

Business IT Strategy in Action: Case Study of #PUPRU

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Abstract — Predicted key business IT trends through to 2020 acknowledge there will be increased adoption of disruptive technologies that will impact within business contexts (Gartner (1), 2015). These include moves to small-screen marketing, rising value of big data intelligence and increased use of social systems. However, IT penetration and literacy gaps between advanced and emerging economies, as well as social and organisational issues associated with technological implementation of business strategy, provide challenges to adoption of these trends. Strategy As Practice (SAP) presents a potential solution. It is concerned with the practice of strategising, including both the formulation of strategy and implementation that delivers strategic renewal and change. Through the “*doing of strategy*”, organisations not only gain an insight into strategic management from a theoretical level, but also can focus on micro-level social activities, process and practices that characterise both organisational strategy and strategising. In this paper, the Pop-Up Research Unit (#PUPRU), a newly-established mobile research centre in the Salford Business School (SBS) will be discussed. It aims to adopt a SAP approach to inform business strategy. Three disruptive technologies - Beacon, Raspberry Pi and 3D printer - available as part of #PUPRU will be examined. Future experiments in various business scenarios and live projects evaluating how these digital disrupters can be employed will also be considered.

Keywords - #PUPRU; Business IT Strategy; Strategy as Practice (SAP); Disruptive Technologies; 3D Printing; Beacon; Raspberry Pi

I. INTRODUCTION

In business “Disruptive Technologies” have become a buzz term describing a change and shift in the importance of IT in strategy. As businesses implement digital platforms based on disruptive technologies, and consumers spend greater time using digital platforms, it has become important to establish appropriate IT strategies to drive business efficiency and profitability. This paper will explore the impact of disruptive technologies in business, challenges of establishing IT strategies within organisations and Strategy As Practice (SAP) as a potential solution. This will provide background context to #PUPRU.

1.1 Emerging Technologies in Business Environment

According to Christensen (1997), a disruptive technology is a “*new emerging technology that*

unexpectedly displaces an established one”. For example, the personal computer displaced typewriters changing working and communication practice; smartphones have largely replaced cell phones because of portability and functionality which disrupts a range of industries, such as the manufacture of cameras, MP3 players, calculators and GPS devices.

In business contexts, disruptive technologies are new digital goods and services that revolutionise, change and disrupt accepted methods of performing business activities and transactions (Accenture, 2016). These innovations can transform business process and drive competitiveness with positive and negative affect. Technological leadership is the primary source of “First Mover” and ‘Fast Followers’ (Wunker, 2012). The positive of disruptive technologies in business is the creation of a culture of continued innovation and fluidity in operational strategy. Businesses able to foresee technological trends and integrate appropriate technologies into strategy can evolve and align themselves with market to benefit from *self-driven* disruption. All disruptive technologies have potential to be the “*next*” big thing, creating significant opportunity, as with past disrupters like the *Internet* and *Google*.

However, unforeseen digital disruption drastically impacts business revenues. For example, GAME group closed 277 stores in the UK and Ireland in 2012 (BBC, 2012) when consumer habits shifted towards downloading of games. EE’s 2015 third quarter results showed a 10.3% collapse in voice minute revenue as customers moved to VOIP communication apps like Facebook Messenger, WhatsApp, and WeChat (Business Insider, 2015). Desktop PCs and laptop sales declined by 9.5% in 2015 with increased global demand for tablets and smartphones; it is not a necessity for many to own large-screen devices when there are cheaper mobile alternatives (Gartner (2), 2015). Fear a new service could disrupt an existing business is a strong motivator to align IT with business strategy. This will be discussed in detail in the following section.

1.2 Technology Strategy in Organisations

IT has become a key function for most organisations: many have great expectations of their investment in

technology to deliver future benefits and achieve 6 strategic business objectives:

- Operational excellence
- New products, services, and business models
- Customer and supplier intimacy
- Improved decision making
- Competitive advantage
- Survival

To achieve these objectives, IT must be aligned to and support business strategy. This degree of alignment is critical to business success, the effective use of its resources, and in turn, the perceived value of IT implementations. However, there are 2 principal difficulties:

1. In practice, there are few instances of business-oriented IT strategies. Most are entirely technology-centric or focused on technology products and services.
2. Impact of technology is difficult to evaluate because it affects multiple aspects of the organisation, such as culture, people and legislation.

Concern about gaps between theories what actually happens within organisations has given rise to “*practice*” approaches in management literature. Research of Strategy As Practice (SAP) suggests business strategy is not necessarily about analysis and planning, but understanding how strategy operates as a way of thinking and a way of acting; through this organisations can deliver value to their customers and increase their competitive success (Wyatt-Haines, 2007). SAP as a research topic is concerned with the “*doing of strategy*” (Pearlson et al., 2016):

- Who does it?
- What do they do?
- How they do it?
- What do they use?
- What implications does this have for shaping strategy?

While people do strategy the theory is populated by multivariate analyses of firm or industry-level effects upon firm performance. There is an absence of human actors and actions in most strategic theory, even in those that examine the internal dynamics of the firm, such as the resource-based view (Johnson et al., 2015). In order to explore how disruptive technologies can positively influence business at a strategic level, SBS has established #PUPRU. The aim is to undertake both technology strategy research and engage relevant industrial and public sectors partners through SAP theory.

II. # PUPRU

2.1 Introduction to #PUPRU

#PUPRU is a bespoke robust mobile display space intended for regular ad hoc installation in public spaces

including the high street, shopping malls, foyers of large businesses, and education institutions.

The digital revolution has significantly impacted traditional business. The unit provides a platform to support research into 4G retailing, digital marketing and the digital high street. Focus is on business exploitation, implementation and integration of a range of digital technologies, tools and methods. Through these technologies, the Unit will capture data in relation to retailing practice, personal digital footprints, e-behaviour and e-supply chains. In the following sections, experiments with #PUPRU key technologies are discussed and potential business scenarios explored.

2.2 PUPRU Technologies (1): 3D Printing Technology

2.2.1 Introduction to 3D Printing and its Use in Industries

Rapid development and increased affordability of 3D printing (additive manufacturing) has attracted much attention in recent years. Gibson et al. (2010) state that the term “3D printing” refers to layer-by-layer creation of physical objects based on digital files that represent their design. The technology has become a viable tool for business and consumer use.

3D printing technology has evolved since its introduction at the end of the 80s by Charles Hull, when it was called *Rapid Prototyping Technology* (Luxexcel, 2016). Initially, 3D printers were used to create prototypes; this is still common in the construction and architecture, aerospace and automotive industries (Stratysis, 2013; Wohlers & Gornet, 2011). 3D printers have become increasingly reliable and powerful so it is possible to develop final products as opposed to models or prototypes. This means there has been a shift in 3D printing towards production as opposed to a prototype development. This has benefited business as well as shifting consumer habit. People are using open source platforms like *Thingiverse* (Thingiverse, 2016) to download designs to print. These are free and easy to use, with numerous models to print with practical uses. Business can also benefit from 3D printing technology by either providing final products (additive manufactory) or Internet retail. The ability to reproduce parts raises efficiency, lowers labour costs and has an impact on multiple businesses; these include the global manufacturing industry, jewellery and toy production, dental reconstructions, medical and health care. Some key benefits identified by AEB White Paper (AEB, 2014) of additive manufacturing include:

1. **Waste reduction:** Traditional manufacturing processes involve removal of material through sanding or milling, whereas additive manufacturing only consumes the materials that are actually needed (Khajavi, et al, 2014; Holmström et al, 2010);

2. Product customisation and bespoke designs to order:

3D printing allows manufacture of individual bespoke products; hearing aid shells which fit recipient, implants and prosthetic devices, surgical instruments, tissue engineering, pharmaceuticals, dosage forms, medical and dental devices (Ventola (1), 2014; Ventola (2), 2014). Equally, it allows printing out replacement parts as needed (New Scientist, 2012) cutting requirements for storage space and to carry spares.

3. Reduction of CO2 emissions: 3D printing technology makes it possible to construct lighter components that reduce CO2 emissions. Karagol (2014) discusses how 3D printing technology is used in the aerospace industry to manufacture aircraft parts, that drives tooling, inspection, maintenance, assembly and inventory management (Karagol 2014, Wohlers & Gornet, 2011).

3D printing could transform online retailing. Retailers can sell blueprint design plans that consumers can purchase on the web and print at home or at 3D print shops. The world's first 3D print shop opened in Zurich in 2012 (3D-MODEL, 2016) and additional shops opened in Munich and Vienna in 2014. In these shops the bespoke nature of the final print has increased so the design can be adapted to improve and modify functionality. Equally, electronically transmitting digital design plans for local printing eliminates customs duties. Nike are an example of this have marketed the first athletic shoe with 3D-printed components for download (Digital Trends, 2015), with templates for shoes that can be printed out overnight. Besides industry and business usage, 3D scanning and printing can be used for educational purposes in school and universities. Teachers and students can combine engineering, maths, design process and history.

It is also clear that 3D printing has potential to revolutionise manufacturing in a wide range of business contexts. However, as with other emerging technologies, implementation in certain contexts faces challenges that are not just technological, but ethical, organisational and political. For some organisations who by nature have had always had a traditional method of work, an emerging technology may create a way of working that may not be considered in their operating procedures. This may in effect force them to rethink requirements and establish new policies and procedures.

Issues with 3D printing technology include security, liability and intellectual property protection. To address and understand these issues, #PUPRU will be taken into industry situations to understand how 3D printing disrupts the supply chain and logistics of the manufacturing industry.

2.2.2 3D Printers in #PUPRU

#PUPRU has two Formlab Form 1+ 3D Printers (Figure 2.1 below). The supplier claims that it is a complete end-to-end system allowing users to 3D print from the convenience of their desktop (Formlabs, 2016). It uses *PreForm*, a software package designed to prepare any .STL or .OBJ for printing. Once a file has been prepared for 3D printing, a specific resin type can be selected. After a part has been printed, it will be coated with excess liquid resin. Users remove models from the build platform and then wash parts in isopropyl alcohol (90% or above) for 20 minutes. Once dried, users can easily remove the part using cutters and the print is ready for use.



Figure 2.1 Formlab 3D Printer Set (Formlabs 2, 2016)

3D printing experiments have been undertaken by SBS staff to print some final products, such as butterfly clip, Apple USB case, and bookmark, as illustrated in Figure 2.2 below. The 3D digital technology was exhibited at the school Creative Entrepreneur event on 25 Nov 2015 at Media City UK (Creative Entrepreneur, 2015), an event celebrating the creative and digital economy.

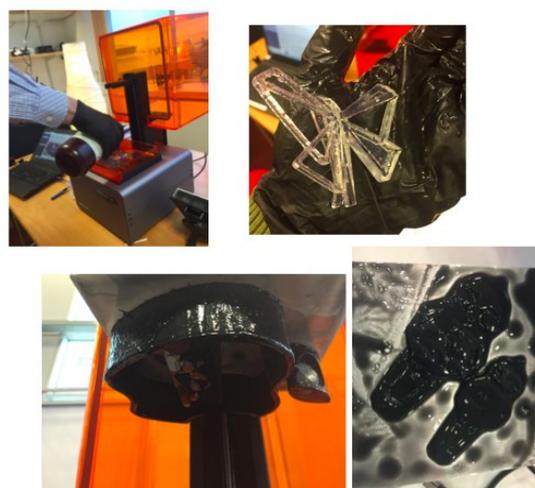


Figure 2.2 Products printed by Formlab 1+ (image: author's own)

Key lessons learned from this 'technology trial' include:

- Software is user friendly, easy to operate with clear instructions within the interface.

- Printing procedure is time-consuming, unsuitable for mass production. For example the butterfly model in Figure 2 has 1187 layers which is a relatively simple model. In medium resolution, it took 3 and half hours to print and 30 minutes to finish the post-printing (cutting supporting materials, cleaning the building platform etc.). When 'fast print' mode is used, the printing time reduces by around 40% to roughly 2 hours.
- The product is resin-efficient, but the product quality is rough and unfinished.

One doctoral research is currently being undertaken in SBS is investigating the impact of 3D printing implementation factors on supply chain designs with the overall aim of developing an additive manufacture implementation framework.

2.2 PUPRU Technologies (2): Raspberry Pi

2.2.1 Introduction to 3D Printing and its Use in Industries

Raspberry Pi is a low cost, credit-card sized computer that plugs into a monitor or TV, and uses a standard keyboard and mouse. It is a device enabling people of all ages to explore computing, and learn programming in languages like Scratch and Python. It can do many things expected from a desktop computer, such as browsing the internet, playing high-definition video, to making spreadsheets, word-processing, and playing games (Raspberry Pi, 2016).



Figure 2.3 Raspberry Pi (Raspberry Pi, 2016)

Raspberry Pi is designed to be used in education for creative teaching and learning. The device's low cost means it is increasingly used as a budget PC alternative in other industrial fields and to drive technology for internal business processes. Eben Upton, a chip architect at Broadcom and a founder of the Raspberry Pi Foundation, says the device is particularly useful in certain functions such as programming displays for digital signage. "It is actually very suitable for industrial uses, especially for industrial control processes," he argued. "The Pi is as powerful as or more powerful than what is currently being used" (Techradar, 2013). There are many innovative things people could do with Raspberry Pi (ITPro, 2016), such as Makeshift face recognition, a Pi-powered lego (aokley.com, 2013) and Retro gaming / ZX spectrums. That said, there is

little literature to show how Raspberry Pi can be embedded into business strategy.

2.2.2 Raspberry Pi in #PUPRU

#PUPRU has three Raspberry Pi 1s, which have 40-pin GPIO headers, 4 USB 2.0 ports, 1SD card socket, audio input and a camera set socket. Key advantages identified through the experiments with Raspberry Pi include:

- **Cost-efficiency and portability** - Available from around £25, the Raspberry Pi is essentially a credit card-sized PC.
- **Energy-efficient** - Can be powered by 5v micro USB.
- **Functional with creative input/output channels** – An author has successfully developed game controllers which can be connected to a Raspberry Pi to play the games (see Figure 2.4 below).



Figure 2.4 Raspberry Pi Game Set

2.2.3 #PUPRU in Action: Raspberry Pi

Based on the key advantages identified, the authors suggest that Raspberry Pi has potential to be used in the public sector to achieve strategic aims and solve problems faced at strategic levels. For example, the UK's National Health Service (NHS) strategic aim is as follows:

"In order to preserve the values that underpin it, NHS must change to survive. Change. Change does not mean top-down reorganisation. Instead 'It means a reshaping of services to put patients at the centre and to better meet the health needs of the future'. There are opportunities to improve the quality of services for patients whilst also improving efficiency, lowering costs, and providing more care outside of hospitals. These include refocusing on prevention, putting people in charge of their own health and healthcare, and matching services more closely to individuals' risks and specific characteristics. To do so, the NHS must harness new, transformational technology and exploit the potential of transparent data as other industries have. We must be ready and able to share these data and analyses with the public and to work together with them to design and make the changes" (NHS, 2013).

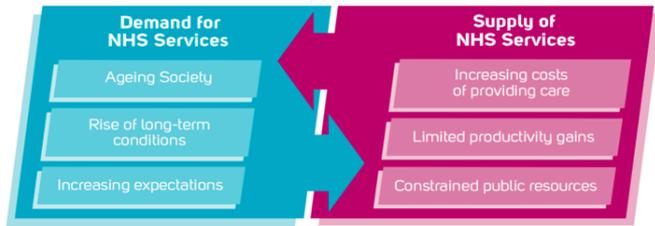


Figure 2.5 NHS Demand and Challenges (NHS, 2013)

Studies suggest that older patients account for the majority of health expenditure. One analysis found that health care expenditure for people over 75 was 13-times greater than to the rest of the adult population (Imison et al., 2012). Nearly two-thirds of people admitted to hospital are over 65 years old. The flexible input/output channels of the Raspberry Pi, such as the speaker, camera and button input may help elderly patient to participate and improve service quality, in a cost and energy effective manner.

To take this innovative idea to action, several meetings and correspondences have been conducted between SBS and the NHS Salford Clinical Commissioning Group. Conversations have focused on how disruptive technologies can help the NHS achieve their strategic objectives. The NHS Engagement Manager, Citizen Scientist Project Manager and Patient Experience Manager were involved in the meetings and have invited #PUPRU to attend the NHS Citizen’s Panel Event to be held at the end of March 2016 in Salford. The event is underpinned by NHS strategy of ‘*reshaping of services to put patients at the centre and to better meet the health needs of the future*’, aiming to get those who live, work or access primary health care services in Salford involved in conversation. Presentations, interactive workshops and information stands will be provided at the event in three key topics:

- **Salford Standards:** Awareness raising of how this will benefit patients
- **GM Devolution:** ‘Our Salford’
- **Awareness of cancer needs in Salford**

A prototype ‘questionnaire device’ (see Figure 2.6 below) had been developed based on Raspberry Pi, which was tested at the event to gauge participant engagement and gather feedback on the quality of service, by using convenient input/output methods.

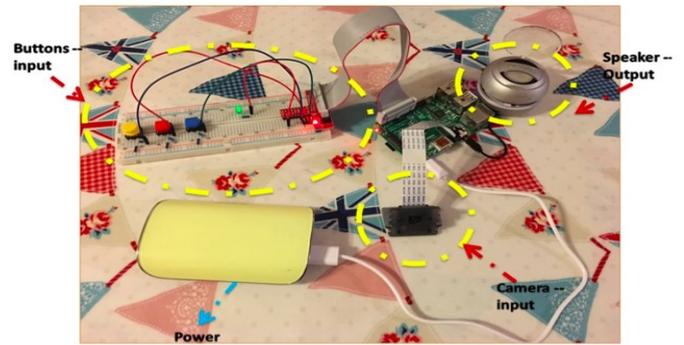


Figure 2.6 Raspberry Pi ‘Questionnaire Device’ (image: author’s own)

As illustrated above, there are two inputs captured from participants. These are i). the camera and button panel, and ii). an output channel from Raspberry Pi which is connected to a speaker. When a participant approaches the device, motion detection by camera will boot the questionnaire program automatically. A robot voice will deliver questions that are pre-set by the program one-by-one, waiting for participants to press colored button on the button panel to give their choices. When the questionnaire is finished, camera will re-start to ready to detect the next participant, which will repeat the previous process *ad infinitum*. The collected data will be stored on SD card of Raspberry Pi for statistical analysis purpose.

Because of the simplicity of the device, the questionnaire can be designed to align with four key issues facing an organisation, in the closed question format. In the demonstration version produced for the NHS Salford Citizen’s Panel event, five questions suggested by NHS Salford Clinical Commissioning Group have been programmed:

1. **Are you enjoying the event today?** *Blue button for Yes, Red button for No, Yellow button for So so*
2. **Would you come to a future event?** *Blue button for Yes, Red button for No, Yellow button for Maybe*
3. **What have you most liked about today?** *Blue button for Salford Standards, Red button for GM Devolution, Yellow button for Awareness of Cancer Needs*
4. **What did you least like about today?** *Blue button for Salford Standards, Red button for GM Devolution, Yellow button for Awareness of Cancer Needs*
5. **What would you like to see at future events?** *Blue button for Information about Health Services and Changes, Red button for Patient/Community Stories, Yellow button for Market Stalls*

The easy use and cheap cost of Raspberry Pi technology inform the next step collaborations between the NHS and #PUPRU which will integrate Raspberry Pi with other emerging technologies such as touch tables and beacons in a wider field.

2.4 #PUPRU Technologies (3): Beacons

2.4.1 Introduction to Beacons and their use in industries

Beacons are small sensors which can be stuck anywhere to provide context and micro-location to smart devices. In a retail environment they have been successfully used to drive customer loyalty and in-store sales (Perka, 2016). Beacons are proximity-based, sending Bluetooth signals to a customer's mobile device when they are within 50-100 feet of the device, to automatically trigger personalised coupons, offers, and loyalty rewards. They can also enable contactless payments, speeding up checkout process (Close, 2016). Retail giants have begun experimenting with beacons and the trend is catching on (Huffpost Business, 2016). Smaller retailers could be fast followers in adoption because of low associated costs, relative ease of implementation, and growing consumer preference to the use of mobile phones in stores, academically referred to as "showrooming (Kotler, 2012)".

Nowadays, beacon technologies have been used in a retail context for the following reasons:

1. **Customer convenience** - Consumers increasingly use their mobile apps to comparison shop in the store, need attention diverted away from competitors like Amazon by triggering offer at the moment they are likely to purchase.
2. **Enhanced shopping experience** - Retailers need to move away from a transactional mindset to a focus on enhancing shopping experience, giving customers more than expected. This can be done through beacons pushing personalised coupons, offers, and rewards.
3. **Affordability** - The low cost of beacon technologies makes them accessible to small businesses.
4. **Competition with larger retailers** - Typically disruptive technologies would be only accessible by larger retailers, but the low cost of beacons levels this playing field.
5. **Customer intelligence** - Beacon-enabled apps collect data on customers' spending habits and product preferences, enabling creation of personalised, immediate and targeted offers.

Beacon technologies have potential to be adopted in other business as well as educational and public sectors. The authors present potential use cases in two categories (MoWow, 2016):

1. **For customers:** e.g. push notification, broadcasting, self-guided tours, social networking functions, parking information & assistance, location and information at conferences and events.
2. **For Business Owners/Sector Managers:** e.g. tracking items within the company via mobile device accelerometers, slow/full day analysis that optimises flow and services, understanding customer preference.

2.4.2. The Beacons in #PUPRU

#PUPRU has 3 beacons made by Estimote, colored Ice, Mint and Blueberry (see Figure 2.7 below)



Figure 2.7 Estimote Beacons (Estimote, 2016)

Some potential use cases of beacon technologies in health care services are suggested by the authors as below:

- **Navigation of buildings and spaces** – use of beacons as a virtual map and to show helpful information
- **Geo-location** – location tracking of patients and visitors
- **Analysis of people as they move throughout a hospital** - identify footfall, hotspots or heat-maps
- **Presentation of information in context to location** – show information about the nearby clinics, ward and facilities
- **Present visitors with live information** – queuing times, bookings and offers
- **Smart signage** – translation of advertisements or visitor information based on smartphone settings
- **Tracking of assets and stock** – follow the movement of large items around hospitals
- **Distributed networks** – some newer types of beacon are able to communicate with each other to act as wireless access points
- **Intelligent healthcare environments** – access authorisation, patient tracking and monitoring and access to patient records

In order to test some of the ideas listed above, beacon demonstration applications have been developed for two events:-

- NHS Salford Citizens' Panel Event (see section 2.2.3)
- Salford Postgraduate Research Conference (SPARC) Conference held in the University of Salford

In **NHS Salford Citizens' Panel Event**, beacon application is used to provide information to users of two stalls and one information point at the event. 15 Samsung tablets were taken to the event with the App installed for participant experiment and observation to be recorded so as to evaluate the usability of beacon technologies as a public

sector event. Three beacons were placed where stalls and information point are located. Participants wishing to know details about what is happening in each place can use a tablet and relevant information will be displayed on screen when they are near to a beacon (see Figure 2.8 - 2.10 below):



Figure 2.8 Cancer Prevention Stall (image: author's own) (Beacon Mint Zone)



Figure 2.9 Manchester Fire Service 'Safe and Well' Project Stall (image: author's own) (Beacon Blueberry Zone)



Figure 2.10 Great Manchester

Devolution and Salford Plan (image: author's own) (Beacon Ice Zone)

At the **SPARC Conference**, #PUPRU is set up in the MediaCityUK foyer to demonstrate the technologies and start conversations with post-graduate students and staff to encourage potential collaborations throughout the schools, as shown in Figure 2.11 below:-



Figure 2.11 #PUPRU Stall at the SPARC Conference (image: author's own)

Three beacons were placed in three conference rooms. Beacon App help conference participants find their way and know what is going on in each room.

The application is downloadable at <http://bit.ly/1UdC1JB>, which is available to the public. As shown in Figure 2.12 – 2.14 below, participants can easily see the schedule for parallel sessions if they install the application and approach to relevant rooms.



Figure 2.12 Media City Room 3.17/18 (image: author's own) (Beacon Blueberry Zone)

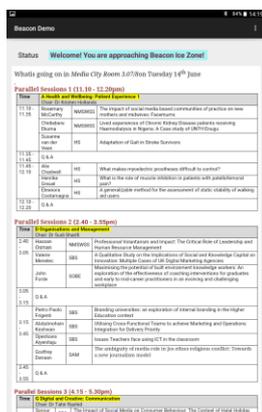


Figure 2.13 Media City Room 3.07/08 (image: author’s own) (Beacon Ice Zone)



Figure 2.14 Media City DPL (image: author’s own) (Beacon Mint Zone)

- Development of modular school application with disruptive technology integration: The successful release of modular application for NHS Salford has inspired a collaboration to develop an application for the school that take advantage of beacons, geofencing and augmented reality, but which can give the advantages of future bolts on as technology develops. The developers see this an opportunity to create an new and saleable product with collaboration of the university, while we can embed its design and implementation into many of the business IT courses.
- High street beacons and geofencing: a retail data exploitation and marketing application for a principal shopping centre in the City Centre: Discussion of the school application has led to discussion of a proximity technology marketing application and the chance for collaborative research to examine how the technologies can be used for drive positive e-WOM and influence e-behaviour through a case with high volumes of data that will need cross disciplinary teams from across the University.

#PUPRU collaborative research into 3D printing with hackonwheels.org

Hackonwheels.org believes that anyone who needs a wheelchair should be able to access one that is fully customised to their individual needs. According to the World Health Organisation over 65 million people need a wheelchair to be part of society and live an independent life but to give freedom and independence a wheelchair must be fully customised to the body lifestyle and environment of its user. Due to the prohibitive price of traditional design, manufacturing and distribution 8 of 10 people who need a wheelchair are deprived of this freedom - that is 52 million people. Inspired by organisations like e-NABLE - who created the first open source functional prosthetic hand that can be 3D printed for less than \$50 - they believe that digital fabrication, open hardware and the maker movement can change this. They are creating an online library of open source designs and instructions for making fully customisable wheelchairs and their components that anyone can freely use, adapt and develop. Through research projects and others driven by the MSc Business Innovation Project we attempting to find a way to introduce a 3D printed wheelchair to the NHS prescription process and examine the legalities of such disruptive technologies.

#PUPRU beacons: in collaboration with Ericsson Telecommunication

The #PUPRU team have demonstrated the different technologies to the senior management team of Ericsson Telecommunications logistics centre. The Ericsson Team were given an overview of what the potential of the various technologies might offer. This demonstration was followed by a tour of the Ericsson logistics centre and a walk through

Observation from both events illustrates potential adoption of beacon technology to benefit the first category of stakeholders identified in Section 2.4.1, i.e. ‘customers’. The next step will focus on investigation of beacon application for business owners.

2.5 Summary

In this section, the key technologies, their potential business scenarios and experiments the authors have undertaken with #PUPRU have been discussed. The final goal of #PUPRU team is to integrate all these technologies and evaluate their potential impact on business strategies in different live projects. This will be described in the following session.

III. # PUPRU LIVE PROJECTS – NEXT STEP

#PUPRU School Application and connected projects

The #PUPRU team have recently established a number of potential collaborative projects with application developers Desap. Initial conversations involve collaborative research and development of applications that incorporate key #PUPRU technologies. Projects include:

of the key procedures was undertaken together with timeframes, bottlenecks and revising of business models were discussed. A shared understanding could then be undertaken and this enabled a degree of clarity on potential business problems to be made followed by a co-creation of possible solutions using the technologies. The following business problems were identified for an exploratory study: the construction of telecommunication cabinets is a complex process, each cabinet is bespoke and is made up of hundreds of individual parts that require 'picking' from a warehouse prior to being built by semi-skilled engineers. These are both lengthy processes that if reduced or streamlined even in a minor way would have an impact on profit margins. The use of sensors could be used to map and gather data of the 'picking' process that can then be analysed for time frames, potential bottlenecks and warehouse layout. The sensors can also be used to push notifications throughout the centre on training, stock levels or any business communications. The next business problem is inventory management and further discussions are planned for the proposed use of 3D printers to aid this part of the business.

#PUPRU and Rapid prototyping for manufacture

Recent discussions with a wool and clothing manufacturer have shown that there is interest in understanding how rapid prototyping could be used to disrupt their traditional Victorian manufacturing process. This is increasingly of interest within the garment manufacturing industry where 3D printing is a relatively new process. It said, recent devices that are being developed to print garments, eliminating waste and decreasing the time to develop a product have started to emerge (Kickstarter, 2016). Technologies like this will undoubtedly disrupt the traditional factory manufacturing environment. Traditional 3D printing will also be considered in relation to maintenance within the factory environment where the age of some essential machines causes issues with supply of parts and spares. As discussed earlier, this has been shown to be effective in other industries (Karagol, 2014; Stratysis, 2013) that need precision spares produced for complex machinery.

#PUPRU beacons: collaboration with Wipro Digital and a "Dutch Supermarket Chain"

In a potential collaboration with Wipro Digital the #PUPRU team will research ways in which beacons can be used in retail to drive sales and gather data on the behaviour of consumers in a Dutch supermarket chain. Some potential uses of beacons in retail have been discussed in this paper. But are there further uses for beacons within retail, and could they be used to gather even more granular data such as how people interact with a physical space? Furthermore, what extra intelligence could be provided to a business using these technologies?

#PUPRU beacons used to gather granular footfall data to understand human interaction with buildings: Media City UK campus, NHS, Hotel Football, TB Ramsden

With strategic partners SBS is intending to explore how granular intelligence data enables businesses to understand how people interact with their buildings, so as to increase revenue and improve profitability through actionable insight. Understanding interaction within a premises could help operators pinpoint areas where profits can be maximised, grow customer conversion, control queue management, increase sales, and inform marketing and merchandising decisions. There is also a heightened need for property managers and retail operators to maximise the value of their assets. Understanding footfall could potentially generate greater understanding of consumer behaviour and pinpoint where return on investment *is* and *is not* being generated.

Our campus at Media City causes debate, because although it places the university at the heart of the creative and digital industry in the city, there are questions about how effectively the space is used. Within the NHS there is pressure to staff accordingly to address the needs of the customers whilst balancing budgetary constraints. In retail hospitality the need to maximise profits on key sales days is clear: understanding of how customers and staff interact with a hospital building could streamline efficiency, and put people in the right place to drive sales at the crucial moment. In the traditional manufacturing environment of a woollen mill there has been very little research carried out into how the building is used and what could be done to drive efficiency and profitability.

IV. CONCLUSION

In conclusion #PUPRU has created an opportunity to engage both students and external organisations looking how emerging technologies can be used in enterprise innovation and business strategy in practice. The authors summarise the next step of #PUPRU in the following three directions:

Using #PUPRU in Teaching

Within Salford Business School #PUPRU is being used as a catalyst to develop innovative pedagogies to enhance the curriculum. It has been embedded into the undergraduate *Business Information Technology* course in both Year 1 and Year 2 curriculums

The Year 1 *Information System* module has a focus upon the role of systems within organisations and society, the overall aim of the module is to encourage and develop students' awareness of the fundamentals, concepts and applications of technologies within a business context. The students are introduced to techniques and modelling tools necessary to analyse information flows within and between

organisational contexts whilst considering any business and societal issues in the planning and developmental process of an Information System. To ensure that our teaching practices are current and innovative the teaching team have designed and aligned the curriculum against Pokemon Go. With a reported 25 million active daily users, Pokemon Go, the location based augmented reality game will be used as a live case study throughout the module with the assessments being mapped against aspects of the gameplay. Technologies that form part of the #PUPRU environment are to be used in this module in the next academic year. Tablets (we would not ask students to use their own devices but they have the option to if they so preferred), mobile wifi and Go-Pro cameras (to capture an alternative socio-perspective of the gameplay) from the #PUPRU, it will be used to get students out of the classroom, take part in the gameplay and understand how the game data information and data is processed, stored, managed.

The Year 2 *People and Computing* module is designed to develop understanding of the deployment, taxonomy, theory and practice of human-computer interaction and interactive systems. In this module the students are given #PUPRU as a case study and are tasked to produce a prototype for a digital presence for the research unit. Through this they gain an appreciation of the #PUPRU disruptive technologies impact on organisations and society in general. At the same time this creates awareness in the learner of SAP and methods that align strategy, technology and business needs centrally in design and development processes. An example of well-presented students' products on #PUPRU can be seen at the URL: <https://pupru.wordpress.com>.

Our Business Innovation Project (BIP) gives our M.Sc. and MBA students the option to complete the dissertation part of their studies through a live industry case study. The brief is defined by the partner organisation, and the student works to meet business objectives. The student applies theory learnt on their course and the organisation receives consultancy in a business-critical area. The technologies of #PUPRU can be used as an action research tool for businesses wishing to explore disruptive technologies. Data gathered through these researches can be used to form the students' dissertations and be fed back into the umbrella #PUPRU research.

Using #PUPRU in Research

#PUPRU provides SBS and Center for Digital Business with a platform that supports research into business exploitation, implementation and integration of digital technologies, tools and methods. Recent reports (The Rt Hon. the Lord Heseltine of Thenford, 2012) have focused attention on the provision of academic support to the small and mid-sized business community, and generating local conditions that rebalance the economy away from overdependence on the City. Despite successes of business

schools, it is evident that their full potential to support innovation and stimulate growth is not realised. What is clear is that industry engagement with schools at local and national level has been variable and this also reflects the debate as to the role and orientation of business schools as a whole. Various approaches to drive and create commercially viable products through industry collaboration that share #PUPRU characteristics are evident (University of Liverpool, 2016). Within the University of Salford the recent creation of Industry Collaboration Zones (University of Salford, 2015) has created an opportunity to *in theory* drive engagement with business, solidifying the sustainability of the school and maximising the flow of technology and innovation research with strategic industry partners. There is further alignment with the PhD of one of the authors' of the paper, which is examining the integrity of business technology innovation in the academic environment. This will look at multi-cases of #PUPRU in the Salford Industrial Collaboration Zones as a method of engaging with industry through consultancy and research. Many further opportunities for doctoral research are possible in relation to #PUPRU and technologies used. Another doctoral research is investigating of the impact of 3D printing implementation on supply chain designs with the overall aim of developing an addictive manufacture implementation framework.

Using #PUPRU in Business

Design spirits are usually associated (and becoming more popular) within the digital sector and possibly echo a different emerging attitude to approaching the web design process ensuring that UX has a prominent role to play when meeting client and their user's needs. On reflecting on what is often discussed with businesses who have enquired how the #PUPRU might benefit them, a distinct business need is emerging – SBS is developing a framework to facilitate innovative problem solving design spirits. Greater Manchester has a long history for being innovative, it was at the heart of the Industrial Revolution and now the creative industries are crowding into the city in a similar manner. But how do you join the party and learn how to be creative, to be an innovator or how to unlearn embedded working practices? Organisations today are time-starved, working in a 'Groundhog Day' manner, fire-fighting problems; they don't have the luxury of the multinationals with commissioned creativity spaces and dedicated time out of the working day to explore ideas or problem solving. Smaller organisations struggle to afford timeout to reflect in bespoke spaces; however it is the acknowledgment of empowering the notion to be creative, and facilitate the 'how to' explore and develop new ideas that are both fundamental and crucial for sustainability. The proposed problem-solving design spirits will look to deliver possible solutions in 48 hours using a range of creative thinking techniques and tools to fit with different business models. This will look to 'change the way your business thinks' or

offer 'alternative approaches to the development of new designs and products' through:

- Business model generation
- Bespoke solutions for complex business problems
- Building of creative thinking skills and techniques
- Innovative thought about how to create new business opportunities for the market place

The additional benefit of #PUPRU design spirits will be facilitation by a team of experienced educators and academics.

Toffler (1970) predicted a future where technology would change things so rapidly that we would be unable to fully adjust before a new emerging technology shifted the paradigm of an industry or business again. In 2016 there is no denying the rapid pace of technological change. Many traditional enterprises have historically been slow to adapt to and adopt emerging disruptive technologies. Although this may have been true in the past it is becoming increasingly less so as smaller players manoeuvre to take advantage, impacting the sales of their major commercial competitors. The industry drive is to react faster to new technologies and integrate them into business models and strategies. These technologies alone are rarely key to economic success: organisations create value by aligning technology and business strategy. Through doing this, as discussed, they manage relationships, capital and assets, and leverage information in new ways. #PUPRU looks to engage with organisations with a "design spirit", looking to integrate emerging disruptive technology into strategies and develop a framework for SAP in enterprise innovation.

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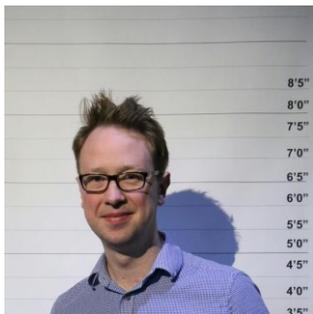
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