

NURTURING AUDACIOUS IMAGINEERING CULTURES

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ABSTRACT:

Revolutionary innovation is an audacious entrepreneurial process aimed at designing novel products, processes, or systems that are informed by research, insight and judicious synthesis. The main aim of design innovation and entrepreneurship is to disrupt current markets with an entirely new category of competitive advantage. This requires audacious hybrid thinking to enable the designer to integrate both technological knowledge and intuitive skills to create a new way of doing things. The paper reviews some life-changing disruptive innovations to foreground the argument for Audacious Imagineering as a better design approach for business transformation. The inadequacy of Design Thinking as a method for innovation is discussed to highlight the importance of the intelligent-creativity-innovation continuum, as a more potent model for innovation. Being informed by those issues, an ideal integrated curriculum aim at nurturing rational and intuitive abilities is discussed along with building Imagineering Cultures. The paper is based on a 10-year case study of a professional Master of Design degree by course work, which the author has designed, led, and is in the process of redesigning.

Keywords: Design Education, Imagineering, Innovation, Entrepreneurship

1. INTRODUCTION

Massive digital platforms are creating hyper-scale enterprises, and changing the culture on how everything is designed. Alibaba, Airbnb, Amazon, Bitcoin, Candy Crush, Coursera, edX, eLance, Discovery, Google, Tencent, Taskrabbit, Walt Disney, Zero, etc. are disruptive new business models - transforming the way we play, live, shop, being educated, buy insurance, pay our tax, and more. They signal the arrival of the Collaborative Economy (Owyang 2015): Also referred to as the Social Economy (McKinsey 2012). These innovations have been predicted two decades ago by various thought leaders (Naisbitt 1984; Naisbitt (a) 1999; Gibson 2001). All this indicates the challenges and opportunities for design education. These are mega-trends that harness design innovation, technology and entrepreneurship to create virtual value that changes our lives and disrupt incumbent enterprises. Tom Peters (2003), warned of this impending disruption and cautioned, *"It is the foremost task and responsibility of our generation to re-imagine our enterprises and institutions, public and*

private". However, design schools have been riding on the design thinking wave for the past decade, and we are crashing with it. The mismatch between design education and industry expectation is increasingly widening.

The design and development of a postgraduate programme calls for complex considerations and coordination involving the faculty's knowledge, university strategy, the nation's priority in human capital development, industry needs, sociocultural factors, the intent, and nurturing of graduate cultures, and so on.

Nurturing young minds to revolutionise and disrupt existing business models is challenging. Disruptive innovation is an Audacious Entrepreneurial Process aimed at designing novel artifacts, processes, systems and brands that are informed by research, insight and judicious synthesis. It is a culture that is knowable, teachable and learnable to varying degrees.

Design, in the past 10 years, has been one of the most discussed topics in the media, as both a potent research and applied discipline, not only to add value to our products, services, and brands, but also to provide answers to global warming, and improving economic and social problems. Nations, enterprises and institutions, such as universities and design schools, have been clamouring to embrace what is endowed in "design" to reshape their competitive advantage in the fast changing technological world. There is much evidence that shows that design-led companies do significantly better than those who are not (McKinsey 2015). However, there is little evidence on the significance that design schools play in contributing to this success. Or, how design schools are adapting to the constantly morphing and changing technologies, and to globalisation.

2. THE MASTER OF DESIGN AT AUT UNIVERSITY

Since 2006, The School of Art and Design at AUT University has designed and developed a one-year, 120-point Master of Design (MDes) Programme specifically to educate students in design thinking, strategy and innovation. The curriculum is designed to deliver a multidisciplinary grounding to students from across the creative industries who enroll in the programme. It is a taught programme aimed at not only bridging the gulf between design strategy, but also to make the best of them through the alliance of papers that develop design practice through analytical, synergetic and symbiotic thinking.

Students are exposed to a range of design research as well as innovation methods and practices. The focus is on improving and extending creativity and understanding about the design of products, environments, services and brands within market contexts. This involves user-centered design of products and services, and exploring how design thinking and the power of design can deliver new forms of value, experience and competitive advantage for business, and environmental sustainability.

Spanning a range of core and elective subjects, the MDes allows students to focus on applied research and design practices within a chosen area of their own expertise. The programme consists of 3 x 30-point core papers, and 2 x 15-point elective papers, selected from the six elective papers offered.

Having delivered the programme for almost 10 years, we are in the process of redesigning the curriculum and our pedagogy to render it more relevant to industry. An alumnus tracking has revealed that we have been successful, to a moderate extent in nurturing a culture for design thinking, strategy, business design, service design, and innovation in our graduates. It is disappointing, however that we have not produced any disruptive entrepreneurs. The following represents some of the issues we are/I am considering in order to transform the current curriculum so that it is capable of nurturing hybrid, interdisciplinary, and disruptive Imaginers.

3. HOW INDUSTRY SEES THE DESIGN PROFESSIONS

With the rising cost and time needed to complete a qualification in art and design, universities and students are revaluing their career opportunities, graduate profiles and the extrinsic value of financial earning of a university degree. A Bachelor or Masters degree in Art and Design is an expensive investment in the student's life. According to the 2015–2016 College Salary Report by "PayScale Human capital" (2015), graduates from the STEM (Science, Technology, Engineering, Mathematics) majors/disciplines, are the most sought-after and highest paid individuals in industry. The top 10 highest paid postgraduate (Masters, MBA, PhD) degrees are: Petroleum Engineering, Nurse Anesthesia, Strategy, Strategic Management, Finance & Real Estate, Electric & Computer Engineering, Computer Engineering, Chemical Engineering, Biomedical Engineering, and Economics. This seems predicable. However, of the 288 postgraduate majors being ranked, the following are some of the relevant placings: Industrial Design, 127; Design, 145; Architecture, 201; Instructional Design, 208; Graphic Design, 218; Interior Design, 239; Art History, 242; Fine Art, 257; Art, 258; Theatre Arts, 271; and Studio Art, 276. Accountants, statisticians, geologists, biologists, nurses, pharmacists and chemists all earn more than all design majors surveyed.

Apart from the intrinsic value of high personal meaning and satisfaction to the individual student, is a Masters Degree in Design a good investment? Are Design Schools nurturing graduates for jobs and careers relevant for the industry needs?

A mid-career individual in the top 10 Majors earns between \$136,000 and \$173,000 a year. One in the bottom 10 Majors earns between \$48,000 and \$56,000 per year. Simply put: a Masters Degree in Early Childhood Education (ranked 288/288) earns \$1,400,000 in a lifetime of salaried employment, while a Masters Degree in Petroleum Engineering earns \$4,800,000 during a lifetime in employment. Basing on these figures, the average difference in earnings between the highest and lowest paying masters degrees is \$3,400,000 in a lifetime.

An extrinsic perspective on how industry places the various design professions in terms of salary scales may be a significant indicator on how designers are valued as contributors in the organisation's business. Apart from industrial design and architecture, the ranking of other design graduates' salaries are near to the bottom positions. This is a sobering piece of information – especially in view of all the hype and platitudes on what design, and design thinking could do to transform businesses, enterprises and societies, and making them

better. The point is: few design schools have developed a nimble and result-focused curriculum and pedagogy to realise the latent potential of “design” - to add value to the changing world - yet.

4. DESIGN, INNOVATION AND ENTREPRENEURSHIP

Design has been touted as a discipline that can transform everything from improving business competitiveness to transforming the world into a better place. These claims are not new. Berger (2009) stated that the notion of design as a transformative force is a 200 year-old idea that has become new again. The late 19th century experienced the Art and Craft Movement, and the modernism and futurist movements in the early and mid-20th century have been fueled by the ambition to improve life for the population. By the 1980s designer-brand products – from jeans to high-end goods – ushered in a golden era for designers. The ‘design for design sake’ craze took hold. Target advanced the ‘democratising of design’ for yuppies who could afford the price and the desire for status for the works of such rock-star luminary designers as Graves, Rashid, and Starck. Many design academics in universities today hail from this era. Those days, and the old values we attached to design, are gone.

To be competitive and to apply design to gain advantage today, a business must innovate and perform on every level of the **‘Design Innovation-Technology-Entrepreneurship’** continuum in order to create and differentiate. Design in the 21st Century is highly competitive and survives on Strict Darwinian Principles: Enterprises Innovate or Die. Design education must adopt more extrinsic aims to develop competitive intellectual and creative human capitals astute in technology, entrepreneurship, and wealth creation for enterprises, institutions and societies.

5. THE NEW ZEALAND CONTEXT

The strategic design and management of New Zealand’s economic transformation is a sophisticated and long-term process. Economic transformation is not merely a re-branding exercise, although a forward-thinking national design and innovation strategy could provide the catalyst for promoting the repositioning strategy. New Zealand’s economic performance has always been affected by global events, socio-cultural factors, and physical constraints because of its small population size and its distance from key global markets. Therefore, New Zealand cannot compete in ‘low road’ strategies by simply opening the economy to international trade, investment and technology flow, or by providing cheap labour. New Zealand’s economic future will be transformed by significant human capital developments to enable the workforce and businesses to become design-savvy. Also it is necessary for imaginative entrepreneurial audacity in harnessing and commercialising new technologies, networking globally and adding value to everything we design and produce so that it is significantly more innovative and better than that of our competitors.

Managing such a ‘high road’ economic transformation strategy is both complex and challenging. Design Education is important. Design Thinking is important. But, they are no panaceas. *“Economic transformation must build on an understanding of the need for continuous change and adaptation. A small and relatively isolated developed nation in the*

South-West Pacific – the most isolated developed nation in the world – has to build its prosperity on its flexibility and adaptiveness, its responsiveness to changing market conditions and demands. The most important contributor to economic growth in a modern economy is human capital” (development). (NZ Budget 2006).

Design education is indispensable for creative human capital development. Systems and processes must be put in place to enable the government, corporations, businesses and universities to work in partnerships and clusters for exploiting creativity, innovation, technology and entrepreneurship to sustain global advantage. Capability development in creativity, innovation and the judicious use of technologies are the greatest assets for New Zealand’s economic transformation. A rich pool of creative human capital will enable the nation to integrate its products and services into global value chains – thus adding value, forging new competencies, developing niches, and establishing a high profile, national identity, brands, jobs and wealth for the nation (Yap 2006).

This paper discusses a 10-year old Master of Design programme that was originally shaped by these forces. These forces include: the Government’s Growth and Innovation Framework, Sector Taskforces, Country Branding, New Zealand Trade and Enterprise, and the bold New Zealand Design Policy.

6. THE GAME CHANGER: THE INTERNET OF THINGS

Digitisation and interaction are reshaping every country’s economy. The Internet of Things (IoT) is a computing concept that describes a future where everyday physical objects will be connected to the Internet and be able to identify themselves to other devices. The term is closely identified with RFID as the method of communication, although it may also include other sensor technologies, wireless technologies or QR codes. The IoT is significant because an object that can represent itself digitally becomes something greater than the object by itself. No longer does the object relate just to you, but is now connected to surrounding objects and database data. When many objects act in unison, they are known as having "ambient intelligence." Most of us think about being connected in terms of computers, tablets and smartphones. IoT describes a world where just about anything can be connected and communicate in an intelligent fashion – through interaction. In other words, with the Internet of Things, the physical world is becoming one big information system. This has significance in the way we nurture imaginative human capital via design education.

Derbyshire (2015) Chief Technology Advisor at SAP UK and Ireland, opined that the Internet of Things is ushering unparalleled opportunities for designers, innovators and entrepreneurs. By 2020 there will be 25 billion connections between people and social networks, and 75 billion connections between smartphones, appliances manufacturing equipment and wearable devices. This connectivity is said to have a projected global value of at least £9 trillion. At the same time, the collaborative economy, which is predicted by online services from Airbnb, Uber, to Zipcar, etc., is set to provide up to £9 billion opportunities by 2025 in the UK alone. All these mean that the goal posts for designers have shifted. The proliferation and assessability to data means that imaginative individuals have equal opportunity to

information and knowledge as large corporations. Small, nimble and audacious entrepreneurship is already tapping into blue ocean gaps in the market, where large, cumbersome multinationals have not been able to reach. In the IoT era, a lone, audacious designer with Imagineering, and with only a laptop could disrupt any market. From Amazon's replacement of bookshops, Airbnb's transformation of the hotel industry, JustPark's vision to enable homeowners renting their driveways, to Zipcar's car sharing, entrepreneurs are disrupting and rendering traditional business models obsolete in unprecedented ways.

Such mega-changes provide unlimited potentials for shifting a nation's human capital development towards better understanding, and towards new insights into design innovation, technology and entrepreneurship. All enterprises – from education, retail, agriculture, healthcare, manufacturing, tourism, to entertainment – will be affected. This has opened up unforeseen and astonishing opportunities for design education to take on the challenges ahead. Those with imagination and audacity, and who are adept with technology and entrepreneurship will be well positioned to disrupt existing design models. This calls for deep understanding and insight into what an ideal future design education for the future should be, and could be; also, more importantly, how the design curriculum is shaped to deliver graduates to compete in the network society in which the Internet of Things resides. In the New Zealand context, such a curriculum must be aimed at developing human capital capable of securing high wages, high value and contribute to the nation's economic transformation.

7. THE INTELLIGENCE-CREATIVITY-INNOVATION CONTINUUM

A revolutionary innovation that has high value is the product of imaginative entrepreneurship. Success is driven by the integration and synergy of three key human elements: Intelligence – Creativity - Innovation. The 'design thinking' innovation model developed by design thinkers at IDEO, and the d.school programme at Stanford University transformed the focus of designing the product to designing the experience. People do not buy a product per se, but they buy the story and the meaningful experience the product conveys (Jenson 2001). Design Thinking, therefore, should be human-centred, and one of the key tasks of the designer is to have empathy of the user/customer. After discovering and gaining customer empathy, the next step is to define the problems and opportunities to guide the development of possible concepts and solutions through an ideation process. Concepts are then prototyped and tested repeatedly. It is good to fail repeatedly in the hope that the product or service will fail no more when they are developed for sale in the market. This step by step process is considered by many as an important "engine of corporate profit", and that "business leaders must begin to think like designers" (Martin 2010). Thousands of designers and businesspeople have now attended a one-day "design thinking" boot camp that entitled them to qualify as Design Thinker, Innovator, or Strategists! If this sounds too simplistic - it definitely is! Such a linear process could only lead to minor improvements or incremental innovation of a product or service. Apple, Airbnb, Amazon - to Zipcar etc., are revolutionary innovations. Revolutionary innovations are the result of the audacious Imagineering in design innovation, technology and entrepreneurship – aimed at disrupting entirely new markets, and in most cases, supersede the existing ones.

Well-known revolutionary or disruptive innovators are astute entrepreneurial individuals such as Steve Jobs of Apple, Zuckerberg of Facebook, or Bill Gates of Microsoft. They are market disrupters with a unique combination of intelligence, creativity and innovation capabilities. The three abilities are interrelated, which they activate to disrupt industries.

Recent research has shown that both intelligence and creativity are required to activate and optimise innovation. Squalli J & Wilson K (2014) who reviewed some 40 studies on the relationship between intelligence, creativity, and innovation believe that intelligence is more central to creative cognition in innovation than previously recognized. Their analysis highlighted the importance of the intelligence-creativity hypothesis for innovation. More intelligence – knowledge in the STEM subjects - leads to more creativity – not the other way round. They found “support for the proposition that intelligence is important for creative achievement; it takes intelligence to convert creative activities into creative achievements”.

That is why STEM graduates earn more. Intelligence (Knowledge) is a key aspect of human capital in any country and human capital is important for economic growth. A significant part of global innovation is the result of engineering and scientific discovery. This may consist of the application or commercialisation of such discoveries that are imbedded in intellectual property. The authors argue that intelligent people are more able to undertake the considerable intellectual challenges associated with knowledge creation, transfer and innovation. However, “intelligence and creativity are more closely related than popular research contents”. Innovation requires both expressive knowledge and implicit knowhow to flourish. Intelligence, creativity and innovation are intimately interrelated to one another.

The important point argued here is that design innovation and entrepreneurship require knowledge, system thinking, integrated imagination, hybrid thinking, and evidence-based design and evaluation approaches to creative disruptive products, processes or systems. Understanding the Intelligence-creativity-innovation synergy and other models, such as the relationships within art-science-technology, the rational-intuitive and logic-emotion continua, etc. should stand design educators in good stead in nurturing successful disruptive innovators and entrepreneurs.

8. IMAGINEERING AS A HYBRID PARADIGM

Imagineering is used here to coerce a change in mindset towards integrative thinking, for disruptive innovation and entrepreneurship, where “interdisciplinary thinking” – rather than just art and “design thinking” is more beneficial in the innovation process. Imagineering is an old portmanteau word combining the two words “imagination” and “engineering” to signify the importance of creativity and technology. Walt Disney used Imagineering for humanising technology to deliver experience, excitement and entertainment in theme park design.

Imagination is a key element to creativity, design and innovation. It is an outcome of the synergy of smart, intellectual thinking to humanize new technology in an original way so that customers are willing to pay for the meaningful experience the product conveys. The conventional engineering mindset, which focuses on algorithms, analysis and quantification,

is ill-suited to the ambiguous and creative process of transformation, innovation and strategy, especially in the hyper-connected business environment (Gartner 2010). Successful innovators and entrepreneurs in the new economy must be endowed with audacious Imagineering abilities to enable them to build new business models that disrupt and supersede existing ones. They are nimble, smart and fearless. They are audacious and pride themselves with the willingness to take bold risks. They are insightful hybrid-thinkers, with incisive imagination. They are able to create and capture value in new products, services and brands based on their knowledge and prudent imagination. They optimise analytic and heuristic capabilities to enable them to create, capture and commercialise large and scalable economic value propositions, such as Amazon, Airbnb and Alibaba etc.

Much research, for example, Florida (2015) & Dutta et al. (2014), have showed evidence that design-centric companies and nations do better economically than those who are not. However, the production of a nation's graduates' employability, creativity and economic wealth cannot rely on simplistic processes – such as design thinking and studio practice – to drive economic growth in the new and changing economy. Design thinking at its best can only produce incremental innovations (Norman & Verganti 2012). Disruptive designers of the future must be nurtured with both analytical and creative skills to enable them to unlock value in “human-computer interaction” that is embedded in digital technology. They must be insightful with some key STEM subjects, and with big data analytics to inform them – and trigger them - in the creation of high value strategic design outcomes

Design curricula – for New Zealand - must instill and cherish a strong culture of entrepreneurship. It must nurture its students with intellectual, analytical and creative knowledge and skills that are based on New Zealand's audacity, multiculturalism, heritage of clean, green environment, smallness and distance from world markets, and the advantages of isolation and freshness of thoughts. It must nurture a deterministic culture to take calculated risks. It must nurture a culture of audacity to envision products, services and brands that have “exponential” value (Ismail et al. 2014), capable of transforming our lives, businesses and the global economy with authentic and meaningful experience.

9. HYBRID LOGIC-EMOTION THINKING IN IMAGINEERING

In the *Whole New Mind* (Pink 2005) argued that right-brain dominated artists are increasingly outshining the left-brain dictated STEM professionals. This was a decade ago. He encouraged us to use both sides of our brain as a metaphor for understanding the importance of rational and intuitive thinking in the new economy. He emphasised that both rational and intuitive abilities are important to creativity, innovation and entrepreneurship.

Imagineering is an optimisation process in intuitive and rational or emotion and logical thinking in design innovation and entrepreneurship. An understanding of the “logic-emotion”, “expressive-experiential” or “rational-intuitive” continua - as the Hybrid Paradigms for Imagineering is important. Each embraces mixed quantitative and qualitative research methods, for the production of new knowledge and tangible design. This disciplinary merging – between positivism and constructivism - is necessary for addressing increasingly complex

societal and technological issues. "Design now plays a role in the general evolution of the environment, and the design process takes on new meaning" (Friedman 2003). Consequently, new technologies, and their successful implementation through design and innovation, have evolutionalised the way we view design, from simple craft tradition to increasingly more complex products, infrastructures and systems, and other commercially, industrially and environmentally-altering IoT interactions.

The challenges that are facing designers to solve problems – and to create opportunities - in the complex world can no longer be subsumed in the current model of design practice that is supported only by a heuristic paradigm for craft production. Current design problems and opportunities have necessitated researchers and designers shifting current design thinking and conceptualizing in product, system and service designs, not only to a preferred one, but to one that would change the cultural perception of how designers harness, use and transform advanced technologies, sustainability and social innovation in the future.

In this complex wicked environment, the designer has to have integrated and hybrid explicit and tacit knowledge to enable the prioritization of critical problems and opportunities to judiciously propose solutions. She has to capture empirical data, with strong analysis, synthesis, and ideation skills. She needs knowledge to evaluate system complexity via scientific methods, storytelling, visualization and prototyping. These are based on knowledge in relevant STEM subjects. "Because a designer is a thinker whose job it is to move from thought to action, the designer uses capacities of mind (intelligence) to solve problems for clients in an appropriate and emphatic way" (Friedman 2003). These activities involve both analytical and intuitive actions. Within contemporary industry and business models of design, explicit research information to support intuitive design propositions is increasingly being demanded - to align left brain rationality with right brain creativity (Yap 2012).

This requirement and expectation of the designer has, in the past 10 years, led to the merging of human factors, brand strategy, business model and product envisioning in "Design Thinking" approaches in many design consultancies. However, we are becoming increasingly aware that creativity in the design processes must be deliberated within the confines of rationality of the design transformation. The mental function that connects both the rational and the creative minds, in a hybrid, symbiosis, and reflective and iterative manner – such as the Hybrid Design Paradigm embraced in Audacious Imagineering would provide.

In "Imagineering", the logic-emotion positions design as a hybrid research and creative continuum not only to address complex technical/engineering problems, but also to position it as a integrated paradigm capable of knowledge and theory production. The positioning of Imagineering in a logic-emotion integrated design process, and as a new empirical-constructivist paradigm, transform design - from a craft subject - into a more potent tool that enables designers to seamlessly develop new knowledge on the one hand, and practice design intuitively on the other.

10. AN INTEGRATED CURRICULUM

The notion of the intelligent-creativity-innovation continuum is that innovation is interdisciplinary. It has a theoretical and an applied component. An integrated curriculum is closely related to an interdisciplinary, or hybrid approach to teaching and learning.

Curriculum integration develops knowledge and skills from multiple subject areas. It is an education that is organised in such a way that it cuts across subject-matter lines, bringing together various aspects of the curriculum into meaningful association to focus upon broad areas of study. It views learning and teaching in a holistic way and reflects the real world, which is interactive (Shoemaker 1989).

Integrated curricula are particularly suited to nurturing an Imagineering Culture of hybrid thinking to work in ambiguous design projects. This is particularly suited in postgraduate design programmes where students enroll from different disciplines and countries.

Innovation is intelligible and designable. Design education “needs to train people – who can tell machines what to do: scientific, technical, engineering and mathematics (STEM) talents - how to innovate”. STEM skills per se, however, are not enough. We need to nurture them with innovative hybrid thinking skills to do things machines can’t do: to imagine, emote, coordinate, coach, care, and create. Likewise design schools need to nurture business, art and design talents of the importance of STEM subjects in the innovation process: the importance of big data analytics, interaction, social networks, and the Internet of Things.

11. AUTHENTIC TEACHING, LEARNING AND ASSESSMENT

Authenticity implies that we design some kind of real world application of the discipline. Going beyond content, project or assessment, authentic learning intentionally brings into play multiple disciplines, multiple perspectives, ways of working, habits of mind, and community. Grant Wiggins (1993) describes authentic learning and assessment as *“engaging and worthy problems or questions of importance, in which students must use knowledge to fashion performances effectively and creatively. The tasks are either replicas of or analogous to the kinds of problems faced by adult citizens and consumers or professionals in the field.”*

An authentic curriculum and pedagogy complement the intelligent-creativity-innovation model for effective design education. The following work of Marilyn Lombardi (2007) has distilled the essence of the authentic learning experience down to 10 design elements that might be productive in clarifying for us what to include when designing an authentic design programme.

1. **Real-world relevance:** Authentic activities match the real-world tasks of professionals in practice as nearly as possible. Learning rises to the level of authenticity when it asks students to work actively with abstract concepts, facts, and formulae inside a realistic— and highly social—context, mimicking “the ordinary practices of the [disciplinary] culture.”
2. **Ill-defined problem:** Challenges cannot be solved easily by the application of an existing algorithm; instead, authentic activities are relatively undefined and open to

multiple interpretations, requiring students to identify for themselves the tasks and subtasks needed to complete the major task.

3. **Sustained investigation:** Problems cannot be solved in a matter of minutes or even hours. Instead, authentic activities comprise complex tasks to be investigated by students over a sustained period of time, requiring significant investment of time and intellectual resources.
4. **Multiple sources and perspectives:** Learners are not given a list of resources. Authentic activities provide the opportunity for students to examine the task from a variety of theoretical and practical perspectives, using a variety of resources, and requires students to distinguish relevant from irrelevant information in the process.
5. **Collaboration:** Success is not achievable by an individual learner working alone. Authentic activities make collaboration integral to the task, both within the course and in the real world.
6. **Reflection (metacognition):** Authentic activities enable learners to make choices and reflect on their learning, both individually, and as a team or community.
7. **Interdisciplinary perspective:** Relevance is not confined to a single domain or subject matter specialization. Instead, authentic activities have consequences that extend beyond a particular discipline, encouraging students to adopt diverse roles and to think in interdisciplinary terms.
8. **Integrated assessment:** Assessment is not merely summative in authentic activities but is woven seamlessly into the major task in a manner that reflects real-world evaluation processes.
9. **Polished products:** Conclusions are not merely exercises or substeps in preparation for something else. Authentic activities culminate in the creation of a whole product, valuable in its own right.
10. **Multiple interpretations and outcomes:** Rather than yielding a single, correct answer obtained by the application of rules and procedures, authentic activities allow for diverse interpretations and competing solutions. (p.3)

The adoption of authentic teaching and learning is becoming increasingly more important in the rapidly changing world. Information life span is short. Our graduate can expect to progress through multiple careers. To be competitive in the global job market, our design graduate must be cognizant and skillful with the complexity of ill-defined real-world problems – originating from the STEM subjects. The greater the breadth and depth they are immersed in authentic multidisciplinary communities, the better they will be prepared to deal with ambiguous wicked problems, and put into practice the kind of complex integrated thinking and practice that is required of them as innovative professionals (Lombardi 2007).

12. CONCLUSIONS

Interactions – the searching, coordination, and monitoring that people and businesses do when the exchange of goods, services, or ideas permeate all economies, especially modern developed economies – are changing the traditional notion of value we place in product and service innovations. It changes the way industries are structured, how businesses are organised, and how customers react and behave within social networks – social networks that support and sustain all interaction via a human-artifact interface.

A convergence of interaction through the Internet of Things is disrupting businesses and industries. The growth of interactive capacity has ushered in new ways to configure businesses, organise companies, and serve customers. This will have a profound effect on how enterprises design and structure strategy, and on competitive advantage. The disruptions this has brought are unprecedented and game-changing. Doing business in a world of abundant and cheap interaction will require new skills and a new mindset. No business or industry will be left unaffected. Those who understand the fundamental nature of the changes ahead and actively reshape their business models will be best placed to exploit the opportunities (McKinsey 1997).

These changes have already disrupted design education, rendering many of our graduates unprepared for the jobs and opportunities created by interaction and the collaborative/sharing economy. Design schools need to change – adjusting and adapting - with new technologies and new business models to enable students to be insightful in design innovation, technology and entrepreneurship, and to keep up with the real world of enterprise Darwinism.

Materials in the new interactive and sharing economy are virtually free. The laptop is the factory for anyone to reap exponential profits. Designer educators must nurture Imagineering cultures by arming graduates with better-integrated curricula and authentic pedagogy to developing hybrid thinkers. This will enable them to becoming disruptive innovators and entrepreneurs.

This paper has discussed Imagineering as a potent creative process, for nurturing innovation and entrepreneurship, from the perspective of current and future design education, technology and industry needs. Based on a 10-year old case study, which we are in the process of redesigning, I had argued that the narrowness and inadequacies of current dependence on design thinking and design skills as innovation tools are stifling the revolutionary business-model innovation in the new economy. We must reimagine design education. To do this we must benchmark our graduate's profile against current business and technological trends, and future business-model innovation that enterprises and nations seek: to create jobs, economic value, and competitiveness.

REFERENCES

- Berger (2009). Glimmer. Random House Business Book.
 Budget 2006. The Treasury (New Zealand). <http://www.treasury.govt.nz/budget/2006> (Retrieved 2 May 2010).

- College Salary Report: Highest Paying Graduate Degrees. PayScale (2015). <http://www.payscale.com/college-salary-report/majors-that-pay-you-back/masters> (Retrieved 28 September 2015).
- Derbyshire (2015). Is The Internet of Things The New Entrepreneurial Battleground? <http://realbusiness.co.uk/article/30686-is-the-internet-of-things-the-new-entrepreneurial-battleground> (Retrieved 5 August 2015).
- Dutta, Lanvin and Wunsch-Vincent (2014). Global Innovation Index 2014. (Retrieved 18 May 2015) <https://www.globalinnovationindex.org/userfiles/file/reportpdf/GII-2014-v5.pdf>.
- Florida (2015). Insight: The 2015 Global Creativity Index. <http://martinprosperity.org/content/insight-the-2015-global-creativity-index/> Retrieved 1 August 2015.
- Friedman (2003). Theory Construction in Design Research: Criteria: Approaches, and Methods. *Design Studies* Vol 24 No.6 November.
- Gibson (Ed) (2001). *Rethinking the Future*. Nicholas Brealey Publishing, London.
- Jenson (2001). *The Dream Society*. McGraw-Hill Books.
- Lombardi (2007). Authentic Learning for the 21st Century: An Overview. "Educause" Learning Initiative.
- Martin (2010). Design Thinking: Why Business Leaders Need to Think Like Designers. *The Economic Times*. http://articles.economicstimes.indiatimes.com/2010-12-24/news/27627350_1_design-ideo-business-strategy (Retrieved 28 August 2015).
- McKinsey (2015). Good Design Is Good Business. McKinsey & Company [publishing@email.mckinsey.com] http://www.mckinsey.com/Insights/Organization/Good_design_is_good_business?cid=digital-eml-alt-mip-mck-oth-1510 (Retrieved 3 October 2015).
- McKinsey (2012). *The Social Economy: Unlocking Value and Productivity Through Social technology*. McKinsey & Company [publishing@email.mckinsey.com] http://www.mckinsey.com/insights/high_tech_telecoms_internet/the_social_economy (Retrieved 15 June 2015).
- McKinsey (2007). *A Revolution in Interaction*. McKinsey & Company [publishing@email.mckinsey.com]. http://www.mckinsey.com/insights/strategy/a_revolution_in_interaction. (Retrieved 15 June 2015).
- Naisbitt (1984). *Megatrends: The New Directions Transforming Our Lives*. Macdonald & Co. London & Sydney.
- Naisbitt (1999). *High Tech – High Touch*. Nicholas Brealey Publishing, London.
- Nicholas et al. (2010). *Introducing Hybrid Thinking for Transformation, Innovation and Strategy*. Gartner, Inc. <https://www.google.com/search?q=Nicholas+G.+et.+al.+%282010%29.+Introducing+Hybrid+Thinking+for+Transformation%2C+Innovation+and+Strategy.&ie=utf-8&oe=utf-8> (Retrieved 5 August 2015)
- Norman and Vergenti (2014). Incremental and Radical Innovation: Design research Versus Technology and meaning Change. *Design Issues: Volume 30, Number 1 Winter 2014*. Retrieved 1 August 2015,
- Owyang (2015). Collaborative Economy. <http://www.web-strategist.com/blog/category/collaborative-economy/> Retrieved 25 July 2015.
- Peters (2003). *Re-imagine: Business Excellence in a Disruptive Age*. Dorling Kindersley Limited.
- Pink (2005). *The Whole Mind*. Riverhead Books. New York.
- Salim et al. (2014). *Exponential Organisation*. Division Publishing.
- Shoemaker (1989). *Integrated Education: A Curriculum for the Twenty-First Century*. Oregon School Study Council 33/2.
- Squalli & Wilson (2014). Intelligence, Creativity and Innovation. *Intelligence* 46 (2014) 250-257). <https://www.google.com/search?q=Squalli+J.+%26+Wilson+K.+%282014%29.+Intelligence%2C+Creativity+and+Innovation.+Intelligence+46+%282014%29+250-257%29.&ie=utf-8&oe=utf-8> (Retrieved 3 June 2015).
- Wiggins (1990). The Case for Authentic Assessment. *Practical Assessment, Research & Evaluation*, 2(2).
- Yap (2012). Design Education for the New Economy: Teaching Mid-Career Masters Students Hybrid Design Methods to Solve Wicked Problems. DesignEd Asia Conference 2012, Hong Kong.