[Re]-imagining vision and values: design as a driver for value creation in the Internet of Things

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Abstract

In digital age in which a myriad of products is becoming connected through the Internet of Things (IoT), new business opportunities and challenges arise for organisations regardless of size and product/service offerings. The traits of digital technology and digital economy results in not only profound changes in the ways organisations create value and develop their IoT products and services, but also emergent and dynamic business models. It also opens new opportunities in terms of how organisations increase turnover, thus conventional theories and practices of how value is created in the design and development process is constantly being challenged. Although, academics and practitioners often critically debate these emergent opportunities and challenges to the adoption of the 'Internet of Things', there is a paucity of established academic theories and industry practices to support and re-think traditional processes of product design and development to meet current needs and potential commercial opportunities in the era of IoT. This paper will offer a critical examination on how design processes have evolved with regard to the differences in value creation between goods-dominant logic and the service-dominant logic in order to identify an emergent design process feasible for IoT product and service development. In addition, factors that affect value creation, and design and development process in the IoT are reviewed. It concludes by offering key insights and observations as to where design can contribute to value creation in the internet of things.

1 Introduction

In a global context, economies follow the path of long-term dynamic waves which is a theory devised by Nikolai Kondratieff in the beginning of the 20th century. A long wave lasts for 40-60 years, and consists of a period of rapid economic growth, followed by stagnation and or depression [1]. According to Kondratieff, each wave is fuelled by a specific set of technologies and societal practices, led by a set of key innovations. As these waves are historically repeating patterns, scholars [2, 3] now assume with some certainty that we are at the threshold, moving from the 5th wave into 6th wave leveraged by digitalization and the exponential rise of computational power-both legacies of the previous wave- that create circumstances for new products and services. As one of the results, the Internet of Things, which has become a new paradigm in which all objects around the world are connected to the network. Figure 1 illustrates modern economies fluctuation of Kondratieff's timeline in a cycle of 40-60 years.

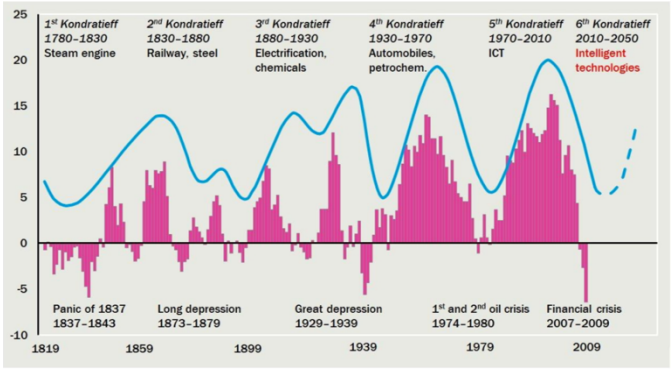

Figure 1. Modern economies fluctuate in a cycle of 40-60years. Rolling 10-years yields of the standard & Poors 500 equity index and the Kondratieff's waves [2]

To anticipate and understand how design is able to contribute to value creation in the upcoming 6th Kondratieff wave, it is best to contrast it with its counterpart in the 5th Kondratieff wave, i.e., the evolution of economy, the way in which organisations create value, the role of design in value creation and, design and development process for value creation. What is needed in order to start towards an economic upturn is for industries to understand and prepare a completely new paradigm in organising economy and production [2]. As connected products have emerged and their capabilities have expanded, creating new arrangements of value beyond their primary function which of shift is changing the sources of value and discrimination to service, customer experience, and bringing forth entirely new business processes and models. To capture this enormous wave of value creation opportunity, practitioners should have an urgent commitment to reframe nearly everything, otherwise their business competitiveness

and sustainability might be at risk. However, despite numerous organizations recently considering extensions or revisions of their products and service portfolio by incorporating IoT components to attain competitive advantages for upcoming economic prosperity [4], achieving success in the market is challenging. Design as a tool or activity has often been neglected or been paid relatively little attention by management theorists, although all other business activities such as marketing, operations and finance have been critically examined [5].

Research recently conducted, underlining how the unique properties of digital technology enable new kinds of innovation processes that are evidently distinctive from the innovation processes in 20th century [6, 7], however there is a paucity of established academic theories and industry practices to support and re-think traditional processes of product design and development to meet current needs and potential commercial opportunities in the era of IoT. Select scholars [8, 9] from marketing and design argue that it is the time to rethink the research into new processes of product design and innovation for IoT. They specifically emphasise reframing design and development process for IoT because, as widely believed, there is a correlation between business success and the existence of a formalized design process [10] so that numerous emerging IoT organisations are able to have suitable process to support themselves in handling their digital innovation efforts.

This paper offers initial results of the early stages of doctoral research, based on a comprehensive literature review of research about value creation, established design and development processes, and key factors affecting value creation in IoT in order to identify and debate how contemporary design process systems can be revised to embrace new market opportunities. It concludes by offering key insights and observations as to where design can contribute to value creation in the internet of things that embraces a user-centred philosophy of application, which could then enable academics and industry practitioners to further understand the process of designing IoT products and services. The following research questions will be both offered and critically debated:

• What are the characteristics of design and development processes and value creation in the traditional push economy?
• What factors affect organisations' value creation activities in terms of design and development processes in the IoT era?
• How and where can design drive value creation in the Internet of Things?

In order to answer these questions, this paper commences with a review of how value is created within a value chain framework [11] and the role of designers and the design development process. It will then argue the significance and different models of design and development process in value creation. Models examined, include, 'over the wall process, Stage-gate system' [12], Rugby approach [13, 14], Double diamond design process [10], Johnson et al's New service development process [15]. Before discussing a new approach toward design contribution to value creation for the IoT, a more complicated value creation model, the 'value constellation model' [16], has been reviewed which is arguably more appropriate than the traditional linear value creation model in the IoT era. The factors affecting design process and organisations' activities relating to value creation will be examined. These include market change and digital technologies, such as S-D logic [17], Digital economy, the six dimensions of digital innovation [18]; Three dimensions of big data [19, 20]; New opportunities in digital age [6], and Three traits of innovations [7]. Finally, based on these discussions, the intrinsic attributes and factors affecting value creation through design and development process for IoT products and services are then offered.

Methodology

This doctoral research process commenced with an extensive examination of current literature and three exploratory interviews framing the value creation for IoT and digital orientated innovation. Due to the early stage of this doctoral research, exploratory interviews [21] were undertaken in order to develop ideas rather than to establish facts and statistics. However, it also underpinned the arguments found in a literature review on value creation in the IoT. Several interviews were conducted via semi-structured interviews lasting average 45 minutes, conducted between October and November 2017, with leading academics participating in the PETRAS project. In line with an exploratory approach, target interviewees were recruited for diversity in terms of their specialties (Digital urban system, Design informatics, and Computing and communication) in the sample rather than representativeness. Questions focused on topics about the value creations of IoT organisations, as well as the differences on business strategy between traditional manufacturers and IoT organisations. The term IoT organisations used in this study are referred to the organisations, running B2C business based on sensor embedded smart products, whilst having a payment system which is oriented toward services rather than physical goods. The interviews were recorded, transcribed and analysed for themes which were clustered into topics and then compared across interviews.

In addition, books, articles and texts were broadly selected through searching electronic databases such as Business Source Complete, Wiley Online Library Journals, Springer Journals Archive, ProQuest Business Premium Collection and Google Scholar. Search terms used, included 1) "Kondratieff's wave", "Linear Value Creation System", "Goods-Dominant Logic", "Push Economy", "Exchange Value", 2) "Design Process", "NPD (New Product Development)", "NSD (New Service Development)", 3) "Value Constellation", "Service-Dominant Logic", "Digital Economy", "Value-in Use", 4) "IoT (Internet of Things)", "Digital innovation", "Hybrid product and service", and "Digital artefact". These were then supplemented by a manual investigation of abstracts and articles published in the following journals – Marketing Theory, Review of Marketing Research, The Journal of Policy, Regulation and Strategy for Telecommunications, Proceedings of CHI, Organisation Science, Journal of Information Technology, Marketing and

Design Management, Journal of Marketing, and Harvard Business Review. Each text was critically examined for their relevance to the central themes or questions of study.

2 Value Creation in the 5th Kondratieff Wave

2.1 How is Value created in the 5th wave and the role of design?

Innovation is viewed as the source of value creation in Schumpeter's theory of economic development and new value creation through the process of technological change and innovation [22]. Therefore, many business operators focus on value creation both in the context of creating better value for customers purchasing its products and services, as well as for the organisations [23]. Current understanding of value creation is that which occurs through consumption interactions, such as, actions, processes and practices that occur in the use and experience of an offering in context [24]. However, the nature of value has been discussed and debated since Aristotle with various nuanced meanings [23] and, recently a shift from "value in exchange" to "value in use" has been made [25], which is a core transition from goods-dominant logic to service-dominant logic [23, 26].

The notion of values are distinguished as follows [27]: in the notion of "value in exchange", value is determined by the producer that is embedded in the operand resource (goods) and considered as the quantity of a substance that could be commensurable value of all things; whereas in "value in use", the qualities with regard to value mean different things to different people so that they are inherently differentiated and heterogeneous and, value results from the beneficial application of operant resources sometimes transmitted through operand resources in which organisations can only make value propositions [27].

Over the 5th Kondratieff Wave, in which the goods-dominant logic is widely accepted, based on the value-in-exchange [28], value is created (manufactured) by the company and distributed in the market, usually through exchange of goods and money [27]. The roles of "manufacturers" and "consumers" are distinct, and value creation is often regarded as a series of activities performed by the company [27]. Porter's [11] value chain model analyzes primary activities for value creation at the firm level, which is a series of activities, includes three steps: 1) physical creation of the product, 2) its marketing and delivery to buyers, and 3) its support and servicing after sale.

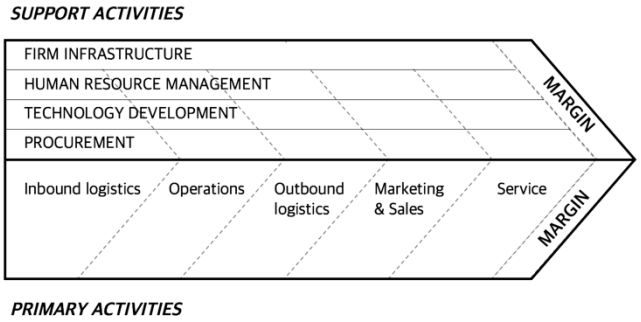

Figure 2. The value chain model adapted from Porter & Millar's Value Chain [11]

The value a company creates should exceed the cost of performing the activities for a business to be profitable, and one of the way to be more competitive in the market is to perform the activities in a way that leads to differentiation [29]. As seen obviously in this traditional linear value chain model, value is created beforehand without any co-creation contribution from customers [30] and organisations just push the products to the market which is also known as a push economy [31]. In order to add value at peak moments, which is the moment of the point of sale when a consumer pays for the product, the ability of designer has been vital property of a push economy [9], contributing to the primary activities for value creation. It is easy to find the value, according to certain parameters and their business model is relatively simple [31, 32].

However, it is challenging for designers to create value through developing innovative products because, they are only able to access to limited information on existing needs in a reactive manner at a single point beyond its selling point [33, 9]. Therefore, what designers can do best was to anticipate and develop best-guessed goods, which secure a place on the shelves of shops, and to add values of the brand, a logo, improving type styling and colours to stamp a unique identity [9]. The product, after being sold, becomes obsolete over time, and consequently organisations are able to sell the next product and keep making profits [33]. Although with these limitations, it is believed that design process is a central to product and technological innovation, [5], which will in turn considerably add value to products [10] and lead to growth in sales and enable both the exploitation of new markets and the consolidation of existing ones [34].

2.2 A Design and Development Process for Value Creation

Despite numerous research efforts conducted since the 1950s, there is no single design and development model, which is agreed to provide a satisfactory description of the design process [35]. Over the past fifty years, not only design processes have progressed from tried and tested ways of problem solving and are constantly refined by the design practitioners applying them to 'real' client projects [36], but also, a number of factors have widened the designer's horizon and working methods in design process [37]. By reviewing design and development process including highly cited design processes and NPD process models, such as Over the wall

process [38], a stage gate system [12], a rugby approach, a double diamond design process [10], a service design process [15], the paper will review the trajectory of progress of design and development process.

Within manufacturing economies, design and development processes are close to conventional linear approaches such as 'over the wall process' or 'departmental-stage models' which represent the early form of new product development model [38]. These are usually illustrated in the following way: marketing identifies the need and plan the concept; R&D provides the interesting technical ideas; design produces the concept design and prototype; manufacturing produces it; and sales take it to the market [37, 38]. This is accepted by large manufacturers in particular that the insular departmental view of the process hinders developing products; the problems and solutions were transferred from one department to another, increasing time and cost of product development [37].

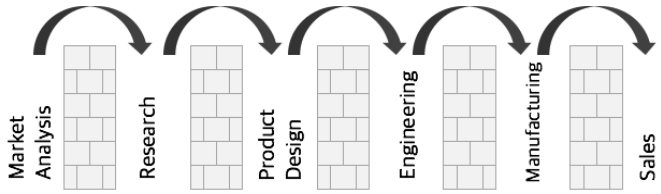

Figure 3. Over the wall process [39]

Decision stage models illustrate the new product development process as a series of decisions that need to be made in order to progress the project [40]. These types of models are popularized by Cooper [41] who developed a variant stage-gate new product development processes. The one of the commonalities of these processes is that the whole team at various stages throughout the NPD process gathers around to review and approve movement to the next stage [37]. However, these linear models are considered too prescriptive and mechanistic, slowing down the process, so failing to take into account overlaps of activities that will occur naturally in the workplace [42].

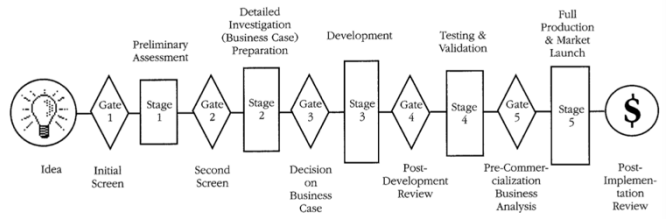

Figure 4. A Stage-Gate System [12]

Base upon the idea to considering the project as a whole rather than the singular stages [38], different approaches have emerged which are deemed as 'simultaneous approach' or 'rugby approach' such as parallel processing models [13], Concurrent Engineering [43], Activity-stage models (Crawford, 1997), multiple convergent model [44] and the Third-generation model [41]. Essentially, the key benefit of these development processes is to emphasise the need for a cross-functional approach [38] in which multidisciplinary teams working together from the beginning of the process [37]. This not only increased the speed of the development process but also enables it to be accompanied by new philosophies of design, such as market led design, implementing flexible manufacturing in order to respond to the flow of new information on customer demand and preferences, allowing products to be more tailored, adaptable and desirable to the customers [45].

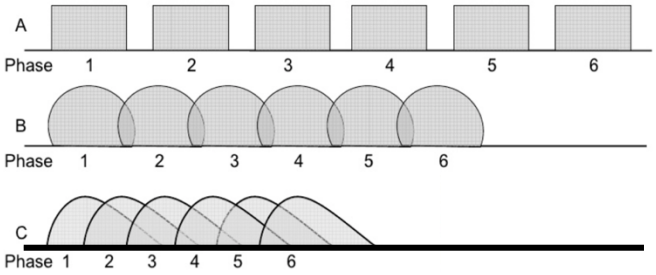

Figure 5. Sequential (A) vs. Overlapping (B and C) Phases of development [13]

Design process does not illustrate the full scale of a new product development process, however whatever process model used for new product development, understanding how to manage the design process is crucial [5]. This matters more significantly among organisations because the organisations do not simply make use of design to add a little extra value at the end of new product development process but demand that their design teams participate every stage they can from initial idea to final recycling [10]. The Double diamond design process model has been created based on the understanding of the design process of eleven leading global organisations which are, such as what elements they involve, how these processes take a product or service from an idea through to implementation and launch [10]. It is founded that different designers manage the process of design in different ways, however there are striking similarities and shared approaches among the designers [10]. The design process is divided into four distinct phases, Discover, Define, Develop and Deliver, which mapped on the divergent and convergent stages of the design process, showing the different modes of thinking that designers use [10].

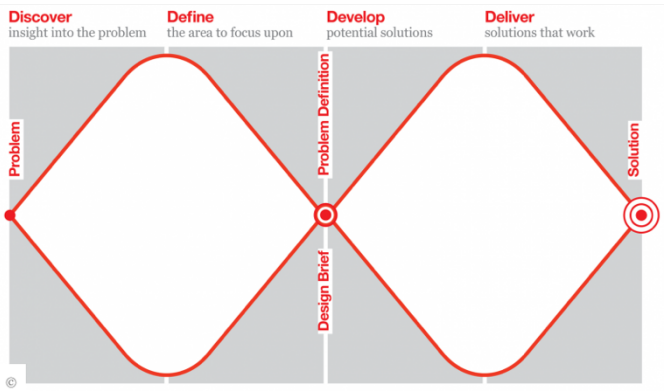

Figure 6. Double Diamond Design Process Model [10]

As manufacturing economies in the late 20th centuries started to be replaced by service economies [46], service design process is considered eminent method to create value for customers in industry [30]. The rationale is the changeover in

focus, from product-orientation to understanding why customers buy a particular service (i.e., a focus on value creation) [30]. One of the representative service model is developed by Johnson, Menor, Chase, and Roth [15] which describes the NSD sequence, including 4 broad stages and 13 tasks that must be conducted to launch a new service, and the components of the organisation that are involved within the process.

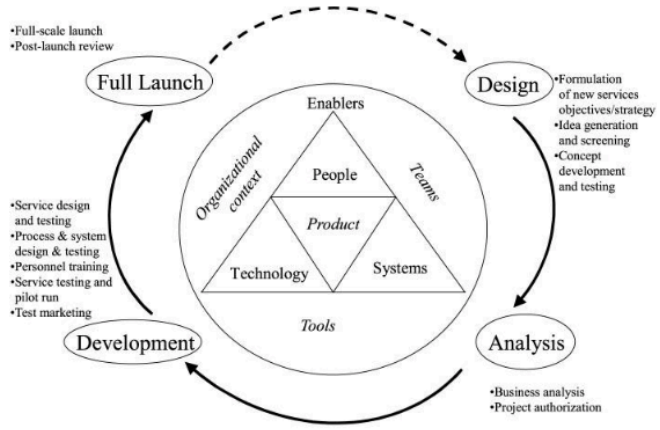

Figure 7. New Service Development Process [15]

Chesbrough's [47] open innovation model is not presented as a model of design process per se; however, it has many commonalities with a generic design process. The open innovation approach emphasises the significance of having open mind for ideas and suggestions driven from outside a firm in relation to design and development activities [47]. This approach has been widely recognised due to a number of factors such as the reduction of the product life cycle, the aggregation of global competition and the rising costs of research and development [48].

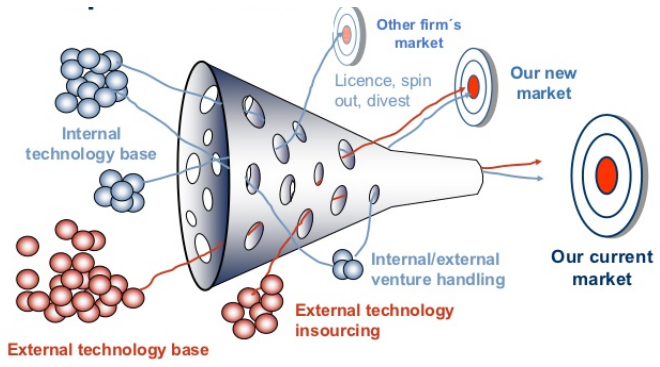

Figure 8. Chesbrough's Open Innovation Model. [47]

As flexible product development is becoming important aspect in recent years, agile development method, which is for software development based on iterative and incremental process consists of a number of short development cycles, known as sprints, begins to attract interest from designers and developers of physical products [49, 50] who experienced the limitations and challenges of traditional design and development processes. It is argued that these 'short cycles' improve communication and coordination activities, speed to market and faster responses to changing customer requirements [51]. However, since the agile development method is for software development, some challenges for manufacturers adopting agile practices have been identified, i.e. a lack of scalability and a lack of management [52].

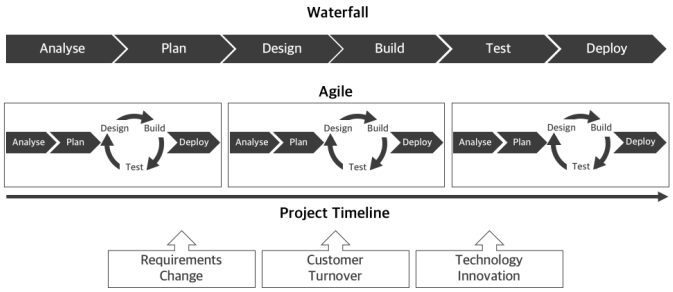

Figure 9. Agile Software Development adapted from Mistral [53]

Summarising the evolution of design and development process, a number of factors are identified as changing the nature of the commercial design process and widening the designer's working methods which are described as follows: Although, design processes are described as non-linear and iterative by devisors, the models illustrate linear process involving sequential phases, except service design development model [15] which is because one of the characteristics of services is intangibility, constantly being able to be revised and improved while being provided to customers; Secondly, the design and development process runs simultaneously, as the multidisciplinary teams start to work together from the beginning of the process which also brought it to be accompanied by market led design; Thirdly, as market conditions, customer expectations changed and marketing strategy evolved, recent approaches are more likely to work with customers, competitors and suppliers, in order to find new strategic partners and establish comprehensive networks to have more value. Finally, in certain fields, such as electronics, hardware development is becoming more like software development with shorter and faster iterations, the sprint approach becomes more suitable within the design processes.

Although the way of value creation and design process has evolved significantly over the 5th Kondratieff wave, they are regarded obsolete in 6th Kondratieff Wave, requiring entirely new approaches [6, 7, 18, 54]. This is because unlike the classical marketing paradigm in which organisations create value embedded in the products through linear value chain, push the products toward the market, then investigate the market in order to collect data about consumer needs for future products, creating products and services, and value for the IoT is affected by real-time data from sensors embedded in the products, traits of digital technologies [8], service dominant logic [55]. Therefore, the attention of this discussion focuses upon more details of the key factors that are influencing value creation and design process for IoT products and services and how they differentiate from existing design process.

3 Value Creation for Internet of Things in the 6th Kondratieff Wave

3.1 New approaches towards Value Creation for IoT

There is a paucity of studies that focus upon new approaches towards value creation in the IoT. One such study is an information-driven value chain for IoT, which include four inputs as illustrated in Figure 10 [56]. Each of the four inputs undergo value addition through production/manufacture, processing, packaging, and distribution/marketing as an end product [54]. Although this value chain explicitly offers a sequence of value-generating activities, it lacks the emphasis of network-centric view in IoT business model. Organisations must collaborate with competitors and importantly, across industries [54]. Consequently, IoT organisations will no longer simply develop and push products through a linear value chain, but keep redefining and co-constructing values with users and networks through more complex ways [32, 33].

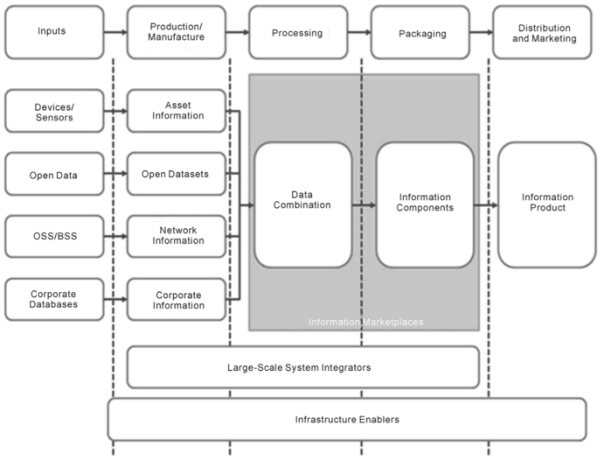

Figure 10. Information-driven value chain for IoT [56]

Reflecting this shift, the term value chain has now largely been superseded by a modified title – 'value constellation' [16] shown in Figure 11. Although it is not only applicable to the value creation in the IoT, since it describes the interplay between economic actors-suppliers, business partners, allies, customers- and resources in order to co-produce value [57, 58], it is arguably more pertinent than the traditional linear value chain model in the IoT era. In a value constellation, the emphasis does not lie on the firm or the industry as it previously did in a linear value chain perspective, but on the value-creating system itself, within different actors and industries [59]. Value constellations appear dynamic in nature, hence various needs of the same consumer may bring about different value constellations, with the same need occurring in diverse consumer segments which may result in different value constellations, and even different occurrences of the same need in the same consumer may lead to different constellations at different times [60].

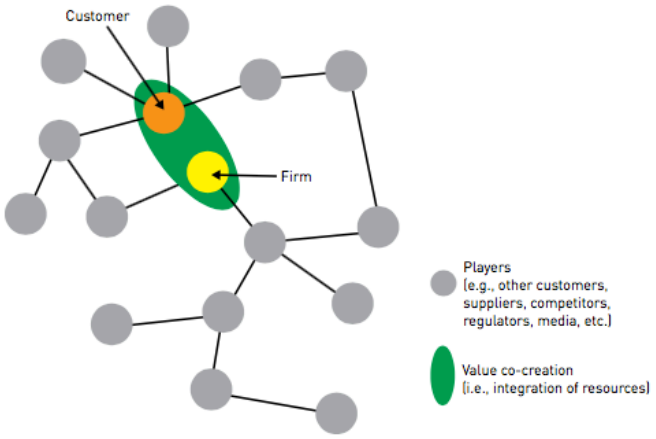

Figure 11. A value constellation and the space of co-creation as described [9]

There are factors related to the traits of digital innovation and technology that are associated with the shift of the value creation model in digital economy, which refers to an economy that is primarily based on digital technologies [61].

- The characteristics of digital technologies [7]: the reprogrammability and homogenisation of data, and the self-referential nature of digital technology.
- The dimensions of big data commonly referred to as the 3Vs [19, 20, 62]: volume, velocity, and variety.
- The six dimensions of digital innovation [7]: convergence, digital materiality, generativity, heterogeneity, locus of innovation, and pace.

The factor influencing its dynamic nature arises from the reprogrammability, which refers to a digital device that is, functionally incomplete, reprogrammable, allowing the device to perform a wide array of functions [7]; the digital convergence, which refers to continuous integration of diverse and heterogeneous technologies through homogenization of data [7]. It causes open and flexible boundaries of smart products and ultimately enables users to materialize manifold affordances and to dynamically modify them to match their competences within environment, evolving all entities into providing a service [63, 25]. Consequently, regardless of product lifecycle, various needs and different value constellations spontaneously will occur so that managing customer relationships and key partnerships becomes significant strategic issues for IoT organisations [64].

As data enables organisations to acquire a massive volume of real-time information on customers' experiences, IoT organisations are able to keep changing and creating value propositions. This is due to the dimensions of big data including volume, velocity and variety [19, 20, 62]. The analysed data is frequently interpreted as personalising propositions or personalising value, which might be considered, social, economic, or cultural value [31]. Thus, it could be argued that the value for IoT products and services is created by data [31, 32] and it can only be recognised when different applications, devices and stakeholders work together seamlessly across within different sectors, creating system-

wide effects whilst enabling new capabilities and processes [65].

The homogenisation of data and heterogeneity is also related to the value constellation approach that introduces a novel, multifaceted way to consider a given context, and a keen perception of the ecosystems, networks, and markets [9]. The homogenisation of data results in blurring the boundaries of products and industries, combining any digital contents with other digital data in order to deliver diverse services [7]. Similar to the homogenisation of data, the heterogeneity that refers to the integration of diverse forms of data, information, knowledge, and tools enables independent activities at different layers of digital service architecture [7]. Thus, this more complex model of value creation offers a distinctive opportunity for designers to work more closely across disciplines and customers groups and to consider beyond the artefact or service in order to understand how material and technical interventions play a role within a constellation [9].

Physical products can be designed to be interchangeable: often through an application interface which enables usage customization to respond to emergent contextual situations; or with a sensor that can shift the products physical function based on intelligence, as conceptualised in IoT, Hence, consumer needs and wants can be satisfied not only with physical offerings but with compounds of the physical and the digital, personalised with consumers' own data [8]. The nature of combining digital technology with physical objects offers radical changes regarding value creation from business perspectives: different collaborations between partners of vastly different industries [55]; the reconfiguration of monetization strategies [8]; reframing of traditional processes of product design and development [8]; and rethinking of value-creating logics [54].

The traits of digital innovation and technology influence the design and development process for IoT products and services. Consequently, IoT organisations need to have a robust approach toward IoT design process that are more strategically able to contribute to the value of products and services. Therefore, the attention of this discussion now focuses upon 'how' design can drive value creation in the Internet of Things.

3.2 New approaches towards an IoT design process

The model, (Figure 12) is a new approach towards designing IoT products and services, developed through combining existing design processes and New Product Development models that concentrate on underlying principles and related tools that must be taken into consideration when designing IoT products and services [37]. The process contains three distinct phases. The Discovery phase enables co-design and collaboration to uncover latent requirements and attributes crucial for user experience [37]. Secondly, the Define phase uses narratives, scenarios and fictions to visualise and test the design idea prior to the final Development phase, through which the products and services are created with users and lead adopters and implemented, with in use insight revealing emergent and new qualities that feed another cycle of discover, define and develop [37].

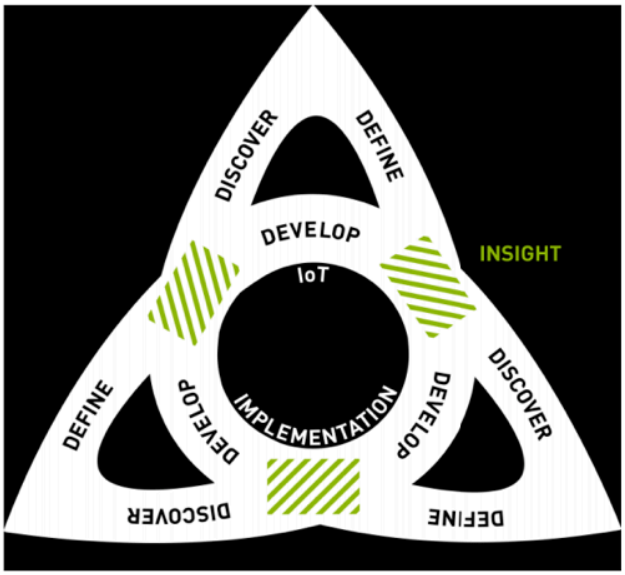

Figure 12. A new process for designing IoT products and services [37]

One of the most distinctive attributes distinct to the existing design and development processes is that this new approach is not in linear but it is a continuous and emergent process [37]. This is because digital components in IoT, dissimilar to tangible components, are able to modify subsidiary functionality, add supplemental functionality, or introduce entirely new functionality over the product lifecycle [6]. These distinct characteristics of digital technology and dimensions of digital innovation [7], which do not exist before, the scope, feature and value proposition of IoT products and services can continuously evolve even after being launched and while being used. Thus, design and development process for IoT has continuous and never-ending process cycle, which indicates that value propositions through IoT products and services are able to keep evolving for enhanced customer experiences.

The process contains a short cycle of discover, define and develop phases, which can be explained with pace, one of the attributes of digital innovation and the dimensions of big data, commonly referred to as the 3Vs: 1) volume, 2) velocity, and 3) variety [19, 20, 62]. Due to the fact that the use of IT enables to reduce communication costs will result in increased speed of design processes. Moreover, as data enables organisations to collect an enormous amount of real-time information on customers' experience for current products, the pace of designing and improving the products and services should be shorter and faster. Data is not only changing design process but also the role of the designer(s). They no longer have to anticipate and develop generic products, with limited access to the data on customer needs as big data aids to acquire user and market information.

Finally, the process has to become more complicated because unlike generating value in a linear value creation system, the spatial and temporal division between design, development,

production, and consumption of offerings are increasingly collapsing into the same space, especially with changeable offerings informed by data [8]. The generativity also influences the more complex design process. It refers to the way those actors, who were not directly involved in the original creation of a technology; begins to create devices, services, and contents which may not be consistent with the original purpose of the artefacts [66]. Moreover, due to the emergence of distributed innovations which is one of the primary attributes of innovation(s) associated with the locus of innovation [7], the control over value creation activities occur across organisations and value creation networks during the process of developing IoT products and services.

IoT organisations are required to define and redefine value proposition, and value proposition must be flexibly changed, since they start to use real-time data which can personalise propositions or value which could be social, economic, and cultural [31, 32]. Design, in this context, should not be treated in isolation apart from business processes but it should be used more proactively throughout the value creation process [10]. Value in the IoT era is created through data [31] and the transformation of customer experiences, thus, design processes need to evolve in a way more focusing on the mediation of value across a value constellation [9] and through fluid, reconfigurable, engaging service offerings that afford meaningful experiences to the consumer. [67].

4 Conclusions

As a myriad of products become interconnected through the Internet of Things (IoT), new business opportunities and challenges arise for organisations regardless of size and product/service offerings. How to capitalize on the opportunities, shift from products toward services, and create digital based business value are questions of strategic significance for organisations. Organisations address questions such as “How should we implement IoT into our offerings?”, “Which innovation processes and design processes must be in place in order for business value to be realized?”, and “What types of value are created through the IoT?”. These critical questions are what IoT organisations need to keep in mind in order for their value proposition(s) to exceed customer demand. However, this seems not easy since physical objects, have mutated from static products into fluid, dynamically reconfigurable, engaging service offerings that can incorporate consumer customization [8].

The primary aim of this study is to examine how design processes have evolved with regard to the differences in value creation between the goods-dominant logic and the service-dominant logic in order to identify an emergent design process feasible in IoT product and service development. Through examination of established literatures and a series of exploratory interviews, this paper provides attention to the primary research questions at large: 1) What are the characteristics of design and development process and value creation in the traditional push economy? 2) What factors affect organisations’ value creation activities in terms of design and development processes in the IoT era? Finally, 3) How and where can design drive value creation in the Internet of Things?

The authors have argued that the ways of value creation and the role of design in the traditional push economy which are identified as organisations create value embedded in the products through linear value chain, push the products toward the market, then investigate the market in order to anticipate and develop next generic products. The role of designers to create value through design process is limited in terms of adding value of the brand, logo and styling, and challenging due to the limited information on existing needs. Then, the characteristics of design and development processes are identified as: established design and development processes illustrate linear process; simultaneous processing is regarded as one of the key factors for successful design process management; design process models are more likely to find new strategic partners and build comprehensive networks outside the company to have more value: design process becomes to have sprint approaches with shorter and faster iterations. However, existing design process models are regarded obsolete in order to create value in the IoT.

Since the characteristics of digital technologies, the dimensions of big data, and the six dimensions of digital innovation affect the way of IoT organisations create value, value chain model has been superseded by value constellation model; which appears dynamic in nature; introduces a novel, multifaceted way to consider a given context, and a keen perception of the ecosystems, networks, and markets; and in which organisations are able to keep changing and creating value propositions. It is identified that the value for IoT products and services comes from data and it can only be recognised and created only when diverse applications, digital artefacts and stakeholders co-operate seamlessly across within different sectors and industries, creating system-wide effects.

This paper refers to a new process for designing IoT products and services. This novel approach should be a continuous and emergent process, containing a faster pace and short cycle of discovery, definition and development phases. The role of design in the organisation could transcend both upstream and downstream activities in the product development process and even in the value creation constellation. Moreover, the activities to generate value during design and development process for IoT products and services should be occur and operate across organisations and value constellations.

Although this study has explored issues related design and development process for the IoT there are some limitations that need to be taken into account through further research. Relying solely on a limited literature review in order to identify new approaches towards designing new IoT products and services where only a limited number of studies have been critically examined. Consequently, this paper has identified related and practical questions for further research: How IoT organisations effectively define and redefine value propositions under the value constellation system in practice. What is the role of designers in terms of generating values for IoT products and services within value constellation? Finally, is there a generic design process for IoT products and

services? If so, how and where could this emergent and fluid design process be both illustrated and implemented in order to drive value creation? With further research, organisations could clearly define and generate the distinctive customer value that they can offer across the value constellation eco-system, thereby distributing the roles of design and designing across the constellation.

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