Seen and contributes to the consumers Browsing History that is stored in the form of browser 'cookies'. The Adverts Seen may result in a product or service being 'wanted' in which case the consumer would proceed to Click & Buy. Adverts that are 'seen' are registered as Click Through and those that are 'ignored' are counted as Not Wanted. Both Click Through and Not Wanted results initiate a 'repeat search' or the end of web searching. External Reviews, such as Tripadvisor, provides 'data' that influences the Consumer Perceptions, as does their own 'experiences' of searching for and purchasing goods and services. These are instrumental in

determining the consumer's Trust in Product and Trust in Provider that, in turn, influence their browsing habits.

Click & Buy and Click Through generate 'data' that may be analysed and thereby potentially contribute to better understanding of website and advert effectiveness, as well as consumer preferences, and contribute to the Quality of Web Metric Analysis. They may also 'stimulate new demand' in consumers. Adverts Seen that are subsequently 'ignored' may not provide such data, depending upon the sophistication of the web systems employed. Click & Buy would result in 'demand fulfilled' and may fully or partially reduce Consumer Demand. Click & Buy is a 'sale' that increases the Advertiser Income, which may also increase that advertiser's ability to offer a 'competing bid' and thereby raise the Bid Price. The highest 'competing bid' would set the Bid Price and the 'winning bidder' would become a function of the 'Advertiser Filter' whereby the 'winner's advert' then becomes one of the Adverts Seen by the consumer via their web browser.

The Bid Price also influences the 'revenue' and raises the Website Owner Income. This enables the owner of the website(s) to make an 'investment' in Website Development, informed by 'website design' suggestions based upon the Quality of Web Metric Analysis, that improves the Website Effectiveness. This investment is realised through higher Web Page Value and higher Bid Price. Successful website development and improvement improves its 'attractiveness & retention' properties and thereby affects the Websites Visited by the consumer and their resultant browsing behaviour. The Quality of Web Metric Analysis also influences the 'viewer-advert matching' and thereby affects the Website Valuation which, in turn, creates a demand that influences the Bid Price.

The platform software provides the dashboard through which web owners and advertisers may access web metric data. 'Revenue' from successful Bid Price enables platforms to make 'investment' in Algorithm R&D that improves the Matching Accuracy and thereby improves the Quality of Web Metric Analysis. Increased Platform Income also enables higher 'investment' in Marketing Expenditure, further 'advertising' and a greater Number of Broker Dashboard Users. This in turn further increases the Platform Income through dashboard 'rental charges.

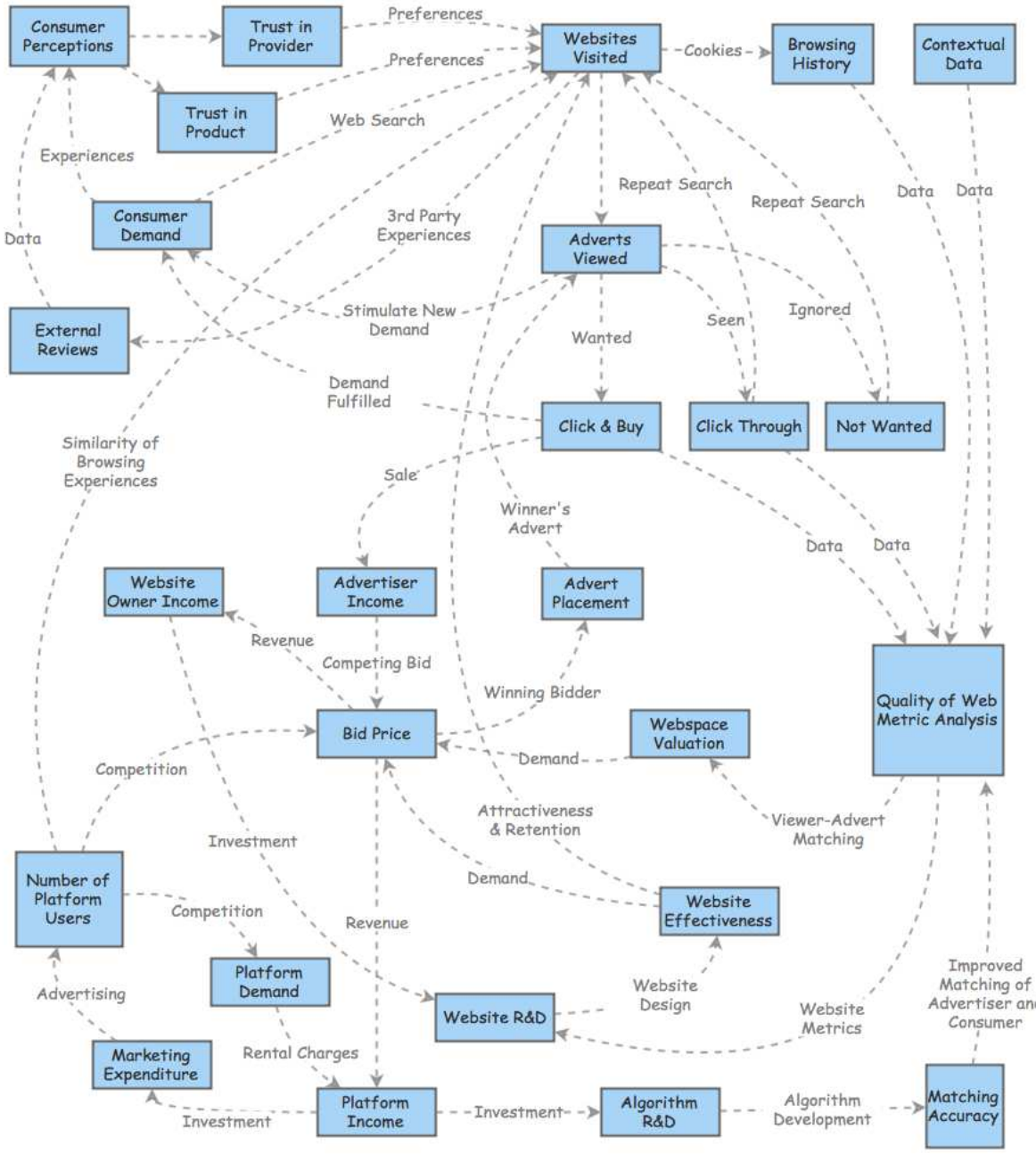

Figure 2, Concept Map of the Programmatic Advertising System

ANALYSIS & DISCUSSION

Tensions

This section reviews the tensions that are inherent within the PA system, based upon the issues that have been highlighted within the literature review coupled with the interviews with expert scholars. The issues of 'algorithm accuracy', 'data ethics', 'fraudulent traffic', 'non-human judgement' and 'loss of serendipity' that are recognised within the extant literature are addressed in turn and their resultant effects are discussed (shown in Table 2). In addition to

this, two further mechanisms by which a loss of serendipity can occur are identified. These have not yet been recognised within the literature and their effects are also examined.

Tension	Origins
Algorithm Accuracy	Bush (2016), Kosorin (2016), Schafer and Weiss (2016), Benady (2015)
Data Ethics	BBC (2018), The Guardian (2018), Forbes (2017), Aguirre, Mahr, Grewal, Ruyter and Wetzels (2015), Van Doorn and Hoekstra (2013)
Fraudulent Traffic	Bashir, Arshad, Kirda, Robertson and Wilson (2018), Shiller, Waldfogel and Ryan (2018), Turner, Shah and Jain (2018), Fulgoni (2016), Innovation in Media Magazine (2016)
Non-Human Judgement	Campaign Live (2018), The Guardian (2017), The Telegraph (2017)
Loss of Serendipity	Lambrecht and Tucker (2013), Concept Map Analysis

Table 2, Programmatic Advertising System Tensions

Tension 1 - Algorithm Accuracy

The key attribute of PA lies in its ability to match adverts with potential consumers that are viewing a webpage or are exposed to a digital advert through film or television. It follows that the more 'accurately' that this matching can be carried out then the more effective the advert will be: that is, the viewer is more likely to engage in the service or will procure the product that is being offered. The ability of the algorithm to achieve this end is dependent upon two key factors, the accuracy of the algorithm itself and the completeness of the data that is processed by the algorithm: the term 'complete data' is used to infer data correctness, timeliness and relevance. Both the accuracy of the algorithm and the completeness of data are necessary for 'perfect' matches to be identified.

The improvement of matching algorithms is fundamentally driven by the ability of a platform developer to fund research and development or procure a knowledge base such as patents, software or expert individuals. It can be seen that any platform that possesses a more effective matching algorithm will have obtained a distinct competitive advantage. This would, in turn,

result in the acquisition of more organisations that utilize their services and a resultant rise in competitive bid prices, and enable the increase of platform charges. Collectively this results in greater income for the platform broker and thereby enables further investment in algorithm research and development. Acquiring larger data sets in order to improve the algorithm matching capability leads to the tension of Data Ethics.

Tension 2 - Data Ethics

The completeness of the data that is processed is dependent upon the availability and cost of acquiring viewers' browsing and contextual data. It therefore follows that any platform that can acquire more complete data, and more data in general, would be in possession of a distinct competitive advantage. This would, in turn, result in increased business, and therefore increased income, that would enable the acquisition of more complete data. However, the ability to acquire more complete data is moderated not only by cost but is also limited by contemporary legislation and viewer perceptions of privacy invasion. This highlights a key contradiction within the PA system: in order to improve the efficacy of viewer-advert matching increasing amounts of data are required that, in turn, raise viewer concerns over their digital privacy.

Tension 3 - Fraudulent Traffic

It is increasingly difficult to discern the real efficacy of PA due to the advent of purposeful 'bots' that create fake web traffic. In order to provide accurate performance metrics to participating organisations PA platforms will need to develop mechanisms for preventing bots from creating false traffic. Those platforms that are able to do this would then be in possession of a distinct competitive advantage, further enabling the funding of bot-avoidance mechanisms. It is likely that, in response, bot technologies would improve, thereby leading to a continuous cycle of expenditure on development.

Tension 4 - Non-Human Judgement

Part of PA's attraction lies in its automation. However, while this delivers perceived cost benefits and is resource-friendly, the removal of human judgement can result in improper ad placement. This is damaging, not only to the organisation whose advert has been placed, but also to the PA platform that made the placement. The speed of automated PA trading means that it is impractical for marketers to undertake a final 'sense check' of ad placement. Instead it suggests that algorithm developers need to incorporate some form of digital environment analysis in order to avoid ad misplacement. The technical feasibility of this is moot but the

costs of development would need to be shouldered. PA platforms that could develop this capability would not necessarily possess a competitive advantage but would be able to mitigate what is a significant competitive disadvantage.

Tension 5 - Loss of Serendipity

There is danger that PA can lead to viewers being repeatedly exposed to the same, or similar, adverts. This lack of serendipitous experience leads to consumer weariness whereby adverts do not just have little impact but they are completely ignored. In order to avoid this, broader data sets need to be utilised, comprising personal and contextual data, that enable matching algorithms to recognise and display appropriate offerings. PA platforms that can offer a serendipitous advert experience would be in possession of a distinct competitive advantage. There is however a need to balance the degree of serendipitous exposure with the exposure to products and services that are known to be of current interest to the viewer in order to maintain customer loyalty and income. The question of 'how much serendipity is enough' is one that requires attention.

There are two other mechanisms that may decrease viewers' serendipitous experiences that are not mentioned within the literature review but are evident from the inspection of the concept map (indicated in the lower left quadrant of Figure 1). First, 'loss of serendipity b' whereby a PA platform that gains a distinct competitive advantage would be in the position to enable the adverts of its base of participating organisations to be displayed more widely than those of competing PA platforms. Viewers would then be more likely to be exposed to the range of adverts of organisations that utilise that PA platform. It is conceivable that this would lead to increasing income for that platform and its partnering organisations so that they could collectively invest in further algorithm development and data capture to further increase their competitive advantage. Viewers would ultimately be 'locked in' to viewing the adverts from the leading platform. Second, 'loss of serendipity c' whereby larger organisations, with greater financial reserves, are able to outbid smaller organisations. This would lead to viewers being presented with only those adverts that belonged to larger organisations. Both of these situations would lead to a decrease in serendipitous experiences for viewers.

PA Actor Perspectives

The individual tensions that beset PA may be considered to be of more immediate concern to one of the three actor groups; comprising PA Adopters, PA Platform Developers and Consumers. However, the sociotechnical complexity of PA means that each tension has some

cumulative effect upon the others. Figure 3 depicts the three actor groups and the tensions that would appear to be of primary concern within each of their domains.

For example, PA Adopters are primarily concerned with the overall cost benefit of PA compared to more traditional means of advertising. Part of the cost benefit analyses needs to take account of the PA metrics, for example, in terms of the number of adverts that were delivered to human (and not digital/fake) target consumers, and how many advert views resulted in a purchase. This then becomes an issue for PA Platform Developers to address in being able to provide reliable metrics. Consequently, an improvement in the cost benefit of PA is likely to result in its wider adoption and thereby increased Consumers exposure to programmatically generated adverts. This, in turn, drives a reduction in serendipitous experiences that is countered by the increasing use of personal data. Consumer perceptions of intrusiveness increase with the use of larger and more personalised data sets and this may provoke avoidance of situations where PA is implemented. Conversely, curtailing the use of larger and more personalised data sets in order to accommodate Consumer perceptions of intrusiveness results in a reduction in the cost benefit of PA.

Overall, what this indicates is the complex and interrelatedness of the components of the PA system. Furthermore, that the overall efficacy of PA is dependent upon the goals of each actor being in harmony with the expactations and perceptions of the others. For instance, PA Platform Developers need to take heed of Consumer perceptions of intrusiveness when endeavouring to improve their ability to match prospective consumers with targeted adverts. Similarly, PA Adopters must be mindful of the damaging effects that can be incurred through improper, automatic advert placement, and not be lured by the promises of cost benefits alone.

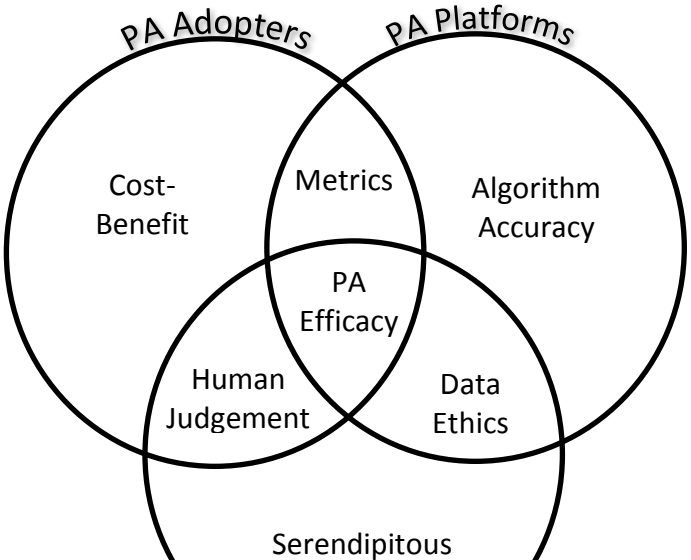

Figure 3, PA Actors and Tensions

FUTURE SCENARIOS

This section builds upon the discussions of the PA tensions to generate four future scenarios of PA. Developed by Kahn (Kahn and Weiner, 1967) scenario planning encompasses a suite of approaches for picturing possible futures (Ringland, 2010; Bradfield *et al*., 2005; Meadows *et al.,* 1992; Van der Heijden, 1996; Raskin *et al*., 1998; Huss and Honton, 1987). The resultant scenarios contain information about a given situation or system so that they may be used to guide decision-maker's thinking and are particularly suited to fast-moving, complex, technology-based phenomena (Harries, 2003; Alexander and Becker, 1978). Scenario development may be based upon qualitative evidence or quantitative modelling, and usually culminates in the generation of several scenarios (Schwartz, 1991; Wack, 1985). The process may be highly structured or more organic in order to allow the expertise of evidence to give rise to insightful imaginations of the future (Camponove, Debetaz and Pigneur, 2004).

Adopting an organic approach, using discussions with expert scholars, the four scenarios for the PA system are identified as 'perfect algorithms', 'ethical limits', 'negative cost advantage' and 'fewest platforms'. These appear to be congruent with the view that PA is experiencing a hype-cycle pattern of adoption. Understanding these future scenarios, and their intrinsic tensions, affords insight into PA that may enable developers and adopters to ameliorate the negative consequences of entering the 'trough of disillusionment' phase of the hype-cycle.

Scenario 1 'Perfect Algorithms'

The development of programmatic algorithms may continue to the stage where they offer near perfect matching between viewers and adverts. That is, algorithms are capable of exposing viewers to adverts for products and services that they habitually consume or are likely to consume, and also to products and services that meet their current circumstances even if the

individual was not aware that they needed those products or services or that they were even available. For instance, adverts for cheap, local accommodation are presented to travellers that are about to be affected by impending flight delays.

Comprising the tensions of ‘algorithm accuracy’ and ‘data ethics’, this scenario requires several assumptions to be met. First, the large, ‘live’ data sets that are required for such an action are available. Second, those data sets are not prohibitively expensive to acquire and process. Third, the acquisition of such large amounts of information is not prohibited by the prevailing legislation in the countries where the activity is being practiced. Fourth, that the acquisition of large amounts of highly personal information does not result in viewers perceiving that it is some form of invasion of their privacy. Last, that all PA platforms develop ‘perfect algorithms’ at or around the same time, else Scenario 4 would take effect.

The outcome of all PA platforms possessing ‘perfect algorithms’ would be that none of them would benefit from this is a competitive advantage. All platforms would be able to provide comparable matching of viewers with adverts and therefore there would be no advantage for organisations to place their business with one platform instead of another. Without any discernible performance advantage it is likely that PA platforms would then enter a price-competitive market and this may ultimately lead to Scenario 3.

This scenario could also manifest in other technologies such as that used by the top two companies in the Forbes 2018 list of the ‘World's Most Innovative Companies', which are ServiceNow and Workday (Forbes, 2019). Both companies offer technological solutions to the management of dispersed workforces and clients and are investing heavily in the development of algorithms to predetermine client and workforce needs and thus build predictive models that can decide incoming request. Fundamentally they are developing programmatic systems that predict future workload request, workflow determination and client needs, much like a PA systems does but without the bidding process for media placement. Thus, the need for these organisations to develop algorithm accuracy in order to appropriately predict future scenarios presents a similar dialectic challenges to avoid Hype Cycle decline.

Scenario 2 ‘Ethical Limits’

Consumer sensitivity to the capture and utilization of large sets of highly personal data may rise to the point where the access to further data becomes limited. This may occur through changes to legislation, perhaps motivated by consumer lobby groups or other political pressures. It may also occur in an alternative manner whereby organizations that use PA, and

by association are utilizing vast data sets, become shunned by consumers: a move that has been replicated for example in the avoidance of organizations that are perceived to be at odds with consumers' values regarding slave labour and the environment.

Underpinned by the tension of 'data ethics', this scenario is dependant upon several assumptions. Firstly, that the improved efficacy of PA remains dependent upon increasingly large data sources. Also, that these increasingly large and complex data sets can be practicably and cost effectively acquired. Finally, that legislation and consumer attitudes toward data privacy remain constant.

The outcome of the emergence of an 'ethical limit' on the degree to which the acquisition and processing of large data sets is tolerated would suggest that the motivation to develop algorithms further would diminish. It is possible that some further refinement could take place but it is envisaged that the majority of development would have taken place to take advantage of new data types. The result of this is that PA platforms would be unlikely to be able to develop any algorithm or data-driven competitive advantage. Consequently, SSP providers may become the dominant players since they would control the webspace that was available for ads to be placed upon. This may result in a situation where premium webspace prices rise to the point where only large organizations with correspondingly large marketing budgets may be able to afford to outbid competing organisations, leading to the tension 'loss of serendipity c' and potentially Scenario 3.

This scenario also may manifest for any technology that relies upon big data. Returning to the example of ServiceNow and Workday discussed in the previous section their ability to predict future workload requests would be improved through the capture and use of increasingly large and personalised data sets. Consequently, they may well be faced with issues of transgressing perceptions of the ethical use of data.

Scenario 3 'Negative Cost Advantage'

It is very probable that programmatic algorithms will continue to improve in their effectiveness at matching consumers with products and services. Assuming that such facilities are made available to the majority of the market, at a cost that is not prohibitive, then it is highly likely that organisations would enter a 'bid war' in order to take advantage of the increased sales that may ensue. Thus, the cost of programmatic advertising to the participating organisation would exhibit a rising trend.

It is also likely that fraudulent traffic would also increase, both in type and frequency. This would require a concomitant investment in bot-avoidance systems and an increased cost that would need to be factored into the programmatic platform charges. The presence of fraudulent traffic along with improving, but less-than-perfect, programmatic algorithms, plus the inefficiences caused by the non-human judgement of ad placement, all conspire to further reduce the cost-effectiveness of PA.

Under these conditions it is foreseeable that the actual return on investment may drop to the point where PA no longer offers a meaningful financial advantage over more traditional forms of marketing; channels that are also better understood by marketers (Benady, 2015; Seitz and Zorn, 2016; Gertz and McGlashan, 2016).

Scenario 4 'Fewest Platforms'

The first PA platform develop to be able to develop or closely approximate a 'perfect algorithm' would have obtained a distinct competitive advantage. Assuming that this is not prohibitively expensive to achieve, and that the large data sets that are necessary are also affordable and are not abhorrent to consumers (tension of 'data ethics'), then this is likely to result in that platform becoming dominant within the PA marketplace.

If a single, or few, PA platform were to become dominant then this would propagate a 'bidding war' whereby organisations engage in aggressive bidding to ensure that their adverts are presented to viewers that are 'perfectly matched' to become consumers. This scenario may well result in consumers being faced with limited choices (tension of 'loss of serendipity b') and participating organisations may find that the platform costs rise to the point where Scenario 3 transpires.

DISCUSSION

While it is impossible to predict the future with any certainty, having developed several possible future scenarios for PA, it is desirable to at least consider the potential for each to occur. As Jun (2012a) noted, the phases of the hype-cycle may be offset for different system actors. Our prognostications reflect this by suggesting that Consumers are most likely to have concern over the 'Ethical Limits' scenario unfolding. In fact, this is something that has already been recognised in practice (Aguirre, Mahr, Grewal, Ruyter and Wetzels, 2015; Van Doorn and Hoekstra, 2013). Consequently, it would be logical to consider this scenario as one that PA Platforms should address immediately.

Contrastingly, PA Adopters are more likely to be concerned with the Negative Cost Advantage scenario. However, this is a situation that would be exacerbated by any adverse effect caused by the 'Ethical Limits' scenario unfolding in tandem. Therefore, this also suggests that while PA Platforms should work towards improving the reliability of performance metrics, this must not be done at the expense of ignoring current Customer issues of data privacy and feelings of intrusiveness.

The development of increasingly accurate algorithms is undoubtedly an activity that is of interest to PA Platforms since it is one way in which they may be able to assert a competitive advantage. However, since this is constrained by 'Ethical Limits' and also inhibited by the difficulties of imbuing information systems with true serendipitous capabilities, it would not appear to be an issue that is of immediate concern. Similarly, while the 'Fewest Platforms' scenario would appear to be of concern to all three PA system actors, through reducing market diversity, this situation would appear to be a long-term effect of the efficacy of PA as a whole. Consequently, both of these scenarios are comparatively long-term situations that may or may not become realised. Based upon this putative rationale, Figure 4 presents our interpretation of the likelihood of each of the four scenarios causing, or contributing, to the decline in PA utilisation according to the accepted or 'Typical' interpretation of the hype-cycle.

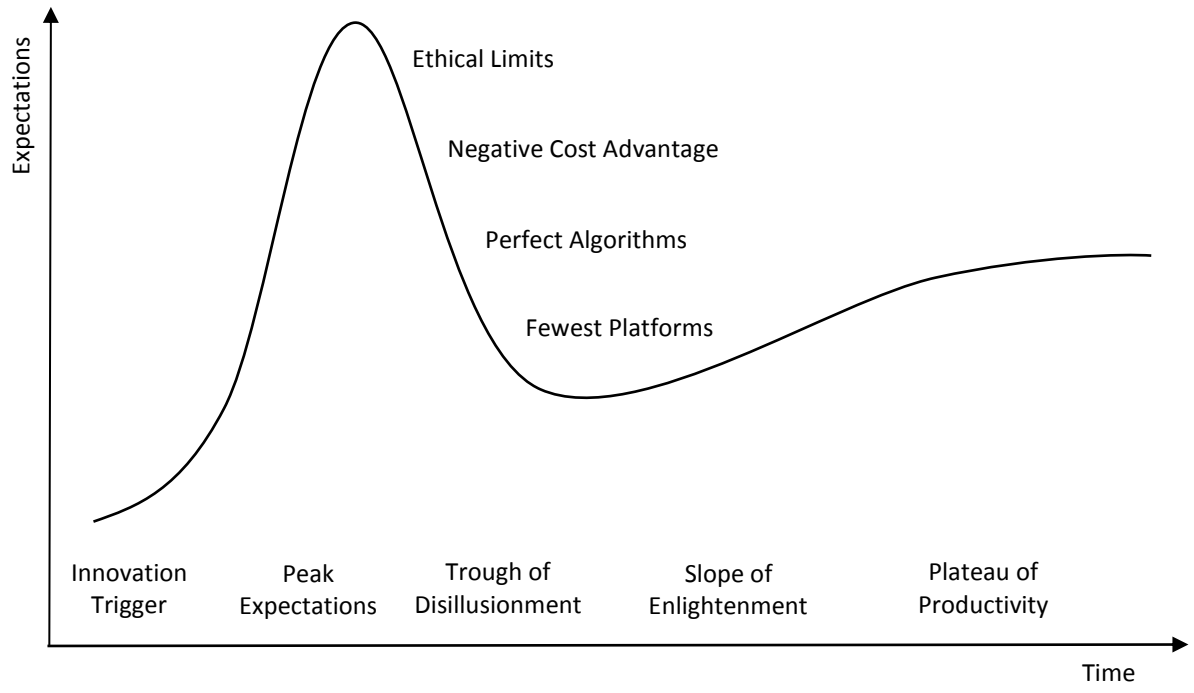

Figure 4, Navigating the Traditional Hype-Cycle

Responding to Dedehayir and Steinert's (2016) observation that not all technologies conform to the 'Typical' hype-cycle as stated by Gartner, we proffer two alternative interpretations of the future development of the PA hype-cycle. Figure 5 depicts a 'Concurrent' hype-cycle whereby it is assumed that the challenges of the four future scenarios are addressed within the same relative time frame. Successfully tackling the challenges of each of the four future scenarios may well enable a more rapid and/or greater degree of recovery of the technology into the 'plateau of productivity' phase.

Figure 6 depicts our interpretation of a 'Sequential' hype-cycle whereby the challenges of the four future scenarios are addressed in turn. We conjecture that the successful amelioration of a specific set of issues may initiate a new phase of increased interest and adoption of the technology. This may be particularly true if the problems that are addressed are those that are significant to a new actors within the PA system. For instance, addressing concerns over data privacy may lessen consumer concerns and thereby spark a renewed interest in PA adoption. Similarly, improvements in data reporting may attract new partners to existing platforms, or it may stimulate the entrance of new PA platform providers to the market. Additionally, improved algorithms that reduce the instances of adverts being placed next to inappropriate materials may rekindle organisations' confidence in PA technologies.

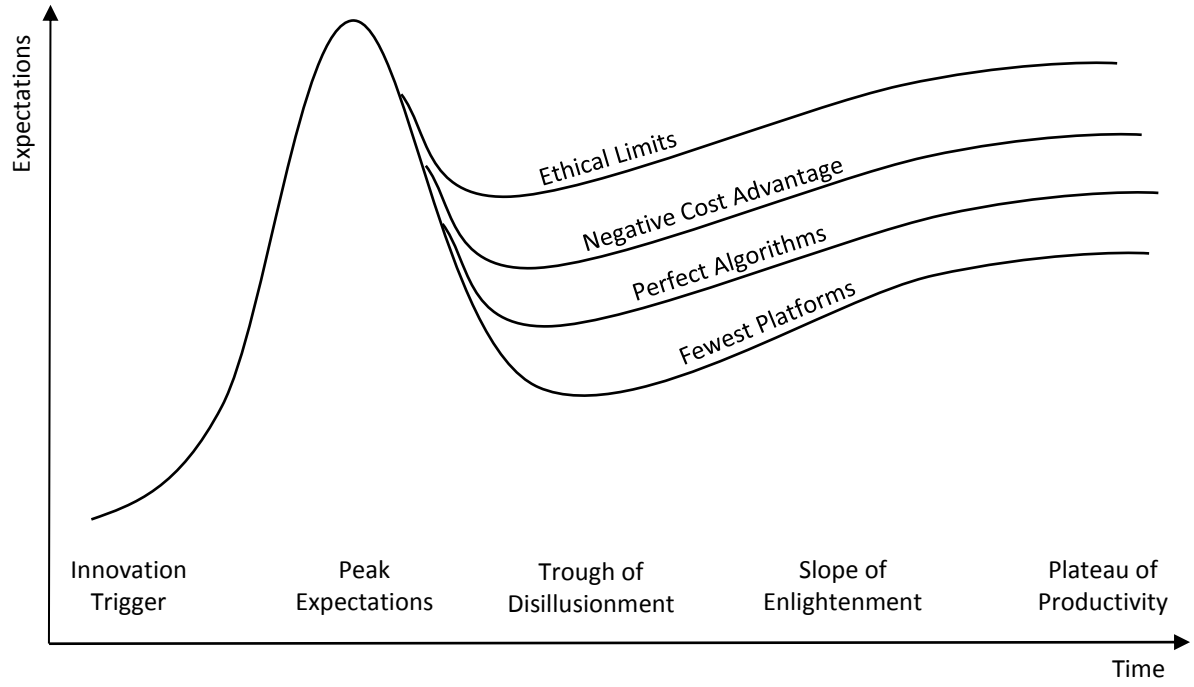

Figure 5, Navigating the 'Concurrent' Hype-Cycle

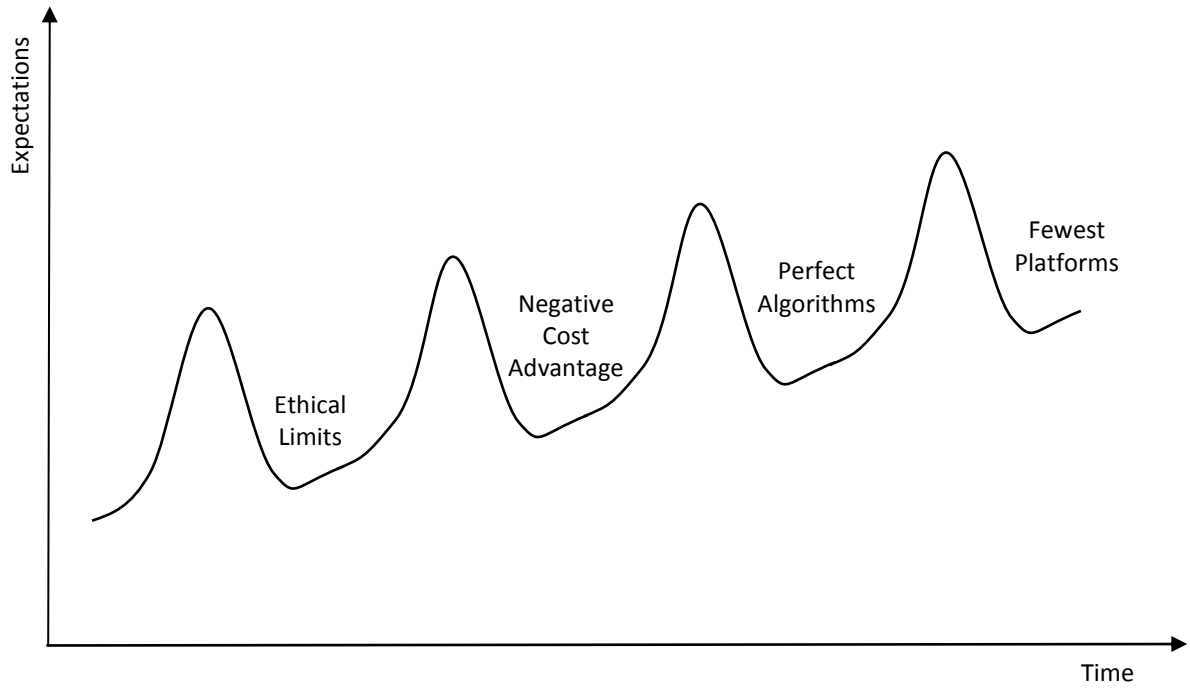

Figure 6, Navigating the 'Sequential'' Hype-Cycle

Whether PA conforms to a 'typical' hype-cycle, or one of the alternative patterns that have been presented, remains to be seen. However, each would be benfitted by the whole or partial resolution of the issues that have been detailed in each of the four future scenarios. Consequently, a discussion of the ways in which the issues that surround the adoption, usage and development of PA systems is provided next.

Firstly, consumer and societal concerns over data privacy are a current issue that have already had material effect on several sociotechnical systems and their usage. PA's dependency upon complex and personal data, and its probable use of ever larger data sets, suggests to us that the real and perceived ethical use of consumer data is likely to be of immediate and ongoing concern. Platform developers and participating organisations should be mindful of the paradoxical requirements of rich data that enable real-time, personalised consumer targeting but increase the possibility of alienating privacy-sensitive individuals.

Concerns have already been raised over the actual cost-effectiveness of PA. Increased bidding competition, rising development costs and the need for improved and transparent performance metrics would contribute to a further escalation of costs. Ultimately, the tensions that are inherent within the PA system suggest that the return on investment may become eroded to the point where PA offers no discernible advantage over other methods of engaging with the consumer audience.

It is not uncommon for new technologies to cause a proliferation of providers and for this to be followed by a period of consolidation whereby the market becomes dominated by a few key players. It is likely that a similar situation will occur in PA. The dominant PA platform providers may well be those that are able to offer more transparent metrics dashboards, better bot-deterrence, data acquisition techniques, or demonstrably improved algorithm efficacy.

Finally, it is considered least likely that a 'perfect' PA algorithm could be developed. While algorithms will undoubtedly continue to improve, their ability to provide a 'human-like' ability to consider the context and content of ads and their placement is, as yet, a desirable future goal.

CONCLUSION

Programmatic Advertising (PA) is a multi-billion dollar technological development, that demands interdisciplinary academic attention in order to capture and understand its rich and impactful complexity. To date, very little scholarly attention has been paid to this apparently hype-driven phenomenon. This study has addressed this gap by constructing a Concept Map of the PA system and develop four future scenarios of its potential hype-cyle decline.

The paper makes several important contributions. First, through review of the emergent literature that is critical of PA's capabilities and an examination of the proliferation of the term "Programmatic Advertising" across the internet, it is evident that PA is balanced upon the initial peak of the hype-cycle. Examination of the tensions that are inherent within this complex sociotechnical system, through the construction of a Concept Map of its constituent elements, four future scenarios are developed that indicate the means by which PA may slip into the 'trough of dissilusionment'. These are arranged in order of likelihood of occurrence and thereby afford some indication of the issues that participating organisations and platforms developers should be mindful of. In particular, the real and perceived ethical use and treatment of personal data is an immediate issue that platform developers and participating organisation need to consider carefully.

Second, while there is a large body of work that acknowledges or utilizes the term 'hype-cycle' most of this does so in a superficial manner. Recent research suggests that few technologies actually develop in the manner that is depicted by Gartner's hype-cycle model. In response, this study proffers two alternative means by which Programmatic Advertising technology may manifest. The 'Concurrent' model assumes that the simultaneous resolution of the challenges that best PA adoption will ameliorate the effect of the 'trough of disillusionment' by reducing its maximum decline and overall duration. Contrastingly, the 'Sequential' model assumes that

challenges are addressed in order of need and that the resolution of each may invoke a repetitive cycle of gains and losses, which ultimately lead to the technology reaching the 'plateau of productivity'.

Third, the loss of serendipity is a known issue for many marketing systems and comprises exposing consumers to an 'echo chamber' of repeated product and service offerings. This study advances our understanding of serendipity in PA systems by identifying two further ways in which it may be eroded or lost. Firstly, through a reduction in the number of PA platforms caused by the dominance of one, or few, PA platform providers in the marketplace. Fourth, through the dominance of large organisations, with correspondingly large budgets, that can induce and win a 'bidding war'. This is an issue for platform developers that may be reliant upon the development of PA algorithms in order to deliver serendipitous moments. While the continued improvement of PA algorithms is clearly of their concern, they should be mindful that other, economic, mechanisms may also conspire to adversely affect their ability to deliver new and inviting offerings to prospective consumers.

Lastly, PA is a system that has, so far, largely delivered upon its promises, but is beginning to be questioned by many of its users. However, it has become a 'black box' solution that is poorly understood by most and this has prohibited its critical investigation. This study is the first that provides a complete overview of the PA system through the generation of a detailed Concept Map. In doing so, it affords practitioners a device that describes the major functions of a PA system and enables them to make an informed decision about its adoption or continued usage.

The study has some limitations not least of which is the confidence with which future predictions may be made about complex sociotechnical systems. Also, while this study has considered the perspectives of the different actors that are involved with PA systems it must be recognised that these are the homogenised views of highly disparate groups. Despite this, the issues of data ethics and actual return on investment are pressing matters that should be carefully considered by PA adopters and addressed by PA developers. Also, PA is a complex and evolving business and as such there is a proliferation of ways in which PA is implemented. Consequently, the Concept Map that is developed in this study should be regarded as a generic overview of the key elements that should be encountered in PA systems.

Future research should endeavour to further our understanding of PA systems through the examination of situation-specific PA applications. In particular, valuable contributions could be made through more interdisciplinary research so that the interplay of the technical and

socioeconomic systems could be better understood. Research should also examine the effect of privacy-sensitivity upon user's attitude toward organisations and systems that depend upon the acquisition and analysis of large data sets. Research is also needed that examines the actual cycles or trajectories that are followed by nascent technologies. In particular, PA appears to have conformed to Gartner's original observation that new technologies experience rapid increases in expectations before more critical commentaries are observed. Research should monitor the development of PA, and examine other technologies, in order to discern whether they conform to some other predictive pattern.

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