Design as a Catalyst for Innovation in Irish Industry. Evolution of the Irish Innovation Voucher Initiative within Design+ Technology Gateway

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Abstract: Innovation has been identified as a key driver for rebuilding the Irish economy. Design has been recognised as a strategic tool in delivering innovation. The difficulty is in understanding how designers utilise this methodology in a business context. The research question is; how do the applied design research experts transfer knowledge to industry. The methodological approach has been a single case, case study of an Industry Gateway within an Institute of Technology, utilising Innovation Vouchers as the unit of analysis. The findings have highlighted that it is the combination of; time spent, environment and tacit knowledge of designers that enables the process. The Innovation Voucher initiative is identified as an opportunity to introduce Irish Industry to innovation and the human resource behind the value of design. This may now be of benefit to other innovation accelerator initiatives in communicating how design can be utilised as a catalyst for innovation.

Keywords: Design, Ireland, Institute, Industry, Innovation

1. Ireland Winning by Design

Irish economic strategies, in line with broader global strategies, aim to promote innovation and knowledge creation. In 2013, Ireland was in a position to exit a bailout from the EU International Monetary Fund and in doing so, begin to rebuild its economy. This provided the opportunity to assess and re-strategise, focussing on entrepreneurship. By 2014 the Department for Jobs Enterprise and Innovation (DJEI) produced a report of the Entrepreneurship Forum entitled 'Entrepreneurship in Ireland–Strengthening the Start-up Community' (DJEI, 2014). A culture for funding entrepreneurs was nurtured with opportunities through Enterprise Ireland, reflecting the shift in economic drivers towards innovation and enterprise. (Whelan, 2018a). Innovation has been identified as the key driver for rebuilding the Irish economy. The evolving strategies of how this is introduced to businesses are published in a yearly 'Action Plan for Jobs' by the Department of Jobs Enterprise and Innovation. The plans released between 2012 and 2016 focused on skills base and employment figures. In 2016 it was acknowledged that the main focus to date had been on stabilising an exceptionally difficult situation in which thousands had lost their jobs and that Ireland was now in a new position (DBEI, 2016). Innovation became the focus. 'Innovation 2020' is a report outlining a new strategy to create a culture of innovation right across the country – from schools and universities to big and small enterprises, whether in traditional or cutting-edge areas of activity. Innovation 2020 sets out the roadmap for continuing progress towards the goal of making Ireland a global innovation leader, driving a strong sustainable economy and a better society (DBEI, 2015). There was a recognised value to innovation

throughout this period which was supported through multiple pilot programmes across the country. Whilst some of the programmes are funded under local initiatives others are supported by the European Cohesion Policy.

As the link between innovation and the creative industries began to develop, programmes such as Creative Momentum were introduced. This was a transnational project which aimed to support the development of the creative industries sector across Europe's Northern edge. This was a 3 year programme from 2015-2018 with a €2million budget. There was recognition within this project of specifically working with creative enterprise in collaboration to result in increase in creative and business skills. Whilst this programme was designed to align to EU cultural policy of enabling the sectors to research their economic potential, it did not specifically mention a design approach. It was 2017 when the connection between design and innovation in Ireland was published with the release of 'Winning by Design' (National Skills Council, 2018). This report marks the clear linking of design and innovation by the Irish state. Design was recognised as a process of innovation and design thinking as a strategic tool for innovative business development. This was a pivotal moment for Irish Design, marking the beginning of a shift in how design is recognised in Ireland. Design had long been associated with aesthetics but was now being sought after by industry education and policy makers alike in this changing innovative culture. "Ireland's policy-makers can, by encouraging a design culture in Irish enterprise, attract and nurture design talent and help to attract and retain foreign direct investment and grow indigenous enterprise." (National Skills Council, 2018). Throughout this period, further investment was made into design in Ireland with the release of a national strategic report 'Ireland 2040' which commits to a National Design Centre for Ireland (DBEI, 2018). Pilot programmes were instigated to prepare for the development of the National Design Centre. Design4Growth was one such programme and their aim was to specifically utilise design as a tool for growth and innovation in Irish business (DBEI, 2018). This development can be attributed to a broader global shift in economic demands. "Society is witnessing a paradigm shift in the drivers of economics. We are moving from the Industrial Age of production economy, to the Knowledge Age of innovation based economy." (Whelan, 2018b) The requirements for the past production based economy were steeped in uniformity, repetition and efficiency, a knowledge based economy however requires critical thinkers and a new approach to achieve innovation for future growth.

Design has been recognised as a strategic tool in achieving and delivering innovation, the difficulty would appear to be in understanding how designers transfers or utilise this methodology in a business context. Many non-designers seem to equate "good product design" with the Apple iPod, rather than with a set of practices that underlie the development of products such as that one. (Kolko, 2007). It is this underlying practice which holds the key to designs impact on business innovation.

2. Design+ Technology Gateway

The national Design+ Technology Gateway based in the Institute of Technology Carlow was established by Enterprise Ireland in 2016. Enterprise Ireland is the government organisation responsible for the growth and of development of Irish enterprises, supporting them to achieve export sales to global markets. Design+ is one of 15 Technology Gateways of research and development excellence working with industry in 11 Institutes of Technology (IoTs) across Ireland (Enterprise Ireland, 2018). The Gateways vary considerably in size, age, technology theme and location.

The Design+ Technology Gateway was selected for this research as it provides a design led approach to projects, providing end user insights to inform decisions that drive strategic and tactical progress. A variety of funding mechanisms are available to companies wishing to work with Technology Gateways. Those most commonly used are Innovation Vouchers. The value of the Innovation Voucher is €5000

and is fully funded by Enterprise Ireland to assist a small to medium enterprise (SME) explore a business opportunity or problem with a Higher Education Institute. SMEs may make use of a maximum of three vouchers, one of which is a 50-50 co-funded fast track voucher. The 50-50 co-funded voucher covers project costs of up to ten thousand euros and is structured so that the company contributes fifty percent of the project costs.

Design+ currently completes approximately fifty industry projects per annum. These projects range in size from €5000 Innovation Voucher funded projects, to large Innovation Partnership Projects with a value of up to two hundred and thirty thousand euros. The company sizes vary from start-ups, micro and SMEs to multinationals. Knowledge exchanges between educational facilities and industry are becoming a familiar addition to Institutes and Universities across Europe. Academic engagement with industry in the form of the Innovation Vouchers originated from the Limburg region in Netherlands in 1997 lasting until 1999. It did not have a maximum funding value and was deemed so successful that it was carried through to the Dutch national programme. The Invest NI is an Innovation Voucher scheme in Northern Ireland. It allows companies in Northern Ireland to also work with knowledge providers in the Republic of Ireland and grants up to three innovation vouchers to the value to five thousand euros each. The West Midlands in the UK also allows eligible local businesses to avail of a two thousand five hundred pound sterling innovation voucher, which they need to match fund. (Purcell, 2019). In the Design+ Technology Gateway, all industry engagement primarily comes through the design team and can result in engagements with Engineering, ICT or Bioscience. In an attempt to capture the nuances of how design acts as a catalyst for innovation, this paper looks at the framework developed in the Design+ Technology Gateway based in an Institute of Technology in Ireland.

The research focussed on the design teams' engagement with industry, and their measure of success. This was followed by framing where these activities sit in relation to existing commercial practices and the longer term goals of a client project. The team in this case is a multidisciplinary design group of product designers, design strategists and visual communication designers. All five team members come from an industry background are full time employees of the Institute of Technology Carlow and all are academically qualified in their fields. The emphasis of this research is specifically on the Innovation Voucher funded projects as they account for eighty percent of overall projects and were created with the aim of stimulating innovation in Irish industry. The research team were involved in over 100 industry projects which utilised Innovation Vouchers since the establishment of Design + in 2016.

3. Design as a Catalyst for Innovation

3.1 Context

The context for the research sits in the theoretical innovation management field. The founder of the Innovation Management Research Institute (IMRI), Lois Bouwer, has a research focus on how innovative management can assist corporations to sustain growth. In a recent publication, Bouwer frames a fundamental problem in the area of theoretical innovation management; that due to its theoretical nature, is not accessible to industry executives who need to implement the findings. (Bouwer, 2017). This is particularly relevant in the context of design as a catalyst for innovation as design by its nature is based on subjective and tacit knowledge which in itself makes it difficult to communicate and transfer. A recent study in innovation management by Paolo Landoni (2016) focusses on design contribution to the competitive performance of SMES. Landoni's research provides a conceptual framework to measure a company's design innovation resources and design innovation

capabilities against turnover and number of products landed on the market. It is notable that Landoni also refers to the other intangible contributions of design such as, culture, business, philosophy, strategic knowledge assets and business approach. This again highlights the tacit elements of designs contribution which are difficult to acquire, imitate and transfer between firms. Landoni's conceptual framework can be used in innovation management to map competitive performance against external and internal investment in design resource and capabilities. In order to build upon this framework and provide an insight for industry executives, this research paper presents the nuances of how a specific design team actively transfer knowledge and the elements that come together to act as a catalyst for design led innovation in Irish industry. Understanding how all these elements come together may assist industry executives and those involved in innovation accelerator initiatives both in Ireland and internationally to access and implement design as a catalyst for innovation.

The research shows that on the establishment of Design+ Technology Gateway in 2016, the initial client request was reflective of the older perception that design was primarily for industrial or craft based products. Almost 80% of clients arrived with an existing product idea. The general request for use with the Innovation Voucher was for the designers to communicate the idea as a 2D or 3D representation. In other words, they presented the design team with the problem as a given. The client was often presenting a presumed 'need' without user feedback, the business model around the idea was not taken into account and the client had no real direction as to where the idea was ultimately going. The design team recognised that there was significant additional value that design could bring. Design by its nature is based on undetermined outcomes; it is this element which enables the opportunities for innovation to become apparent. Jonassen describes it as the difference between well-structured problems and ill- structured problems;

> "Well-structured problems are constrained problems with convergent solutions that engage the application of a limited number of rules and principles within well-defined parameters. Ill-structured problems possess multiple solutions, solution paths, fewer parameters which are less manipulable, and contain uncertainty about which concepts, rules, and principles are necessary for the solution or how they are organized and which solution is best". (Jonassen, 1997)

Steve Harfield (2006), faculty of Design, Architecture & building, University of Sydney describes these different approaches by positioning a distinction between two categories of problem: 'the problem as a given' and 'the problem as a design goal'. "Such problematization, different for each designer and for each project, is posited as being central to architectural design, informing and constraining both the design activity. The research shows that it is by providing the space for 'opportunity as yet unknown' that acts as a catalyst for innovation. As Tim Brown IDEO describes it, begin at the beginning' (Brown, 2018). This may sound obvious and simplistic, but where exactly is the beginning.

3.2 Approach

The Design+ teams approach was to begin with 'opportunity as yet unknown'. The initial ideas must be brought back to a point where the opportunities were deemed as yet unidentified; in order to effect the greatest impact from design as a tool for innovation. In approaching the projects in this manner, the first Innovation Voucher is used for the 'strategy phase'. This phase provides the opportunity to scope and frame all the existing key resources and capacities of the company. It also provides the opportunity to visually map key activities and for a user centric approach to identifying viable needs. This activity is a facilitated process with the design team and the company which takes place in a studio room with dry erase white walls for capturing and displaying the information. It requires time and reflection and the designers experience to identify and capture the necessary information in a way

that is open to new and surprising situations which may occur. Schon describes this in 'The Reflective Practitioner' as reflection in action which enables you to think on your feet.

> ''The practitioner allows himself to experience surprise, puzzlement, or confusion in a situation which he finds uncertain or unique. He reflects on the phenomenon before him, and on the prior understandings which have been implicit in his behaviour. He carries out an experiment which serves to generate both a new understanding of the phenomenon and a change in the situation.'' (Schon D. , 1983)

This infers that designers make meaning from one experience and understand how or when it may be applied in different situations that present themselves "the familiar situation functions as a precedent, or metaphor, or an exemplar for the unfamiliar one" (Schon D. , 1983). This is a tacit skill which is difficult to communicate but which is necessary part of a designer's toolkit. Tacit knowledge is described by Polyani as; 'highly personal and hard to formalize, it is deeply rooted in an individuals' actions and experience as well as in the ideals, values, or emotions he or she embraces'' (Polanyi, 1966). The Design+ team of five work on combined delivery of up to 50 industry projects on average in a 12 month period which continuously builds upon their experiential knowledge.

It is the capture and visualisation of this existing state of play within a company which acts as a baseline measure prior to entering into ideation. This 'ideation phase' is where the majority of projects move into the use of the second Innovation Voucher. This marks a constructive commitment by the company in re-applying for the second voucher and committing their time into the continuing workshops. This indicates a perceived value in the engagement with the design team and with research and development activities. Ideation by definition of Oxford Dictionary is the 'formation of ideas or concepts' (2018). The challenge faced by companies is how to approach ideation and knowing how to recognise when a good idea or concept has been reached. This is where the designer excels. Designers are trained to value critique and to be challenged. Designers actively seek out critique to ensure robustness of their ideas. As described by DesignLab, good critique is using questions to raise awareness of a problem and invite a response (2018). Critique should identify both good and bad, be focused on the objective qualities of the work, be constructive and understand that mistakes are information (Wilshere, 2018). The training and experience of a designer results in an instinct for asking the right questions, to challenge, to probe and not fear. Designers have honed this practice and can trust in the process they know. They have already established a baseline of information against which the viability of any idea can be checked and this provides a freedom to be open to all possibilities. The ideation stage of the project is similar to the strategy phase in that it is a co-design phase with the companies and the designers in the same studio workshop space. The co-creation and engagement between the designers and the companies has been recognised as an important part of the process. There is an element of relationship building, a familiarity of the studio environment and a level of trust being established. In Forbes Business, Christine Crandell defines co-creation as the "purposeful actions of partnering with strategic customers, partners or employees to ideate, problem solve, improve performance, or create a new product, service or business." (Crandell, 2016) . In a design context, Filberti Amati, Growth Expert at Amati & Associates, describes co-creation as "where users are elevated from observation to participation". (Amati, 2017). In this instance, the industry partner is the user and the design team the facilitator. The design team immerse themselves in the company throughout the engagement with a 'walk a mile in my shoes approach' that requires the tacit skill of empathy from the design team. The designers are acting as facilitators to the process as opposed to consultants. This ensures the company's expertise and knowledge is fully utilised throughout the process to combine with the design teams tacit skills and outlook. This creates not a one way consultation, but a two way knowledge exchange and learning interaction. The familiarity of the team and the physical studio environment also add to the 'safe' space for innovation. A trust has built

between the company and the design team over the period of time invested in the workshops to this point. This is essential in order for the companies to feel confident in posing new ideas. Jonathan Ives describes Steve Jobs thoughts on ideation as “he better than anyone understood that while ideas ultimately can be so powerful, they begin as fragile, barely formed thoughts, so easily missed, so easily compromised, so easily just squished” (Ive, 2011) . This combination of relationship building, trust and familiar creative space enables ideas to flourish but it is also necessary to have an approach to selectivity of ideas in order to progress. Creative responses through art, music etc. present a level of subjectivity in interpreting whether it is good or bad. The creation of the baseline study throughout the strategy phase greatly reduces the subjectivity of ideas. It is not the design team who decide which ideas are good or bad but rather it becomes self-apparent to both the design team and the company when the idea is considered against the baseline information. In order to develop a sustainable business model the correct product or service must be at the core. In order to achieve this, the designers are combining the baseline information with new ideation ensuring three elements are in place for evaluation (figure 1).

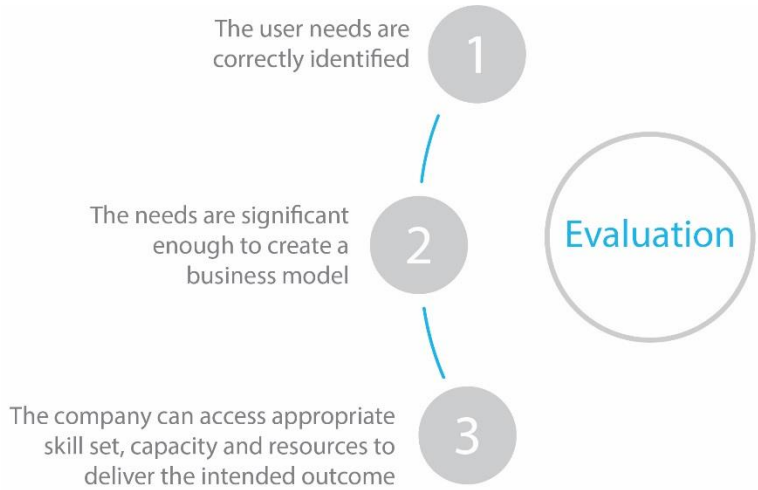

Figure 1 Design+ Technology Gateway Evaluation Criteria for Viability (Authors own 2018)

This brings us full circle to Brown “the needs of people, the possibilities of technology and the requirements for business success” (2018) . These three elements are also described as ‘Usability, Feasibility and Viability’ by many designers such as Interaction Design Foundation (2018). This evaluation completes the ideation phase and together with the client the team combine the insights gathered to this point into a holistic design brief. At this point in the process, the innovation has robustness but no means to communicate all the nuances the concept must respond to. The designer takes all the influencing factors which have come together in order to design a concept. To do this requires a developed tacit skill on the part of the designer who then produces a visual form in response to identified needs. As Cal Swann describes it;

> “A design concept that explores new visual forms to achieve intended outcomes may be immediately “read” by the informed eye, but not necessarily as easily understood by readers of conventional iterate forms. Knowledge of semantics, at least in the shape of tacit understanding built from practical experience of spatial form, is a requisite for decoding the implied function that may be expressed through the shape of an object” (Swann, 2002)

The designer has also been involved with the gathering and interpreting of all influencing factors to this point which contributes to a deeper insight and investment in the outcome. Braun designer Dieter Rams refers to this stage in his ten principles of good design as 'nothing must be arbitrary or left to chance' (Rams, 2017). In other words, the design must have all things considered and be grounded in the identified user needs, environment and culture. In defining innovation, the creation and execution of something new was noted as a key factor. It is through the concept creation phase that the innovation is fully executed and something which is new is converted in to a communicable form. In order to successfully develop the innovation commercially, the company will need to engage with a range of; internal/external stakeholders, customer bases, funding/investment streams, and follow on commercial resources/supports. The ability to communicate an innovation as a tangible entity in 2D or 3D with a robust viability process behind it, greatly improves the chances of successful development.

This concept creation phase may be conducted under the second Innovation Voucher or the third 50/50 Innovation Voucher depending on the scale of the project. Companies who engage in the third voucher are demonstrating a further commitment and investment of their time but also they are now investing financially in the process, signifying a recognised value to the use of design as a catalyst for innovation. The concept creation phase differs to the first two stages in that it is carried out solely by the design team. This phase requires hard skills such as graphics to communicate the concept in a 2D format, or product design to create a 3D model or prototype. The result is a communicable innovation which has a demonstrated process of robustness and viability to support it. This marks the completion of the innovating stage as there is now 'an innovation'. This is an identified milestone in the company innovation process and research and development activities. It is the foundation for entering the development stage with a grounded, viable and communicable innovation. This has been supported through the funding of the Innovation Voucher initiative.

3.2 Methodology

The overall methodological approach was a single case, case study of the Design + Technology Gateway in the Institute of Technology Carlow, Ireland. As the methodologist Yin (1981) states, there are three types of case studies possible; exploratory, descriptive, explanatory. The evidence in this study is presented as explanatory as it is based on inductive reasoning from reflected experience as opposed to merely descriptive or exploratory research. In this instance, the use of qualitative data was gathered through a series of design led initiatives. Follow on qualitative research was conducted in the form of interviews with owner/managers who have utilised the Innovation Voucher scheme. The interviews aimed to capture the perceived value of the Innovation Vouchers and any behavioural changes within the companies that may have occurred as a result of their engagement with a Gateway. The analysis was based on Innovation Vouchers as units of interaction and engagement between a design team and industry.

3.4 Results and Discussion

The engagement with the company and the design team utilising design as a catalyst for innovation goes through three distinct phases as a process; strategy, ideation and concept creation. The Design + Technology Gateway have identified that innovation is never just about a process. It also requires the access to a designer/design team, a specific studio environment, trust and relationship building and a means to communicate the outcome. The key findings can be identified as;

- Three distinct phases as a process; strategy, ideation and concept creation
- The design team bring the tacit skills in approach, outlook, facilitation and explicit skills to communicate the idea.

- The studio environment provides a shared context to promote interaction and collaboration.
- The time spent on each phase builds the relationships of the people involved.
- These elements must all be present to utilise design as a catalyst for innovation Figure 2

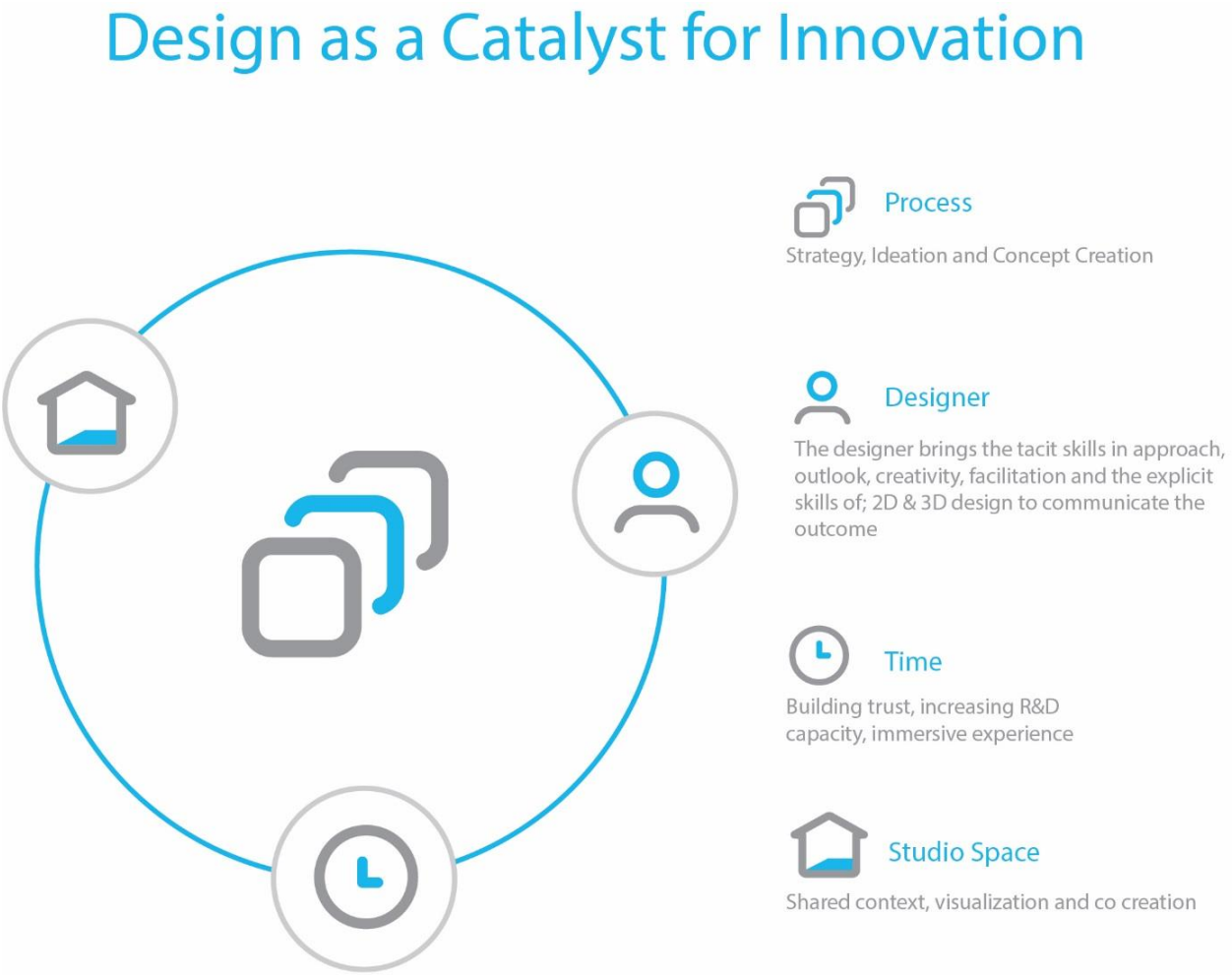

Figure 2 Design + Technology Gateway - Design as a Catalyst for Innovation (Authors own 2018)

It is through this holistic approach that design is accessed as a means to spark and create innovative product and service solutions and also as a foundation to developing sustainable business models. This is how the Design+ Technology Gateway, applied design research experts transfer knowledge to industry. In self-evaluation through reflective practice, the design team also consider the metrics or measure of success of an industry engagement.

In order to measure the success of the design team's engagement with industry, it is necessary to look back at the rationale for engagement. Irish national strategies support the creation of a globally competitive workforce and are reflective of the shift in economic drivers towards innovation and enterprise (Whelan, Towards a Technological University -A Design Approach to Knowledge Creation, 2018a). The national Technology Gateways were established in academic Institutes in order to leverage the expertise of industry focused researchers. (Enterprise Ireland, 2018). The Design + Technology Gateway was established specifically to utilise a design approach to research and development activity in a bid to stimulate innovation in Irish SMEs. The Innovation Voucher initiative was introduced to support this activity. The measure of success in this instance must therefore be, if

the engagement has resulted in any behavioural changes towards increased research and development activities and if a viable innovation has occurred which can be leveraged through a business model.

Ten companies who have utilised an Innovation Voucher were interviewed as part of the research. Eight of the companies purported to have no previously dedicated time or financial investment in research and development activities prior to conducting an Innovation Voucher (Purcell, 2019). The research shows that between 2016 and 2018, the number of Design + company projects dedicating time and financial investment in these activities has significantly increased (Table 1).

Table 1. Design + Company Projects progression to second or third innovation voucher (Authors own 2018)

Year	Total number of companies	Company progression to second or third voucher
2016	20	1
2017	26	4
2018	37	8

This indicates a behavioural change as companies have now invested significant regular hours into the innovation process, and have perceived a value to the activity having chosen to re-apply for each additional voucher and commit additional time towards the process. An OECD report 'OECD Innovation Policy Handbook' highlights output and behavioural additionality as a key motivation behind innovation vouchers (OECD, 2010). Behavioural changes are a key indication of the success of an Innovation Voucher (Purcell, 2019). Behavioural change is also captured within the research through interviews with companies who have utilised more than one voucher, Martin Fox, Managing Director of an SME, had a specific aim for part of the second voucher to "visually map out and integrate research and development as a strategic function within the business" (Fox, 2018). In relation to changing the strategic thinking, marketing manager Grainne Kennedy sums it up as "it was about asking the right questions in terms of challenging us, the right question plays a huge part in moving the thinking forward, it is not the same as having a consultant" (Kennedy, 2018). This indicates the company's recognition of the designers experience and role in critique and ensuring the companies co-design involvement with the process as opposed to consultancy. This element has been identified as essential to innovation. Consultancy is by Oxford definition 'a professional practice that gives expert advice within a particular field' denoting the transfer of existing knowledge only (2018). Utilising design as a catalyst for innovation requires a co-design facilitated process to open the engagement to new knowledge and the development of new ideas. Through the funded supports of the Innovation Voucher, companies can gain this introduction to design which they may not have otherwise invested in. The new recognised value in design will also serve to benefit the commercial Irish design industry.

Other metrics which are taken into account for measuring the success of an industry engagement with an Academic Institute are within the knowledge exchange taking place. The knowledge exchanges taking place between the Design+ Technology Gateway team and industry are; the design teams tacit skills and knowledge as an approach to research, development and innovation in Irish industry. The design team in return have the privileged position of being immersed in the knowledge and expertise of each company as they facilitate the process. This exposes them to the cutting edge of industry directions into new and innovative territories. This learning that is taking place is also invaluable as a knowledge transfer back to the student cohort in developing work ready skills.

Figure 3 Design + Technology Gateway Innovation Journey highlighting the Innovating stage (Authors own 2018)

Measuring the overall success of whether a company has actually innovated requires an extensive period of time as the measurement relies on whether a project has reached commercialisation. The innovation journey is presented in Figure 3 and demonstrates the early phase of innovating. This is the area of focus for Design + Technology Gateway in utilising design as a catalyst for innovation. The follow on stages of testing, iterating and developing can vary considerably for each company and each project. James Dyson for example purports to have taken 5,127 attempts to develop the first bag less cyclonic vacuum (Dyson, 2014). As the Gateway was established in 2016, the research is at an early stage in capturing follow on developments of companies through this process. The aim for future research is to continue to map the journey of these companies, capturing progress in; time, financial inputs/supports, collaborations and ultimate commercialisation and launch to market. This will provide an impact assessment of design as a catalyst for innovation.

4. Conclusion

In conclusion, innovation has been identified as the key driver for rebuilding the Irish economy. There are many evolving strategies within the theoretical innovation management field of how this is introduced to businesses. The Design + Technology Gateway has developed an offering which utilises design as a catalyst for innovation. A case study approach to industry engagement with over 100 SME's over a three year period was carried out by the design team. Reflective practice of the process was captured and analysed through visual mapping in order to examine how the applied research experts in design facilitate the innovation process. The findings in Figure 2 show that it is not just about a process but that utilising design as a catalyst for innovation requiring the tacit and explicit skills of the designer, a studio space and regular time spent in a co-creation environment. Understanding how all these elements come together may assist industry executives and those involved in innovation accelerator initiatives both in Ireland and internationally to access and implement design as a catalyst for innovation.

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