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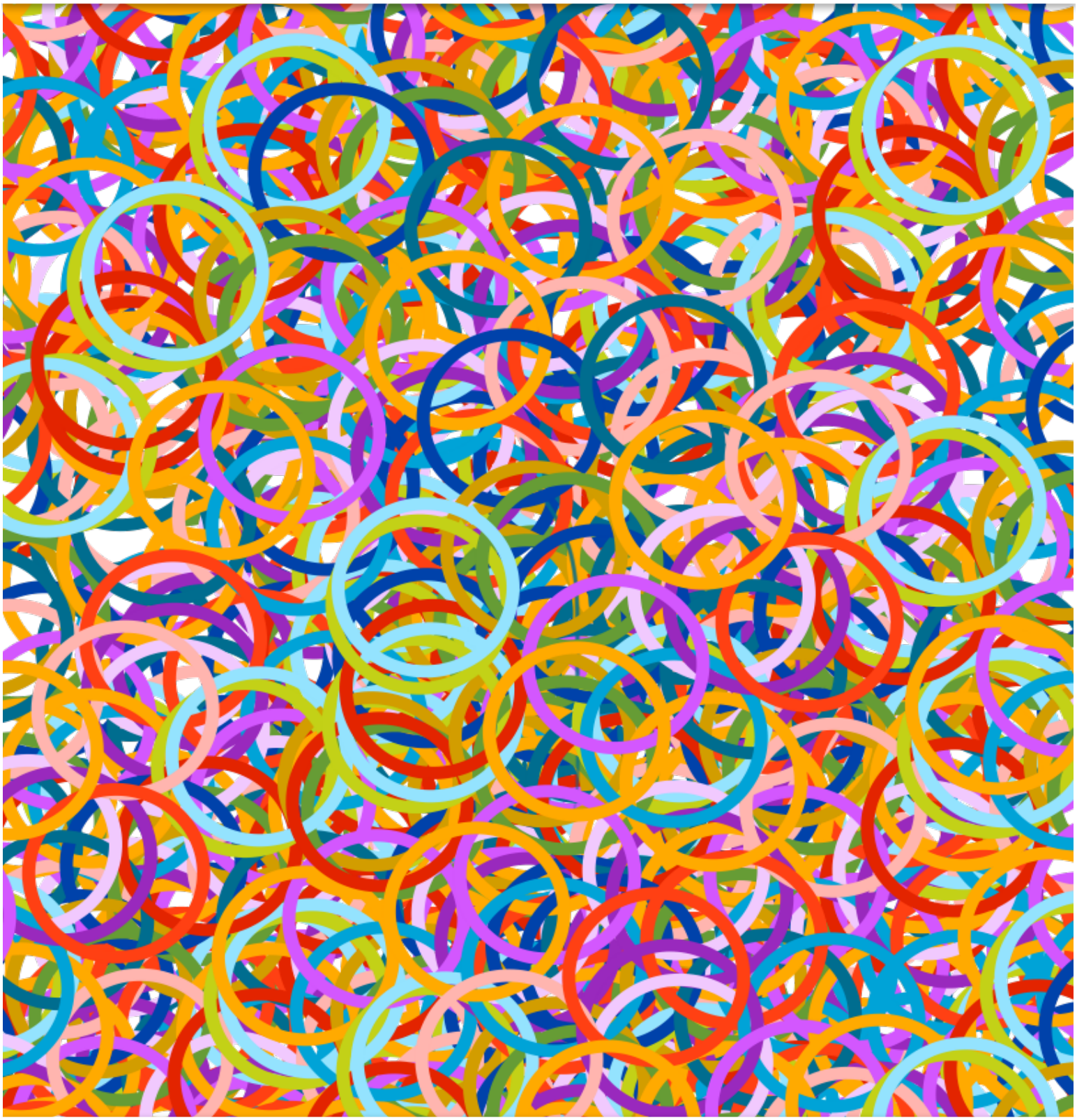

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Table of Contents

Editorial

Letters

Articles

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Journal Editors

João José Pinto Ferreira
Marko Torkkeli
Anne-Laure Mention

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Denis Dennehy - DESIGN THINKING
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Gabriel Amitsis - SOCIAL INNOVATION AND ENTREPRENEURSHIP
Giovanni Perrone - OPEN INNOVATION
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Ioannis N. Katsikis - INNOVATION AND ENTREPRENEURSHIP
John Lewis - LEADERSHIP & ORGANIZATIONAL BEHAVIOUR
Jose-Luis Hervas-Oliver - INNOVATION ECOSYSTEMS
Maria Smirnova - MARKETING
Marina van Geenhuizen - INNOVATION
Michael Dell - CONSULTING
Milton Sousa - LEADERSHIP & ORGANIZATIONAL BEHAVIOUR
Pawel Kawalec - RESEARCH METHODS
Peter Prud'homme van Reine - CROSS-CULTURAL ISSUES
Shawn Carraher - ENTREPRENEURSHIP
Stefano Pace - MARKETING
Susan Castillo - LITERATURE AND LITERARY STUDIES

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Journal of Innovation Management
JIM 4, 3 (2016) 1-2
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Editorial

Revisiting Openness: A must for Society

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Academic literature increasingly stresses the predominance of openness in contemporary organizations - porous boundaries, virtual and agile teams, temporary hierarchies, interconnectedness of networks and ecosystems. Managerial literature also abundantly depicts the benefits of openness. In contrast to what is being observed and reported at organization level, Western Societies and some of their elected leaders currently advocate closeness: protecting borders, erecting walls and barriers, either physical, administrative or legal. This paradox raises concerns: how can individuals and firms be and remain open, while nations isolate and seclude? How can we build an inclusive society while rejecting differences? How can we achieve innovation when turning our backs to variety and diversity?

The very cradle of European ideals, among others the freedom of movement of people and capital, is facing an incredible push backwards, with the tightening of its regulations and the implementation of stricter rules and policies with regard to immigration. Former Eastern European countries, which have been benefitting for about a generation – since the fall of the Berlin Wall in 1989 – are also closing up and self-centring.

Maybe we should go down to the basics! We all live and die, but we seldom reflect upon our existence. What is life? The songs from the musical “Zorba the Greek” give us some answers, namely “Life is…“ and "The First Time". They talk about feelings and emotions, and they talk about all those things that make our hearts both beat and melt.

In a previous editorial, we discussed Openness, however, and as we see societies around the world building new barriers to protect their citizens against the unknown, the whole world should probably go through some in-depth reflection. Anyone remembers the first picture of Planet Earth taken from outer space? Did anyone realize we are all in there together? As Carl Sagan once put it “Look again at that dot. That's here. That's home. That's us.”

So, what is happening? This unprecedented shift towards closeness in Western societies clashes with the growing appetite for openness in other parts of the world, where policies and practices towards openness thrive. Asian countries build alliances, open up their markets, and initiate free trade agreements; and source ideas, expertise,

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novelties and potential, drain more and more brains and hands so as to support their booming economies.

Could the Maslow Hierarchy of Needs help the mechanics of these trends? It would likely help. It is likely that people and societies from all walks to life, may be feeling a threat to their fundamental cultural component. On the other hand, safety needs such as job security, protection from harm and the avoidance of risk, are likely to be in people's minds. So, where is the solution, how can people in desperate need be helped and supported, while ensuring that everyone feels considered, respected and with the confirmed feeling that their needs are being properly considered.

Special care should be taken in the careful reconsideration of the notion of openness at a political and societal level in Western societies, so as to avoid the expectable negative consequences of isolation and of the extremes, whichever those are. A reconsideration that must be meaningful for Society as a whole. Participative revisiting of openness through a collective engagement of all stakeholders and the redefinition of common values is not optional, it is a must for so-called modern societies. Both life and society need proper innovation management framework – preferably more open one!

Innovatively Yours,

Anne-Laure Mention, João José Pinto Ferreira, Marko Torkkeli

Editors

Journal of Innovation Management
JIM 4, 3 (2016) 3-6
HANDLE: http://hdl.handle.net/10216/86100

Retail Medicine in an Era of IoT and Medical Errors in the Age of Ubiquitous Connectivity

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Letter from Academia

Digital diffusion in healthcare is poised to usher delivery of care in integration with software as a service to the edge. Time compression due to the latter may catalyze the convergence between "sense and response" in a manner which may enhance quality of service (QoS) or quality of care at the point of contact (PoC). Digital transformation is likely to influence the broad spectrum of instances ranging from high acuity patients to preventive care scenarios. Access to healthcare for individuals before they become patients may eventually lead to improved health and reduced healthcare cost.

1 Introduction

The deaths due to medical errors (Figure 1) in the US are, in part, due to greed. It stems from the mantra of maximum profit optimization which is the daily chant of vendors in the health industry in the US. In an age where ubiquitous connectivity can be a part of our daily regimen, the resistance to medical device interoperability1 is a cold blooded strategy exercised by the medical industry to build walls around "their" medical devices and data to prevent the collective view, analysis and shared use of distributed information access which may reduce medical errors. The laissez-faire US policies empowers these egregious errors and Wall Street rewards the practitioners of this epic evil in unhealthy proportions.

[1] http://www.mdpnp.org/ Accessed November 2016

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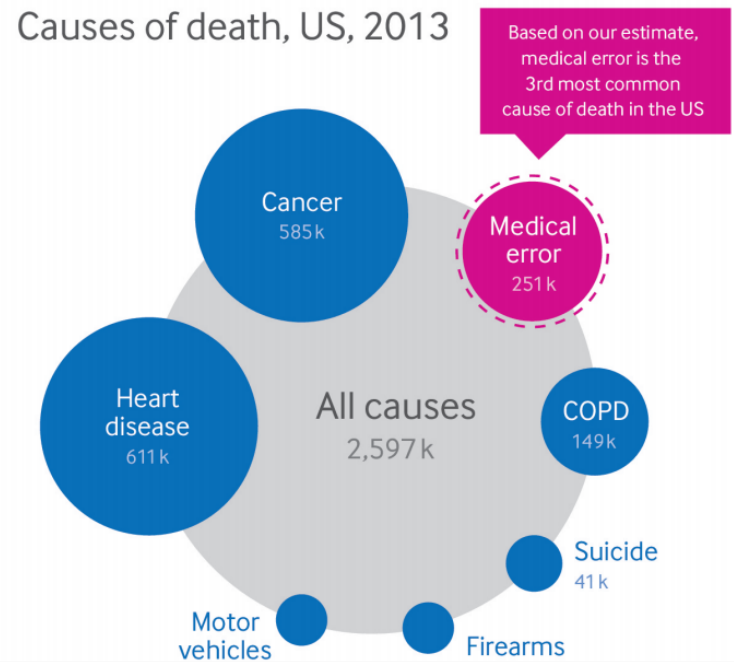

Fig. 1. Most common causes of death in the United States, 2013 (Martin and Michael 2016)

Decentralization of this epic evil control with secure open data (EHR, EMR) and a new breed of medical device manufacturers promoting interoperability by design, may be one solution. A choke point is the lack of infrastructure required for semantic interoperability between systems which uses different standards. Thus, interoperability between standards is equally critical but one which the behemoths may vociferously resist to protect their turf.

2 Elusive Quest for New Roads

Over the past half century, the principles of ubiquitous computing has percolated down to the practice of ubiquitous connectivity. One manifestation is the concept of the networked physical world which led to a range of ideas commonly referred to as the internet of things.

IoT is a design metaphor and the quintessential infrastructure for digital convergence by design. It is in this domain that we may seek conceptual resolution of some of the problems in health IT. But, IoT is not a panacea for health and healthcare. It will not resolve all the ills and chronic malfunctions in the medical industry unless the human roadblocks are dead.

> *"Eine neue wissenschaftliche Wahrheit pflegt sich nicht in der Weise durchzusetzen, dass ihre Gegner überzeugt werden und sich als belehrt erklären, sondern vielmehr dadurch, dass die Gegner allmählich aussterben und dass die heranwachsende Generation von vornherein mit*

> *der Wahrheit vertraut gemacht ist." (Max Planck) (Wikiquote, 2016).*
>
> *[A new scientific truth does not, generally speaking, succeed because the opponents are convinced or declare themselves educated, however because they die and the new generations from the beginning learn about it as the truth.]*

IoT is poised to re-invent almost every facet of health and non-emergency healthcare based on ubiquitous connectivity between *in vivo* precision metabolomics and the need for an environment fostering wellness, preventive medicine or collective clinical attention/action.

The tsunami of the principles and practice of connectivity is expected to usher in an unprecedented era of healthcare information technology that shall be woven into the daily fabric of our lives almost through our entire life-cycle, from conception to the grave.

Digital by design is the fabric that businesses may use in an era where IoT may be the predominant design metaphor. As a part of the group that catalyzed connectivity and ushered in the current networked society, one must plan to help the growth of digital entrepreneurship and intrapreneurship to lift many boats, not just a few yachts. Trans-disciplinary convergence of medicine and engineering offers to morph the brick and mortar clinic/pharmacy from its emergency/retail outlet concept to be an integral function at home for health and healthcare with decreasing demand for high acuity units (HAU).

Retail clinics and "pharmacies" will undergo transformation to create the 22nd Century service centers for medicine, perhaps something akin to "Jiffy Lube" (Boots, Walgreens, CVS) rather than a visit to Sears Auto Center (MGH). The transformation will be catalyzed by pioneers who will usher in, albeit in phases, convergence of a wide variety of precision medicine tools applicable on a massive scale and harvest metabolomics data from device-agnostic, protocol-agnostic, platform aggregators which will connect to streaming data inside and outside the body (humans, animals). Predictive analytics from person-specific data will be the digital path for precision clinical "sense and response" system and offer prescriptive analytics. It will serve almost all facets of preventive medicine, non-emergency medicine but may exclude sudden extreme trauma and few selected ambulatory scenarios.

Retail healthcare may serve as the future point of contact for the confluence of preventive medicine, precision medicine, primary care, tele-health and remote diagnostics. Retail health industry must reform their mission from selling drugs to acquiring data, analyzing and advocating in addition to building alliances to serve individuals who are not patients. The potential of digital by design health IoT will generate business growth and generate massive revenue through pay-per-use micro-revenue schemes. It may help those in the US who are less[2] fortunate and reduce the barrier to entry even for markets in L-26 countries[3] where health spending is less than

[2] http://www.irp.wisc.edu/publications/focus/pdfs/foc262l.pdf (Accessed November 2016)
[3] http://www.who.int/healthsystems/topics/financing/healthreport/41FiscalSpace.pdf (Accessed November 2016)

$50 pa for 2+ billion people (www.pih.org).

Imagination, invention and innovation must be coupled with wireless telecommunication based remote monitoring where changes in physiological status or alerts could trigger applications via intelligent agents using functional mesh (networks) for multi-directional multi-cast communication of data, information, analytics, intelligence and streams for real time decision support or at-home care or ambulatory access depending on the "sense and response" system of systems that provide one-on-one guidance at point of contact (POC).

The retail health industry must demonstrate this concept on a large scale for credibility. It must create the local and global ecosystem of competencies necessary to provide the end to end value chain. It must be driven by less greed and more pay per service. Cybersecurity[4], trust, authorization, validation, privacy, policy, regulatory compliance and authentication may require digital ledgers, such as blockchain-like concepts, to track, trace and secure every instance and events related to every process and nested sub-processes.

3 Conclusion

The complexity calls for a global surge of and focus on, collective entrepreneurial as well as intra-preneurial recombinant innovation. It will create new lines of business and immense economic growth but not through traditional channels and existing business models or organizational *status quo*. This calls for a new organizational platform approach where credible groups lead and coalesce tools from a diverse array of providers and champion a new form of delivery.The leadership must embody the relentless pursuit of frontiers without the fear of failure to lift the future plight of humanity through distributed medical care beyond boundaries and definitions. One must continuously re-invent to re-align with new research, new inventions, new theories, new ideas, new science, new ways to help people and customers, locally and globally. If one thinks that any one solution or company or provider or nation holds the key then one may be suffering from that impossibly incurable ailment commonly referred to (in the medical jargon) as solipsistic bliss.

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Journal of Innovation Management
JIM 4, 3 (2016) 7-11
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Why the New Logics of a Connected World Affect Traditional Innovation Structures from the Bottom Up – and the Role of Open Innovation Networks & Ecosystems in Finding Proper Answers

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Letter from the Industry

2016 has brought us new learnings about ecosystem dynamics and the transformation of design thinking and agile development methods. What most of these methods have in common is a divergent and a convergent phase that allows to think boldly and broadly on the one hand, and to recognize priorities and enable speed on the other hand. But industry logics are very different from theoretical settings as there are complex organizational factors at play which encompass diverse cultural and sub-cultural behaviors. The challenge for the young Swarovski Open Innovation Networks approach is to find ways to manage diversified networks of connections which blur boundaries, collaboration, and interdependence, thus characterizing the real logics of modern innovation ecosystems. The tremendous potential that has been recognized and captured from different R&D efforts of big industry players and research institutes through structured Open Innovation efforts - and how this new value may be transformed into the company's markets - is the central topic of this article.

1 The new ecosystem dynamics

Shortened life cycles of products, speed of technological change and omnipresent availability of information threaten every organization these days. In the area of Innovation Management the year 2016 has brought us a lot of new answers, methods and good practices. But was there any new revolutionary learning? When I met Prof. Bob Cooper, the inventor of Stage Gate, while presenting at the 2016 Stage Gate Summit, he mentioned the transformation of agile methods, such as Scrum and Sprint, proven principles in area of software development, into the area of physical product innovation. In his opinion probably one of the biggest opportunities to increase speed and drive of physical product innovation, and one of the biggest moves since the introduction of Stage Gate logics in the 1990's. A few months later I met Prof. Henry Chesbrough, known for his work on Open Innovation, in Porto at the EU OI-Net conference. He very much focused on understanding the deep societal change of our days and how to find purpose and meaning for innovating in new eco system environments.

Many other innovation methods have been promoted by academics like Design

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Thinking, the Lean Start up Model from Eric Ries, the Business Model Canvas from Prof. Oliver Gassmann or "Jobs to be Done" from Clayton Christensen.

When we deeper look into them we find out that industrial experiences have been providing data and management learning, and academics have derived their theories around these success stories and stories of failure, and vice versa. This circle of empirical and theoretical management learning is very important in order to develop new solutions and answers. But industry logics are very different from theoretical ideal settings because they have at times hundreds of people in different organizational settings, encompassing diverse cultural and sub-cultural behaviors. And that's the reason why these processes cannot simply be transferred 1:1 into an organization.

As practitioners we are forced to choose and train the right methods for the right challenge. The more we go beyond our core businesses towards adjacent and transformative innovation we see that the clever orchestration of methods begs a deeper understanding. What they all have in common is a divergent and a convergent phase that allows to think boldly on the one hand, and to recognize priorities and enable speed on the other hand.

We create environments where all these new methods and dynamics are positioned as drivers in innovation ecosystems. Diversified networks of connections, blurring boundaries, collaboration, and interdependence characterize the logics of ecosystems. Innovation ecosystems in most cases consist of a science ecosystem, producing knowledge and technologies in an exploratory behavior mode and a business ecosystem, producing value for customers and companies in an exploitative mode. The definition of ecosystems is coming from the natural world: communities of living organisms interacting within their shared environment, simultaneously competing and collaborating, creating and sharing resources, and adapting together in the face of inevitable external disruptions. The look into these solutions coming from natural systems can provide us with helpful insights as to how innovation could be understood.

2 Changing dynamics

As a company we have experimented with many of the mentioned processes with different success and outcome. We were a quasi-monopolist of the classical crystal business up till 2008 when we suddenly faced an explosion of competition. The need for more agile processes, robust strategies and new technologies was obvious. After the definition of innovation search fields and must-win battle fields, we saw that we had to significantly open up our mindset and orientation towards the outside world.

Based on both our long tradition of incorporating technologies from other industries into the world of fashion and design, and on the founder's spirit - who recognized very early in the 20th century that "development never stands still and that an invention in one field inevitably leads to inventions in another fields" - we decided, among other changes, to allocate dedicated resources to the field of Open Innovation and inter-organizational networking.

3 The foundation of OI Networks

The Open Innovation Networks department was officially established in 2013 in order to implement a foundation for strategic alliances and initiatives with focus on outside-in technical innovation and long-term relationships leading to additional business for both sides.

Our initial mandate was to formally build a network of potential partners who could contribute to any of our innovation categories, with a focus upon outside-in breakthrough technologies for our business-driven search fields, while increasing transparency and culture of openness and trust for all innovation activities both internally and externally. Initially our key stakeholders included all research, innovation and design related internal actors, those responsible for budget & prioritization per innovation category, as well as various internal leading experts, innovators, and department heads depending on the topic or field. Finally, we established an engagement process which tracks all potential partners through our defined stages of engagement. Conclusively, we established a system comparable to the lead generation or conversion process common to traditional sales & marketing functions, and customized a customer relationship management as software support system. With this implementation, our Open Innovation network became an asset in and of itself, allowing for sustainable operation and transparent collaboration, while generating value for multiple business units, reaching far beyond our initial key stakeholders, and providing interested employees access to the data and networking communities that we manage within our portfolio.

4 Creating customer value through open innovation networks

In November 2015, we were awarded with the "Open Innovation Award" from the Zeppelin University in Germany in the category "Best Open Innovation Network". This helped us a lot in trusting our interpretation of how we see innovation working in future.

Involving external partners was not something new for Swarovski, but to do this on different levels of the organization and to integrate such collaboration into our day-to-day work required - and still requires - both a change in mindset as well as acquiring new skill sets.

We very soon realized the tremendous potential in transforming the results from different R&D efforts of big industry players and research institutes into our markets. However, externally we were not perceived as a technology-oriented company and we have not been present in the global science ecosystems. Three years later, we have now spoken with over hundreds of companies, mainly cross industry, and developed a few dozen opportunities based upon new technology integrations. The analysis of our partner pipe-line surprisingly showed us that their research labs operate in 33 different countries worldwide.

The main source of new contacts was realized through speaker invitations and participation at over two dozen global conferences and networking events. Other indirect sources included referrals from existing partners, or recommendations from networking intermediaries. This widened the ability of the organization to integrate

external knowledge in a fast and seamless manner, delivering on our promise to provide access to breakthrough innovation and increased development speed from idea to market.

5 Arriving in the new innovation ecosystems

As with many businesses, we are evolving from traditionally providing our customers with new products to transforming our offers into new comprehensive solutions. That means that the ability to efficiently collaborate with external science ecosystems – openly, quickly, and more often than in the past – is even more crucial.

The industries we serve simply do not allow the time to follow linear development models that require years to make a new technology available for the markets. Rather we see processes that start in corporate laboratories and research institutes very early on, which are then quickly transformed into new product and service concepts by directly involving the customer at the very beginning. Collectively, these participants comprise as what we refer to as the innovation ecosystem, integrating the science and business ecosystems together as shown in the graphic below. Entitled "The Logics of Innovation Ecosystems," we depict a holistic view of our ecosystem-based approach, a hybrid of the models from Gene Slowinski (Rutgers University) and Katri Valkokari (VTT) in combination with the methodologies we rely upon throughout the various phases of networked innovation development.

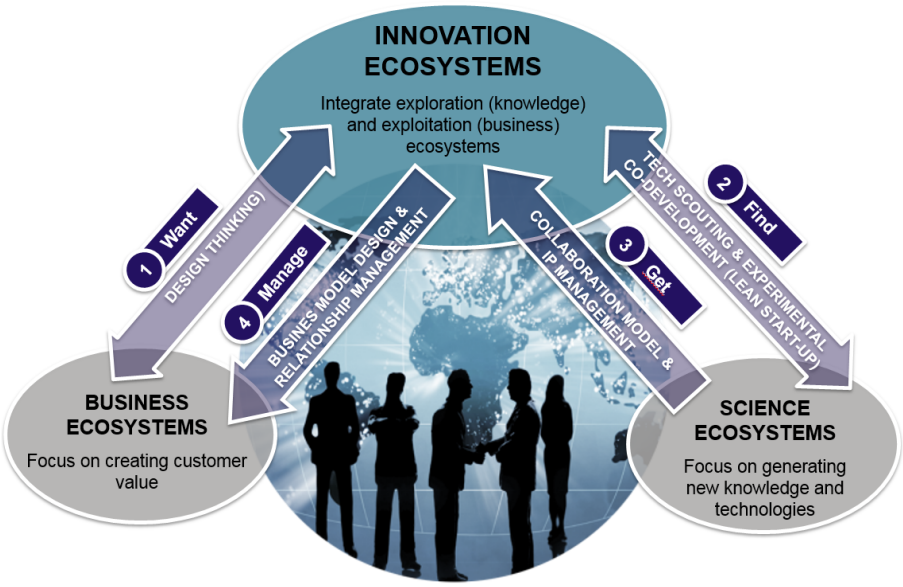

Fig. 1. The Logics of Innovation Ecosystems

6 Our biggest learnings from our open innovation journey

Another shift that we observe in industries today is the so-called "Fail Fast - Learn Fast" and "Experimentation" culture. This is something we can particularly observe in start-up environments, however this has now also risen to the top of the innovation agendas for large corporate environments as well. Our company recently launched a private equity partnership with the community, leveraging the collaborative networking and experimental spirit that the company has been known for since its founding.

Coming back to the previously mentioned agile methods, we see a big focus on design thinking and sprint methods along with a redefinition of the places where - and the processes how - we innovate.

We know exactly how all these methods work, what benefit they can bring at what phase of the innovation development process, and how they can be used. However, in big organizations they must also be combined with the principles of systematic organizational development.

Schumpeter's theory on creative destruction then gains new meaning and can be seen as a company asset if your employees are encouraged to adopt these new methods of thinking. There are a few companies showing us how creative destruction can be embraced within a corporation, such as Google, Johnson & Johnson, IBM, and P&G. Open innovation then becomes a foundational cultural mindset and behavior, and not a responsibility of a single department.

We want to be the missing link between the tech and fashion industries, we therefore have to develop new practices in combining data-driven systems and design thinking methods. We believe that values along the levels of customers, organizations, ecosystems and society are the common language that determines the likelihood of success. The better the contribution to these four levels and the meaning of our products and services, the better our footprint on society as a whole will be.

With the role of Open Innovation networks we have shown only one facet of Swarovski's innovation ecosystems. As innovation leader in our industry we have to guarantee the relevance of our technological expertise, our capabilities around inventiveness, and the ingenuity and motivation to further develop the Swarovski DNA of innovation for the next 120 years to come.

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The Circle of Innovation

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Abstract. Traditional models of innovation are predominantly linear, featuring only very limited feedback loops. This paper builds on a high-level cycle of feedback between technical innovation and social change. In this grand cycle, technological innovation brings about new products but also new ways of using products and services. These in turn change our organizations and social interactions. The new structures generate new unfilled needs, spurring still more technological innovation. The Circle of Innovation is a simple idea. Yet its implications for companies and for researchers have remained unexplored. This paper discusses the Circle of Innovation's implications. We find the Circle of Innovation (i) implies a new way to classify innovations; (ii) should change how firms assess innovations; (iii) gives a new view of target marketing; and (iv) has implications for sustainable product planning. We conclude in a more conjectural vein that the Circle of Innovation provides a frame for other nonlinear innovation models.

Keywords. Innovation; Social Change; Product Line Planning; New Product Development; Technology Assessment; Creative Destruction.

1 Introduction: Feedback in the innovation process

Traditional models of innovation and its diffusion are predominantly linear and uni-directional, offering feedback loops only in the form of customer satisfaction measures, imitation behavior, or concurrent engineering. This paper discusses a high-level cycle of feedback between technical innovation and social change, enabling connection with newer, more detailed nonlinear models of innovation, and encouraging further nonlinear modeling and analysis.

In the proposed grand cycle, technological innovation brings about not just new products and services, but new ways of producing and using products and services. These in turn lead to new ways to interact and organize, socially and professionally. The new structures generate new unfilled needs, which are opportunities for still more technological innovation. That is, each time technology solves a problem, it generates new ones, in a continuing cycle.

The term "high-level cycle" reflects Schumpeter's macroeconomic orientation as he set forth his seminal view of the loop between innovation and socio-economic change. The present paper ties this macro idea, recounted in Section 3 below, to management ideas that span the meso and micro levels.

The Circle of Innovation is a simple idea. Yet it:

I. Implies an additional way to classify innovations, namely, those that are new ways of satisfying old wants, and those that satisfy new, unprecedented wants;

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II. Gives a new view of target marketing – a kind of uncertainty principle for innovation, in which we understand that products cannot be aimed at a usage situation, but rather, that the product changes the situation; and
III. Has implications for sustainable product line planning. The Circle implies firms should assess their own innovative products, predicting what new wants they will generate, in order to be first to satisfy them.

The paper discusses these implications. The grand cycle of socio-technical change means we should augment our thinking about innovation diffusion by considering innovation *reinforcement*, or a Circle of Innovation. We find that Apple appears closest among today's companies to using the Circle of Innovation as basis for a management strategy.

After introducing the Circle of Innovation and some examples of it, this conceptual paper draws on disparate literatures to analyze the circular innovation phenomenon, and proceeds to explore each of the implications numbered above. It concludes by summarizing the findings and (in a somewhat more conjectural vein) diagramming their relation to sustainable product line planning.

This explication of the Circle of Innovation will add value to the practical and theoretical discussion of innovation.

2 Linear and nonlinear innovation models

Table 1 summarizes the traditional linear models of innovation and its diffusion. (See e.g., Godin 2005.) In these models, feedback is gained only via customer satisfaction measures; imitation behavior (Rogers, 1962; Bass, 1969); or "cyclic innovation" (Van der Duin and Hermeler, 2014) and concurrent engineering. Practically speaking, we know there are even more feedback mechanisms than this: Examples include Yelp, TripAdvisor, and Twitter reviews. Yet these are just "small" feedback loops, linking some of the detailed steps in the innovation cycle of Figure 1.

Table 1. Traditional linear models of innovation

Traditional Model 1	Scientific breakthrough ↓ Technological development ↓ Product development
Traditional Model 2	Product introduction ↓ Customer adoption ↓ Growth, maturity, decline

In contrast, this paper re-introduces a high-level cycle of feedback (Figure 1) between technical innovation and social change. Its specific contributions relative to prior literature are its focus on private-sector implications, in particular for product line (as opposed to product) planning; its presentation of a new and challenging view of target marketing; and its clarification of the benefits of comprehending the entire Circle, as

opposed to the restricted arcs dealt with by most research on technology management and diffusion.

The Circle of Innovation enables connection with nonlinear models of innovation, e.g., National/Regional Innovation Systems (Lundvall, 2007), Triple Helix (Leydesdorff and Etzkowitz, 1996; Dolfsma and Leydesdorff, 2009; Ivanova and Leydesdorff, 2014), and "technological transitions" (Geels, 2005).

3 A brief history of the idea

Historians concerned with technology (e.g., Lipsey 2002) have noted that productivity-enhancing technical advances enable specialization – which is a kind of organizational change. For example, the plow increased agricultural productivity, enabling family or community members to spend time on supplementary pursuits, including commerce. They then, naturally (though this is not made explicit in the technology history literature) sought better ways to conduct commerce. Further innovations provided the sought-after improvements.

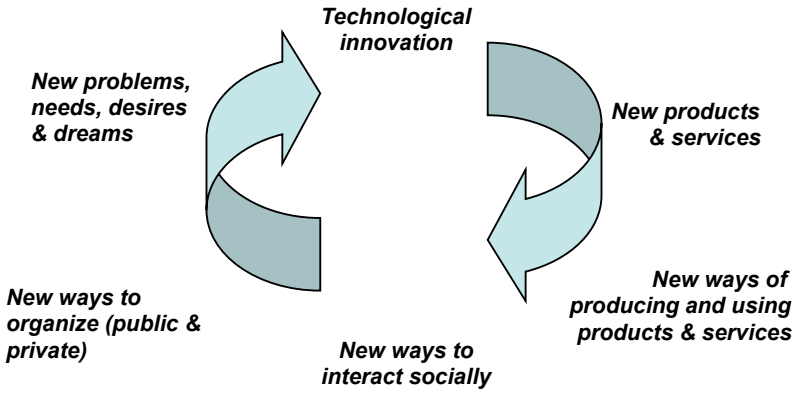

Fig. 1. Technological innovation self-reinforces via socio-economic change.

The foundational advance on the closed loop of demand and innovation is this famous but testy passage of Schumpeter's (1943):

> *…in dealing with capitalism we are dealing with an evolutionary process. It may seem strange that anyone can fail to see so obvious a fact which moreover was long ago emphasized by Karl Marx. Yet that fragmentary analysis which yields the bulk of our propositions about the functioning of modern capitalism persistently neglects it….*

> *Capitalism, then, is by nature a form or method of economic change and not only never is but never can be stationary. And this evolutionary character of the capitalist process is not merely due to the fact that economic life goes on in a social and natural environment which changes and by its change alters the data of economic action; this fact is important and these changes (wars, revolutions and so on) often condition industrial change, but they are not its prime movers. Nor is this evolutionary character due to a quasi-automatic increase in population and capital or to the vagaries of monetary systems of which exactly the same thing holds true. The fundamental impulse that sets and keeps the capitalist engine in motion comes from the new consumers' goods, the new methods of production or transportation, the new markets, the new forms of industrial organization that capitalist enterprise creates.*

The passage is rich with implication. Schumpeter considers it "obvious" that capitalism is evolutionary. Evolution (of the Darwinian sort[1]) requires feedback between organism and environment, a non-linearity. Though he criticizes economic analyses which ignore this reality, linear models have dominated in academic economics to the present day. Economists' overarching principle, say Atkinson and Lind (2013), has been "maximize efficiency." But "the goal of economic policy should not be to maximize static efficiency (the 'right' allocation of widgets), but to create inefficiency – in the sense of disruptive innovation that makes widgets worthless." Flichy (2008), noting that "economists usually exclude [technology] from their field of interest," said plainly, "The linear science-technology-use schema no longer works today." Schumpeter (1943) shared the sentiment: "A system which is efficient in the static sense at every point in time can be inferior to a system which is never efficient in this sense, because the reason for its static inefficiency can be the driver for its long-term performance."

Schumpeter draws the feedback loop between the economy and its environment, and moreover states the "fundamental impulse" driving this interaction is technological and organizational innovation.

Ironically – as he commenced his chapter by citing Marx, whose ideas gave rise to the biggest ideological rift of modern times – Schumpeter did not credit ideology as a co-driver of social change. (Doubly ironic, really, as Schumpeter was berating other economists for ignoring the obvious.) That task fell to George Kozmetsky, an American son of Russian refugees, whose writings emphasized technology and ideology as dual drivers of change (Walters 2003; Phillips 2005; Secrest, Gibson and Butler 2011). In the model of Figure 1, ideology is subsumed under "new problems, desires, and dreams."

Schumpeter's chapter provides depth and theoretical substance to the casual observation of later writers (e.g., Learner and Phillips 1993; Kelly 2016) that new technologies solve today's problems and create tomorrow's. However, Schumpeter offered no advice of specific use to managers.

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[1] Elsewhere in his chapter, Schumpeter actually apologizes for resorting to a biological analogy.

Subsequent writers attended to specific arcs of the circle of innovation. Best known is Rogers' (1962) work on the diffusion of innovation to individuals and classes of individuals. Powell et al (1996) and Strang and Soule (1998) looked at diffusion to and across organizations.

Lounsbury and Crumley (2007) continued the latter thread, adding elements of complexity and nonlinearity. The recent growth of complexity science (see e.g., Mitchell 2009) had encouraged researchers to look for and model feedback loops in the innovation process. Geels (2005), for example, pioneered a widely cited thread of "transition" studies, showing how changing technologies and public attitudes cause a shift from one "technological regime" or dominant design to another. Rothwell (1994) showed how "generations" of innovation models have shifted over the years toward greater acknowledgment of interaction loops. However, Rothwell focused his own work on "innovation activity of firms under different socioeconomic and political circumstances" (Kotsemir and Meissner, 2013) without making contact with the wider innovation environment. Indeed, Kotsemir and Meissner note Rothwell's later generations showed a shift from meso- to micro-level.

Most technology and innovation management (TIM) literature addresses only the first link in the Circle of Innovation: Laboratory invention to new product. A few works have addressed two links; for example, Markus and Robey (1988) look at how information technology produces organizational change. Kash (1989) attacked the broadest arc of the circle, documenting how innovations in many technological fields change organizations. Rycroft and Kash (1999) extended this work, delving more deeply into complexity considerations. Yet the loop remained unclosed: These authors did not go on to note that new organizational forms give rise to new needs which must be satisfied by further innovation.

Storytellers know how technological advances change social relations, creating new problems.

> *A 2008 Tony winner for Best Revival, the swinging '60s farce Boeing Boeing… follows an American lothario living in Paris who's secretly engaged to three different flight attendants. But when the new, faster Boeing jet goes into service, the ladies' schedules get jumbled, and things turn turbulent as all three of them descend on his apartment at the same time, along with an old schoolmate who can't seem to keep his pal's cover stories straight.*[2]

Concepts suggesting the Circle of Innovation are also mentioned in passing in the "Science, Technology, and Society" sub-discipline of the sociology of science (e.g. Bijker and Law, 1992; Pool, 1999). However, neither the entertainers, the economists, the science historians, nor the STS scholars seem concerned with commerce, or the implications of the Circle of Innovation for companies.

[2] http://www.theatreinsandiego.com/boeing-boeing/81/

We do not find prior TIM literature addressing the entire Circle. We surmise this is because the professional interest of most commentators is limited either to the right side or the left side of Figure 1, rather than to the entire loop. One exception, the "constructive technology assessment" thread (Schot and Rip, 1997), laid out implications for governments only, and made no prescriptions for firms.

4 Research gaps

This history shows that the cited studies illuminated important parts of Schumpeter's loop, but collectively did not fill in all the loop's segments nor turn the loop into a useful management tool. Schumpeter perceived the circular path between technological change and what he called economic change. His nonlinear formulation was ignored by subsequent generations of economists, who cleaved to linear models with computable equilibria. His work presented guidelines for managers only by broadest implication, without explication.

Market research was long considered (by marketers – see Kotler 2009) to be the feedback mechanism that made capitalism work. Because in the case of advanced technology products customers do not know what they want, Sony and Apple, among others, famously eschewed consumer surveys in favor of launching visionary products to the market, and were successful in doing so.

Although Rogers' (1962) diffusion model does include some "loops, short-cuts or interruptions" (Prager and Posthumus, 2010), the model begins with the innovator segment exhibiting "latent demand" for the innovation, with no identification of the source of this latent demand. The Circle of Innovation enables us to see its source: New needs emerging from new organizational forms, from new social interactions, and from new ways of using old products and services.[3]

Remaining gaps include:

- No consensus emerged concerning the variables that intervene between socioeconomic change and technical change.
- Connections among any intervening variables were not closely examined.
- The studies failed to see the whole circle, examining only small arcs of the circle, and/or only specific nonlinear epicycles.
- The research focus was intra- or inter-organizational only, or reflected high-level economic thinking without reference to managerial realities or to the interactions of different sectors of society.

This paper will suggest ways to fill these gaps.

[3] Rogers' extensive work with rural populations suggests that some of the latent demand he mentions could stem simply from his informants' poverty, a source different from the one we propose here. If one defines economic demand as need plus the ability to pay, even conscious need combined with inability to pay would comprise a demand that remains latent.

5 The Circle of Innovation introduced

Figure 1 shows the cycle of innovation and change, from lab to society and back again. Technological change leads to new products and services, which in turn change the way we use products and services. These new usage modalities require changes in the way we organize our firms and institutions. New ways of organizing create new needs, generating demands for still newer technological fixes, and the cycle repeats.

5.1 Elements of the Circle

Schumpeter's loop could reasonably be sliced into three arcs – Technology, Individuals, and Organizations, with innovations and their impacts flowing from T to I to O and back to T. These nomenclatures would be too abstract for the purpose of the present paper, which is to establish elements of the circle of innovation that encourage further research and compel managers' attention. An examination of the literature cited above, filtered through the authors' thirty years experience in technology management, suggests the six arcs (or elements) labeled in Figure 1.

5.2 Establishing the flow between successive elements

Some of the pairwise flows are backed by literature. Others are justified below by means of examples, including a running example of ORCID identifiers for researchers. The examples are chosen for illustrative impact, but readers will discern they are far from unique – in fact, in many cases they are driving forces.

Technological innovation ➔ *New products and service.* This link is extensively dealt with in the New Product Development and Diffusion of Innovation literatures.

New products and services ➔ *New ways of using products and services.* Little research has addressed this link, perhaps because it is so self-evident. Cloud computing changes the way we use computers to manage our work files. Inter alia, we no longer have to worry about version control on multiple devices, and have no need to tote files on USB keys. Other examples include E-commerce and home delivery drones, which change the ways we use retail services: We shop from our desktops, and return merchandise at the post office, not at the store. Mobile apps for bus schedules and taxi booking change the ways we use transportation services, allowing us to spend less time waiting for a bus or cab. The interactive web has completely changed the way we consume media.

New ways of using products and services ➔ *New ways of interacting socially and professionally.* Two words suffice to establish this link: Facebook and Linkedin. And not just in cyberspace: "Cars are becoming tantamount to computing devices that have as much to do with software as they do with chrome. This is changing how consumers and urban planners imagine transportation systems" (Tett, 2015).

New ways of interacting ➔ *New ways of organizing.* Information and communication technology (ICT) allowed more frequent and better-documented exchanges between industrial suppliers and customers. As a result, transactional relationships evolved into alliances. Companies now employ alliance managers. When technological change is slow – to look at another example – companies can organize in silos, each division comfortable in its niche. "At Apple, by contrast, Steve Jobs would not let divisions have their own P&Ls and demanded that his managers collaborate with other teams"

(Tett, 2015), allowing Apple to own the mobile music market, beating Sony which was less quick to re-organize. A third and more extreme example is Enron. Riding a wave of new financial instruments and an ideology of deregulation, the energy trading company created new organizational forms, including drastic decentralization (really a complete abdication of management control) and off-balance-sheet LLCs, before its demise and bankruptcy.

New ways of organizing ➔ *New needs and desires.* The contractor and entrepreneurial economies, tele-work, and the proliferation of types of laptop, handheld, and wearable computation/communication devices together illustrate this link of the Circle. They generated a need for secure BYOD ("bring your own device") technology enabling mobile employees and contractors to access company documents while on the go. They generated a need for co-working spaces with amenities for independent workers.

New needs and desires ➔ *Further technological innovation.* The classical technology substitution theory allows for technological substitution at the end phases of the life cycle, but assumes the substituting technology provides the same user benefits as the senescent technology. What is proposed here is that social changes generate demand for new and different benefits, of kinds that were not provided by any existing technologies. These benefits may be sought and satisfied without regard to the life cycle stage of any existing technology. Kelly (2016) refers to "the never-ending discontentment that technology brings. We are… busy making up new itches that we have to scratch, creating new desires we've never had before." Mead (2105) writes, "Birkenstocks, like an iPad, or an eight-dollar bottle of cold-pressed juice, are the covetable answer to a need that hadn't existed before they came along." More examples appear in the next section.

6 The Circle of Innovation: Further examples

Table 2 offers diverse examples of innovations making impacts that propagated around the entire Circle of Innovation. It notes, e.g., that Lyft and Uber allow drivers to rate customers online, and vice versa. Drivers use their spare time to earn by taxiing customers, and better customers get better service. Both lose time that could be devoted to unmonitored leisure (Manjoo, 2015).[4] The Table indicates some people take refuge in retro technologies in order to escape the demands of today's communication devices. Others (Dishman, 2016) use even newer tech (Basecamp, or Slack) for this purpose.

Research into better electrical batteries has been continual over the decades, but smartphones and electric vehicles have elevated the urgency of further advances in this field. The autonomous vehicle problem is self-explanatory. We will expand on the statin drug situation in a following section, after we highlight additional examples of the Circle of Innovation.

[4] By the same token, consumers' growing awareness that their every move is monitored and evaluated signals the death of recreational shopping.

Table 2. Circle of Innovation, short examples

Innovator	Innovation	Social / Organizational change	New problems/demands	Newer or prospective scientific/technological solutions
Uber, Lyft	Mobile web ride service	Customers with high ratings get better service.	Desire to rest or consume without worrying about being rated or scored.	Business models in which customers are not rated. Consumers return to analog tech disconnected from social media (Sarpong et al 2016).
Astra-Zeneca, Pfizer, Merck	Statin drugs for serum cholesterol control	Widely used; fewer heart-attack deaths	Side effects include obesity, cancer, diabetes.	Alternative theories of functions and effects of cholesterol in the body.
Google, others	Self-driving car	Unemployed drivers; shuttered motels	Re-design welfare state &/or job retraining.	Online/mobile education and vocational training.
Apple	Smartphone	Access to information 24/7. BYOD. Tele-work.	Short battery life. Problems of social disengagement.	Apple Watch. Research into better batteries.

6.1 Individual researcher i.d.'s (ORCID)

Advances in information technology facilitated international collaborative virtual research teams and wider access to scientific journals. This, plus the general globalization that is also enabled by new IT, raises research capacity in developing nations. In turn, many more researchers from many more countries produce work publishable in top international journals. Distinguishing among researchers having similar surnames (or names inconsistently transliterated into Western alphabets), never much of a problem heretofore, became an issue and an entrepreneurial opportunity. The universal researcher identifier was invented and promulgated. Publishing companies' author and reviewer databases now need to be modified to carry the extra data field "universal author identifier." The earlier cozy research communities where (as in *Cheers*) everybody knows your name, morphs into a more impersonal but perhaps more productive enterprise.

In this example, summarized in Table 3, technical change led to new ways to use technology, which led to new organizational forms. These in turn created demand for new technological solutions. These newer solutions, once provided, led to still newer usage modalities and a new round of social change in research communities. The wheel takes another turn.

Table 3. Example: Individual researcher i.d.'s and the Circle of Innovation

Each event …	… turns the wheel.
Advances in ICT	Technological innovation
E-journals; Collaboration platforms	New products/services
More submissions from more countries to premier journals	New ways to use products & services
More international co-authorships. More authors with similar surnames.	New social/professional interactions
Online conferences; Global research teams; Bigger research communities.	New ways to organize
Need to uniquely identify researchers with similar names	New needs & problems
ORCID and other identifier systems	Technological innovation; new product/service
Add fields to existing databases, to accommodate researcher i.d. number	New ways to organize

6.2 "Your Phone Is Ruining Your Life: The Real Reason Apple Developed the iWatch"

Apple's iPad and iPhone changed the way we work. Now a revolutionary wristwatch may extend Apple's dominant product line. Apple understands most iPhone users are bothered by the buzz of the smartphone and the constant checking of messages. The phones have become invasive. Technology distracts us from the things we should pay the most attention to—family or friends, or something meaningful in our lives. To filter out useless messages and save the important ones, Apple introduced functions in the iWatch to make a different and better quality of life (Pierce, 2015; see also Maxcer, 2015).

Pierce asks, "Can technology fix a socio-psychological problem it created with another piece of technology?" The iWatch uses your level of interest in the information, as demonstrated by your reaction to it, as a cue for the iWatch to prioritize, to get your face out of your tech. Apple introduced a feature called Short Look: An induced pulse on the wrist signals an incoming text message. The duration of the screen display depends on how long you cock your wrist and look at the watch.

Time will tell whether the iWatch truly reflects Circle of Innovation thinking. So far, bloggers are offering preliminary evidence that it does.[5] CEO Tim Cook has said Apple puts a "maniacal" focus on making "not good products, or a lot of products, but the absolute best products in the world."[6] It appears that anticipating possible psychological, social, and organizational consequences of a product is part of what can place it, and its successor products, among the "absolute best products in the world." We can expect to see more of this from Apple, and to see other companies follow suit.[7]

[5] E.g., the Oatmeal blog, http://theoatmeal.com/blog/apple_watch
[6] http://www.thelowdownblog.com/2015/06/should-apple-get-rid-of-mac.html#more
[7] The examples up to this footnote marker are provided by the International Association for Impact Assessment, http://iaia.org/iaiawiki/techassess.ashx.

7 The Circle of Innovation: Implications

The Circle of Innovation is a simple idea. But it…

1. Introduces a new classification of innovations.
2. Gives a new view of target marketing.
3. Has implications for sustainable product line planning.
4. Should change how we report the prospective impact of innovation.

7.1 Classifying innovations and defining innovation

The Circle of Innovation suggests a new classification of innovations. Traditionally we classify innovations as Continuous, Discontinuous, or Radical. Now we must add a classifier: Innovations that provide old benefits in a cheaper, more efficient, or more enjoyable way, versus those providing new, unprecedented benefits.

Lab-driven innovations (if we exclude those of a "solution looking for a problem" nature) are meant to improve an existing situation. However, the Circle of Innovation shows that such an innovation can, via social and organizational change, lead to new and possibly unprecedented problems. The latter will be addressed by a second kind of innovation, i.e., one that provides benefits that had never been sought before.

Following ideas of Ijiri and Simon (Ijiri 1990), Philips (2001, 2011) defined innovation in terms of the experience curve: "Innovation is a non-differentiable point in an experience curve." This remains vacuously true for innovations that deliver new, unprecedented benefits, as the start of production represents the beginning point of the learning curve.

7.2 The Circle of Innovation and target marketing

Conventional segmentation targets customers' demographic or psychographic characteristics. Echoing Ted Levitt's 1983 dictum, "Customers don't need quarter-inch drills, they need quarter-inch holes," Clayton Christensen (of "disruptive innovation" fame) said in 2003, target products to the customers' "circumstances," or usage scenarios, not to their demographics.

The Circle of Innovation goes beyond Levitt and Christensen; it says, *The product will change the circumstances*. Because innovative products change organizations and create new needs, marketers face an analog of quantum uncertainty: When the product is launched at the target market, the target moves.

As a result, companies must plan products that are robust to changed circumstances. They must anticipate the possible new circumstances and plan follow-on products to fit them. Prior literature hints at this, but does not follow the reasoning far enough to reach the above conclusion. Examples include the ideas of sociological expectations (Berkhout, 2006), and empathic design (Leonard and Rayport, 1997). The idea of scenario-based design (Bødker, 2000 and Carroll, 2000) comes closest, and indeed scenario exercises may be the most fruitful way to plan product lines in the framework of the Circle of Innovation.

Gover (2015) offers an example of how the product changes the circumstances – though in this example the change was unanticipated. Again, ICT was the driver,

enabling the creation of MOOCs. MOOCs were intended to allow any university to economize in offering courses. In an unexpected turn, MOOCs created the media superstar professor, attracting students to tele-study at a progressively smaller number of non-local universities, and then the creation of new training organizations like Coursera and Khan Academy, and even in-house streaming corporate training programs. These things happened in parallel with (and in response to) a growing need for coders and engineers, and rising costs of traditional university education.

Gover remarks that the "linear model [of innovation] is still used in the USA R&D community." Because the product changes the circumstances, it is clear that business people as well as researchers will have to begin thinking in nonlinear fashion.

7.3 Assessing technology and planning sustainable product lines

"Industrial TA" (Daim et al 2011) is Technology Assessment performed by companies. Companies appear to direct most of their assessment activities to the capabilities they aim to procure, rather than to those they aim to sell. A further implication of the Circle of Innovation is that firms should assess the technologies they intend to release to the market – not just the technologies they wish to procure – and that they should do this for potential profit. By anticipating the new needs that today's innovation will generate, the innovative company may jump-start the development of further products to meet those needs, bringing the further products to market before competitors can do so. This results in sustainable product lines.

This will not be easy. Side-effects and created problems/needs are likely to be both delayed and systemic, even as firms rush to meet their market windows. The shrinking life span of corporations (Daepp et al, 2015, report the average company lifespan has dropped from 67 years in the 1920s to 15 years today) exacerbates "short-termism" and would seem to make long-baseline technology assessments nearly impossible.

Porter et al (1991) wrote that home appliance maker Whirlpool Corporation succeeded in this in one project and failed in another. Whirlpool tracked other companies' work on permanent-press fabrics in order to design permanent press cycles for washers and dryers, "beating their competition to market by about a year [and achieving a] substantial gain in market share." In contrast, "Whirlpool introduced the trash compactor without adequate impact assessment." Compacted trash proved not easily biodegradable in landfills, and was perceived to be a "hazard to municipal incinerators." The company introduced new models that mitigated the problems, but these were not very successful in the marketplace.

The Circle of Innovation implies a product planning process similar to that urged by the Responsible Innovation and Sustainable Innovation movements. However, the latter tend to focus on one product at a time. (See e.g., Sutcliffe, 2011) The future-oriented technology assessment demanded by the Circle of Innovation implies the planning of product lines.

Figure 2 assembles the implications of the Circle of Innovation into a rough diagrammatic outline for product line planning in an environmentally delicate, highly regulated, and litigious world. The Figure is intentionally simplistic, for the sake of its rhetorical point. Nonetheless, while ten years ago such a diagram would be dismissed as hopelessly idealistic, it contains no ideas that today's managers cannot easily accept.

In the Figure, technology assessment is commenced before product launch, with foreseeable social/organizational changes, and their consequent new demands, anticipated to the extent possible. Positive and negative consequences are honestly noted, and classified as to whether they are within the firm's control, and as to whether they affect only buyer and seller or are systemic, creating externalities.

The firm examines whether tweaks to the product spec, or other measures the company may take, will change these consequences for the better. Failing that, are there follow-on products that can profitably ameliorate negative effects of the present product? (Our earlier example showed that Apple is doing this, though they commenced doing so long after the launch of the iPhone.)

The alternative to killing a potentially profitable product (due to excessive negative side-effects) is to find a niche market for which the side-effects are minimally important. Statin drugs, for example, while evidently not a good fit for the mass market, may benefit people who are known to be at high risk for heart disease and at low risk for (or are too elderly to worry about the future onset of) cancer or diabetes.

Though marketers would not recommend it, every firm's motto could be "Solving today's problems, and creating tomorrow's!" For this reason, innovators must consider and decide whether the problem they're solving is worse than the problems they're creating. Needless to say, ethical companies will not deliberately create problems simply in order to market solutions to them.

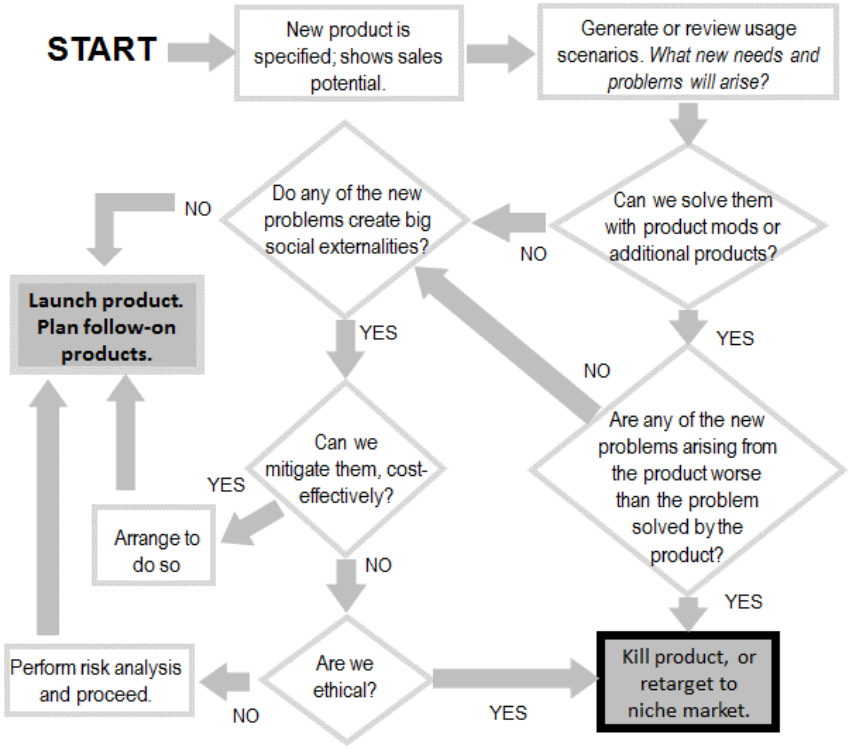

Fig. 2. Guide for planning sustainable innovative products

7.4 The Circle of Innovation implies companies should ask and answer different questions about their prospective products.

It should now be clear that the Circle of Innovation is driven by "side-effects." New products are aimed at solving discrete problems, usually with little regard for the indirect effects which change usage modalities, social interactions, and organizational structures.

The short-term effect of an innovation (treatment) is usually measured by a test like that suggested by Table 4, with a null hypothesis H_o: a=b, and a reported effect size a-b. A medical example will illustrate this section's point.

Table 4. The usual statistical between-group comparison

	Effect	
	Improvement	No improvement
Treatment	a%	(100-a)%
Control	b%	(100-b)%

The Circle of Innovation suggests that unforeseen effects, both positive and negative, are to be expected as a result of the innovation. This implies movement to a test like that shown in Table 5. In such a test, a+c is not necessarily equal to 100%. Two hypotheses must be tested, H_{o1}: a=b; and H_{o2}: c=0. Reported statistics should include the decision and significance on the hypotheses; the treatment effect size a-b; the baseline incidence of the problem in the population, which is b; and c, the incidence of actionable side-effects or unforeseen new problems. Even Table 5 fails to capture unforeseen positive effects; doing so is possible in principle but is omitted here for simplicity's sake.

Table 5. Suggested statistical analysis of innovations

	Effect	
	Marked improvement with minimal negative side-effects	Little improvement, non-trivial negative side-effects
Treatment	a%	c%
Control	b%	0%

A recent paper by Diamond and Ravnskov (2015) provides an important example, in the context of clinical trials of a new class of drugs, specifically statin drugs. Statins are very widely prescribed to achieve a reduction in serum cholesterol levels (*Science2.0,* 2015), but they have "failed to substantially improve cardiovascular outcomes." However, manufacturers of statins have used what Diamond and Ravnskov refer to as "statistical deception" to make inflated claims about their effectiveness. It appears that

statins actually produce only small beneficial effects on cardiovascular outcomes, and their adverse effects, including cancer and obesity, are far more substantial than is generally known. This conclusion does not stem from a possible fluke in a single trial. It appears repeatedly across multiple large-scale trials, which are recapitulated in Diamond and Ravnskov (2015).

The kind of reporting recommended in this section enhances not only corporate transparency, but also the ability of forward-thinking managers to adjust target markets and devise follow-on products to minimize the negative impact of the current product's indirect effects.

8 Summary

Kelly (2016) maintains continuous innovation happens because humans are hard-wired for discontent. We will want something more, he says, regardless of our organizational environment. If true, it does not crowd out the idea presented above, that demand for further innovation is an imperative consequence of organizational change. Kelly does add that we could not satisfy our discontent had our technological capability not been augmented by our development of scientific method. Kelly adds, "The problems of today were caused by yesterday's technological successes, and the technological solutions to today's problems will cause the problems of tomorrow."

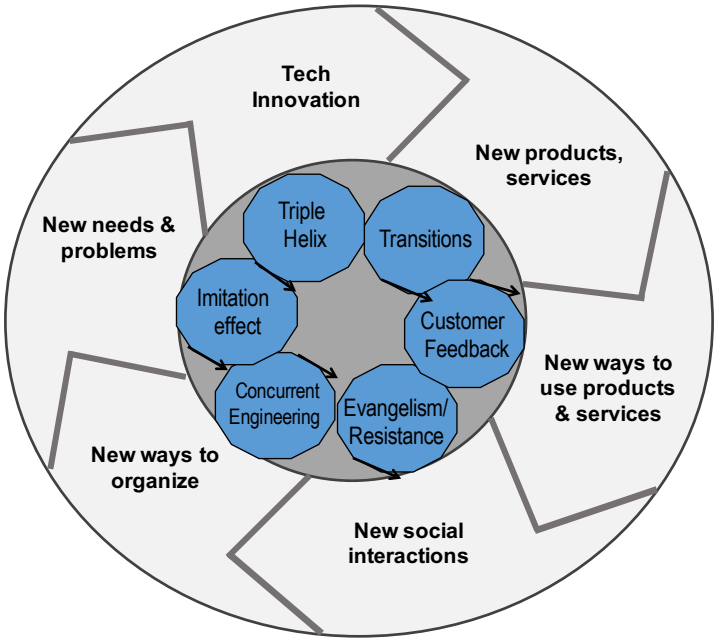

Fig. 3. Nonlinear innovation models portrayed as epicycles within the Circle of Innovation

The Circle of Innovation highlights how innovations change society and lead to demand for further innovations. It suggests a distinction between innovations that

better deliver an existing benefit, and those that deliver a new benefit – and makes it clearer that these are two distinct profit opportunities. As Solis (2014) remarked, "If consumer behavior is evolving as a result of technology, businesses either compete to get ahead of it, they perpetually react to it, or they belittle it." Better to get ahead of it, immersing the firm in awareness of changing circumstances and moving targets.

The Circle of Innovation provides a feedback mechanism that enables co-analysis with other nonlinear effects such as "triple helix" and "technology transitions." (Philips, 2014, characterized the triple helix as an epicycle in the grander cycle of technological, psychological, and institutional change that is the Circle of Innovation.) Figure 3 portrays this idea conceptually. The Circle of Innovation's cyclical imperative explains why once a society boards the innovation wagon, it can be exceeding difficult to get off, barring a severe economic crisis. There is much about the Circle of Innovation that appears self-perpetuating.

It closes a loop, as it were, in Rogers' (1962) theory, by revealing where "latent demand" comes from.

It gives product developers and innovation researchers a conceptual tool for reconciling the zero-one, "go-no-go" linear stage-gate procedure still favored by management, with the nonlinear "yes, but" realities of e.g., the open innovation movement, or market feedback. Figure 3 illustrates a "yes, but" way of thinking.

The Circle of Innovation provides a rationale for sustainable product line planning for the firm, and for a change in the ways we measure the impact of an innovation. These product lines will be based on anticipation (maybe via scenario exercises) of possible ways in which each product will change the circumstances of its own use. That is, the product will not only be used in new psychological, social, and organizational contexts; rather the product will cause change in these contexts. Product line planning will be resilient to this nonlinear effect.

It is difficult to think of a radical innovation – or even a "dynamically continuous" (Goldberg 1997) innovation in that middle ground between incremental and radical innovation, which does not drive the Circle of Innovation. Incremental or trivial innovations and novelties that do not change the way people do things – like eight-dollar bottles of cold-pressed juice – will not propagate through the Circle.

A limitation of the scheme presented here is that the role of ideology in driving the Circle, mentioned in Section 4, is not well-developed in this paper, remaining as grist for further research. Future research should also better establish the six elements of the Circle (or argue about their number and names) and their connections to each other. Formal links among the non-linear models of Figure 3 also remain to be established.

It is hoped that the Circle of Innovation will add value to the theoretical discussion as well as guidance for private sector action.

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The impact of timing in innovation management

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Abstract. An innovative idea launched in the wrong place at the wrong time may not deliver the outcomes hoped for. Based on 55 empirical studies, Bowen, Rostami and Steel (2010) suggest 'timing is everything' if innovation is to enhance organisational performance, but there is also a need to understand contextual factors. The paper presents a theoretical model representing the interaction of idea, place, resources and temporal factors that draws on the Ancient Greek notion of Kairos linking events in time and timely action. Longitudinal studies of four intermediary organisations intended to enhance SME innovation capabilities are compared at different stages in their evolution. The cases highlight the context-sensitive nature of innovation: an idea that has been successfully implemented in one place at one time may not be successful at another place or another time.

Keywords. Innovation; creativity; background rhythms; place; mind-set; idea; resources; infrastructure; life-cycle; timing; Kairos.

1 Introduction

Is timing important in innovation management? The volume of related literature suggests the answer is yes, but in a number of different contexts. A Google Scholar search using the term timing indicated 3.5m hits, some being concerned with timing in technological and biological process. Combining timing and business indicated about 1.9m hits. The timing and innovation combination indicated 670,000 hits. The implication here is that timing is important in innovation, but even more so in relation to other business activities. The most cited articles covered matters of research, development and diffusion (Reinganum, 1989), economics (Freeman, 1982), technology adoption (Farzin, Huisman, and Kort, 1998) and search timing (Katila and Chen, 2008). Combining timing, business and life-cycle yielded 125,000 results, with the most frequently cited articles covering matters of product life cycle (Day, 1981), entry, exit and growth over the product life cycle (Klepper, 1996), consumption over the life-cycle (Attanasio and Browning, 1993), and organisation life cycle stage influences (Dodge and Fullerton, 1994). A search of articles published in the journal Technology Forecasting and Social Change that is concerned with background rhythms yielded 580 hits, with the most frequently cited articles being concerned with the interaction between successive generations of technology (Mahajan and Muller, 1996), technology adoption across countries (Dekimpe, Parker and Sarvary, 2000) and socio-technical interactions (Verbong and Geels, 2010). The implication is that we need to

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consider a multiplicity of contextual factors when researching matters of timing.

In the context of social change, articles in the popular press cite French author and politician Victor Hugo's observation that "you can resist an invading army; you cannot resist an idea whose time has come" (e.g. Economist, 2009). Scientists may refer to an idea whose time has come when a new technology is mature enough to match an application opportunity (e.g. Yang and Giannakis (2004) - ultra-wideband communications). Others make reference to time windows where there is a transient opportunity to adopt a particular technology or introduce a social change (e.g. Perez and Soete, 1988; Kemp, 2001). Oinas and Malecki (2002) suggest that the application of a technology may emerge in different ways in different places, resulting in differing regional innovation eco-systems. The notion of emergence associated with place, technology and timing is implied here.

Bowen, Rostami and Steel (2010) suggest that in managing innovation "timing is everything". Serial entrepreneur Bill Goss (Goss, 2015), CEO of Idealab explored factors influencing the success or failure of some 100 start-up companies promoting an innovative idea, and found that issues of timing - being in the right place at the right time had a greater influence on success than the requisite great idea/great team combination. Benedetto (1999) made similar observations, considering company, competitor and customer influences. Welter (2011) noted that business conditions influencing an entrepreneur may change dramatically from one time and place to another. Watts and Porter (1997: 26) suggest: "Successful innovation relies on many variables, including the technology's characteristics, the fit between the innovating firm and the technology, familiarity of the firm with the market and associated infrastructure, market forces, the economic climate and resource commitments, other socioeconomic factors, and institutional actions or interactions". The notion of interaction in a complex socio-economic system is implied here.

What we take from the foregoing is that getting the timing right in implementing a particular idea is contingent on a number of contextual factors such as accessible resources and 'place' characteristics; but how these factors work together may not always be considered. We suggest that whilst there are numerous single-factor studies (e.g. establishing innovative places, establishing innovation infrastructure) and two-factor studies (e.g. time and technology interaction) there are few multi- factor studies considering the interaction of place, idea, resources and time, and this is our focus in this paper

Ancona, Goodman et al (2001) suggested the use of time as a research lens in studying organisational dynamics, and we adopt this approach. In the paper we are exploring the research question: *What innovation contextual factors condition an ability to explore and exploit windows of opportunity*? We present and utilise the main contribution of the paper - a theoretical multi-factor interaction framework drawing on an Ancient Greek idea that is developed in the next section.

Our focus is on managing planned or emergent windows of opportunity to progress an innovation through development and deployment stages and beyond. A literature review of temporal factors impacting innovation is presented, and a life-cycle mapping framework is presented. We apply our theoretical frameworks in an extended analysis of four longitudinal case studies of successful and partially successful innovation intermediary organisations. Findings from the cases and observations about our

framework are subsequently compared with the work of others in a discussion of the impact of timing in innovation management.

2 Drawing on an Ancient Greek concept of time

The Ancient Greeks described two notions of time. Chronos – linear, divisible time that we use as a management tool for coordinating activities. We focus on precise time intervals, but the concept has its foundation in cyclical astronomical events. Days are associated with the spinning of the earth and years with the journey of the earth around the sun. The other Ancient Greek notion – **Kairos, is about events in time stimulating moments of enlightenment and timely action**. It is less frequently used as a management tool, but we explore its utility here.

In a book on the Future of Innovation (von Stamp and Trifilova, 2009), a Nokia-Siemens network manager observed that an innovation may emerge too early or too late to meet a need/want and refers to the notion of Kairos – an opportune moment in time where action leads to impact when the conditions are right. One example of a kairotic moment given in the general literature is injecting a game-changing thought into a debate at just the right time. Another is the moment a hunter releases an arrow having positioned himself to be able to access his prey and having the right tools and skills to use them (e.g. Krause, 1996). Coessens (2009) refers to kairos as framing matters of timing in an artistic performance linked to the background dynamic environment. But if the orator has not framed the idea to inject into the debate, or the performer the does not have the requisite skill, or the hunter does not have the appropriate equipment (resources) there is no impact from simply being in the right place at the right time.

In considering some matters of context, Dunphy et al (1996) describe an "innovation funnel" where the conjunction of several factors supports innovation: macro factors (technological pre-requisites and sociocultural tendencies), regional factors (material, human, and institutional infrastructures), and micro factors (the nature of the particular industry and firm, management attitudes and standards supporting innovation diffusion). Czarniawska (2004) argues that the interplay of kairotic and chronological timing needs to be studied in organizing. She observed that (p779) 'organisation studies' usually denotes research focused on one or more of the following study objects: places (organisations), people (individuals or groups), issues, and events, but she suggests their interaction should be considered.

The concept presented in this paper draws together a conjunction of place, idea, resources and timing. We contend that a wider understanding of Kairos as a concept can help managers and businesses better comprehend the processes involved in decision-making within the context of innovation management (e.g. Törnroos and Hedaa, 2005).

It is suggested here that the conjunction of the following four primary elements (and related sub-elements) frame kairotic moments:

1. Taking a philosophical view, we observe that consideration of ***place*** in the context of innovation management includes firstly marketplace and where an innovation might best be developed; secondly within an enterprise, the

establishment of physical or virtual interaction spaces; and thirdly intellectual space - matters of organizational culture that condition personal attitudes to innovation and provides reflective space (Ba - Nonaka and Konno, 1998). The culture of particular geographical places can also influence uptake of an innovation. In summary, sub-elements of place are:

a. Marketplace (external to the firm, includes geographical considerations)
b. Operational space (internal to the firm, but may include collaborative ventures)
c. Mind-set (the personal dimension of space and culture, recognising that innovation is a creative social activity)

2. It has been recognised that the nature of an ***idea*** and has a significant influence on its development and deployment pathways (e.g. Utterback and Abernathy, 1975). Does it involve incremental change or radical change (relative novelty)? Is it well developed or is it still a concept (maturity)? Is the idea technology-driven or market/community driven (drivers)? Is the focus on product, process, or organisational innovation (domain)? At different stages there is interplay between idea generation and creative problem-solving practice to either fill a gap or resolve an emergent issue. In summary, the dynamics related to idea that matter are:
   a. Idea attributes (radical/incremental; technological or organisational)
   b. Idea generation process, e.g. from research (a pro-active activity)
   c. Idea to solve a problem / issue (a reactive activity)
3. Physical infrastructure is needed to develop, test and deploy an innovation, and we include accessible technology in this ***resource*** category, building on the 'infratechnologies' concept of Verspagen and De Loo (1999). Financial capital and infrastructure are needed to fund development and deployment. Skilled people, social capital and knowledge capital appropriate to different stages of innovation evolution are needed. In summary, three kinds of resources are needed:
   a. Financial resources
   b. Infrastructure (physical and technological)
   c. Knowledge assets
4. Temporal aspects are framed in terms of background rhythms/trends, life-cycle events and time windows, as elaborated in the following section of the paper.

A model illustrating the interaction of these four aspects of context is shown in *Figure 1*. A number of possible interactions are indicated. We have identified studies of some interaction pathways from the literature: exploring the interactions between geographical place, organization and culture (e.g. Nazari et al, 2011), exploring stakeholder interactions (e.g. Solaimani et al, 2013), locating sources of innovation, supplier - innovation user interactions (e.g. DeBresson et al, 1994), considering science and technology actor knowledge interactions (e.g. Verbeek et al, 2002). Whilst there is a substantial literature relating to creativity, markets, mind-set and requisite resources, we see there is a research gap in considering the impact of temporal factors on innovation pathways. Temporal factors are discussed in the following section.

Two hypotheses are suggested from the previous discussion of in relation to our research question (What innovation contextual factors condition an ability to explore

and exploit windows of opportunity):

- H1 - Viewing past or anticipated influential events in time as windows of opportunity can provide insights into innovation evolutionary pathways
- H2 - Four primary factors frame event context that shapes the most appropriate course of action: place, idea, resources and time, and there are multiple interactions between these elements.

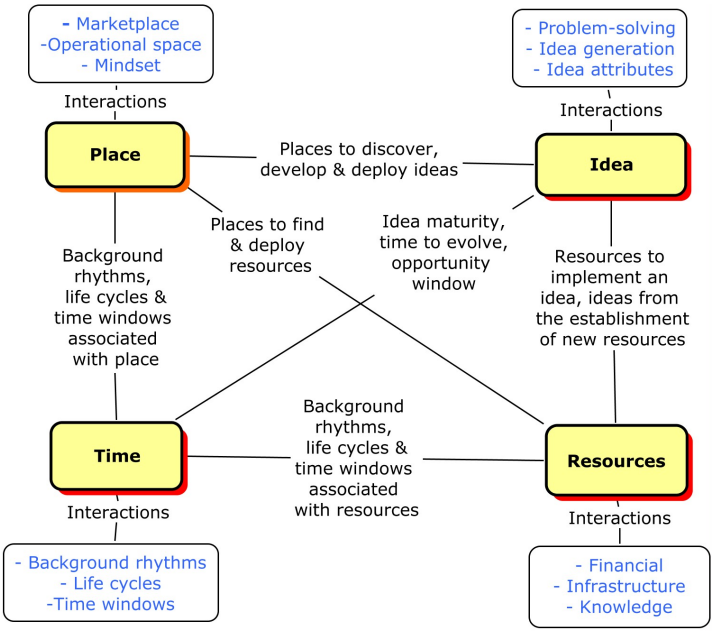

Fig. 1. Contextual factors influencing timely decision-making drawing on the Ancient Greek notion of kairos

3 Temporal factor observations from the literature

Cheng and Van de Ven (1996:598) studied events in time and observed, "prior research eliminated the plausible explanation that the onset of innovation development can be modelled as an orderly periodic process of adaptive trial-and-error learning." They noted that action-outcome patterns differed within two temporal periods, one associated with exploring the idea where external events could have a significant impact, and the other associated with market entry and exploitation of the innovation where matters of scale-up and competition influenced outcomes. Their analysis of the time-series patterns of events in the innovation journey of two biomedical firms over about ten years supported the proposition that the journey may start in chaos but finish in order, whilst context events seemed to appear randomly throughout the journey. The latter events may positively or negatively influence progress. Kairotic moments (positive impact) and critical junctures (negative impact) may be associated with transitions between stages, be associated with what is learned within a stage, or with some

internal/external context factor. At each point, a business decision may be made to proceed as broadly planned but be consistent with changed circumstances, to abandon the innovation, to put it on hold, or to sell off whatever has been developed to that point.

Ancona, Okhuysen, and Perlow (2001) observed that research on time in organizations spanned disciplines and introduced a wide range of concepts. They also discussed the merits of assembling multiple viewpoints. Their study identified three categories of variable: conceptions of time, mapping activities to time, and actors relating to time. In this paper, we start by considering multiple viewpoints of time in an innovation management context, and then consider activities and actors in our case studies. European researchers Andersson and Mattsson (2010) observe that matters of time are often raised in discussions with business managers. Their study of academic marketing-related literature identified a number of papers under different temporal themes - first mover advantage, product life cycle, time to market and strategic windows. Our review of the innovation literature regarding temporal factors noted a range of focus areas, as shown in Table 1.

In our theoretical framework, we cluster these factors using three conceptions of time, each representing different patterns:

1. Time windows - points in time
2. Life cycles - inter-related blocks of time
3. Background rhythms - on-going patterns in time

We now briefly discuss each in turn.

2.1 Time windows

A *window of opportunity* or a critical juncture may emerge from a conjunction of life-cycle and background rhythm patterns. In considering an intervention exploiting a window of opportunity or confronting a critical juncture, the influence of adjacent background patterns needs to be understood in taking a decision to act (e.g. Soifer, 2012; Wenger, Hawkins and Seifer, 2012). Examples of adjacent patterns are market trends and technology trends.

2.2 Life cycles

Taking an innovation management perspective, Westerman et al (2006) point out that different kinds of organisation design are needed to effectively manage different stages of the innovation *life- cycle*. Others point out that a firm's strategic orientation (Nadkarn and Narayanan, 2007) and pace of new product development (Carillo, 2005) depend on the clockspeed of the industry it is embedded in. At some point the innovation may be superseded, but the capability developed to support it may be re-used. *Life cycle stages* have been characterised in different ways by different researchers. Bessant and Tidd (2007) discuss three core innovation activities: generating ideas, evaluating them and implementing them. Others (e.g. Ulrich, 2002) describe implementation activities in more detail, including incubation, investment, integration and improvement stages. Buisson and Silberzahn, (2010) suggest that successful innovation facilitates market domination. Life cycle stages have also been characterized in terms of project team establishment and enterprise evolution (e.g. Phelps, Adams and Bessant, 2007). An enterprise architecture standard (GERAM,

2000) represents such stages as: identification/concept, requirements, design, implementation, operation, decommissioning. Some innovative ideas may fail at transition points between stages, or there may be handovers to others to further progress the idea (Beckett and Hyland, 2011). Reflecting on the foregoing, we offer an extended representation of generic innovation life-cycle events in Table 2.

Table 1. Some observations about time and timing from the literature

Focus Area	Innovation Management Context
Strategic timing	- First mover advantage (e.g. Suarez and Lanxolla, 2007) - Time to market (e.g. Cohen et al, 1996) - Strategy as active waiting, sensing relatively rare large-scale opportunities and being positioned to rapidly grow to accommodate them (Sull, 2005)
Point in time	- A point in time where there is a transient opportunity to adopt a particular technology or introduce a social change (e.g. Perez and Soete, 1988; Kemp, 2001) - Some longitudinal studies of the evolution of innovations refer to critical junctures along the way: points in time where significant change was needed (e.g. Vohara, Wright and Lockett, 2004). - Stage-gates managing transition points (e.g. Cooper, 2008) - Tipping points in enterprise development (Bessant, Phelps and Adams, 2005; Phelps, Adams and Bessant, 2007)
Time windows	- Time windows that are strategically important to an enterprise (e.g. Erdmann, 2005) - Policy interventions and time windows (e.g. Nill and Kemp, 2009)
Time as a resource	- Planning for some 'organizational slack' can facilitate innovation (Lawson, 2001), - Giving employees time to discover, experiment and learn (Edmonson, 2009) - Time as an element of absorptive capacity in small firms (Beckett, 2008)
Background rhythms	- Long-term trends (e.g. Rinne, 2004) - Long wave hypothesis of innovation (Graham and Senge, 1980) - In a socio-technical context, transitional events may be preceded by a period of gradual change, and lead to the beginning of a new trajectory (e.g. Sartorius and Zundel, 2005). - Market trends and cyclic patterns (e.g. Johne, 1999)
Life cycles	- Product / Market life-cycles (e.g. Allanson and Montagna, 2005) - Technology life-cycles (e.g. Haupt et al, 2007) - Industry clockspeed (e.g. Carillo, 2005, Nadkarni and Narayanan, 2007)

Focus Area	Innovation Management Context
Maturity	- Technological and idea maturity (e.g. Makri and Lane, 2007) - Absorptive capacity - time to absorb (e.g. Cohen and Levinthal, 1990)
Time lags	- Performance attributed to open innovation (e.g. Fry et al 2013) - Long term effect of short term decisions (e.g. Chen and Van de Ven, 1996)

2.3 Background Rhythms

Background rhythms may be continuous (e.g. long-term demographic trends), cyclic (e.g. seasonal) or discontinuous (e.g. interrupted by civil or economic events). There are also background rhythms within an enterprise, e.g. associated with fiscal year events.

Table 2. Characteristic innovation project / innovative enterprise lifecycle events.

Transitional / Life- cycle stage	Activities and focus
T_0 - motivation	Starting the innovation process. "Selling Innovation" as a developmental strategy within or outside the innovators world. This is an entry point.
Discovery	Searching for novel ideas or searching for solutions to problems, creatively working in the imagination. Here the *idea* is dominant.
T_1 - promotion	Moving from searching to selecting. Selling the "Idea" within or outside the innovators world. This is an exit point for some innovators who licence or sell their idea
Development	Selecting options for evaluation and experimenting with / refining an idea. Here creatively working the *resources* is a dominant theme.
T_2 - engagement	Moving from selecting to implementing – Selling the" Product" within or outside the creators world. This is an exit point for some innovators and entrepreneurs, licensing a product or selling a start-up business
Deployment	Implementing an idea, launching it into its application domain. Here the market/application *place* is a dominant theme, creatively considering virtual, physical and geographical possibilities.
T_3 - expansion	Moving from implementing to maximising value – Selling the "Value Proposition". This is an exit point for some entrepreneurs, selling an established business
Domination (upscaling)	Capturing benefits from the impact of an innovation in a competitive environment requires on-going innovation. This is where the *timing* is a dominant theme, creatively blending matters of infrastructure maturity, market readiness supporting a clear value proposition, active waiting and fast deployment.
T_4 – moving on	This is the norm for serial entrepreneurs or project-based enterprises, which focus on ideas for identifying substitutes or making the original idea and associated capabilities a foundation component of a new initiative.

Transitional / Life- cycle stage	Activities and focus
Displacement	Capitalise on established assets and re-deploy resources. Examples are the re-use of existing components in a new model car, and the successive displacement of telecommunications technologies that may still build on established infrastructure (e.g. Mahajan and Muller, 1996).

3 The research approach

The research question we are exploring in this paper is what innovation contextual factors condition an ability to explore and exploit windows of opportunity? Two suggested hypotheses are:

- H1: Viewing past or anticipated influential events in time as windows of opportunity can provide insights into innovation evolutionary pathways, and
- H2: that conjunctions of place, idea, resources and temporal factors associated with each event condition the nature of the response (figure 1).

Qualitative research was conducted using a multiple longitudinal case study methodology where the unit of analysis was an organisation, and where two primary elements of context (place and idea) remained constant. According to Yin (2014), a case study approach is appropriate where we seek to explain some present circumstance and require rich data sets. We have studied the evolution of a general idea adopted by four innovation intermediary organisations (e.g. Howells, 2006) - building innovation capability in their client firms. Each firm operated in a particular region (fixed place dimension with background data readily available), and organized different kinds of knowledge diffusion events. This allows us to gain insights into regional and enterprise influence factors. We chose a mix of more and less successful organisations, considering the availability of resources and the impact of positive and negative events in time. Cross case analysis was conducted using Eisenhardt's (1989:540) tactic of selecting a particular dimension, and considering similarities and differences between cases in the context of that dimension. The dimension we have chosen is the innovation life-cycle, which represents both temporal and innovation management viewpoints. Table 3 describes data collection arrangements for each case.

Table 3. Case study data collection arrangements

Case	Data Sources
1. WSITC - Western Sydney IT cluster	The WSITC website was used to collect some data on the enterprise history and membership. Personal observations were made and some informal member viewpoints noted from attendance at twelve network events over a four-year period. Personal interviews seeking information on pre-cursor and current activities were held with two founding advisory committee members and two state government employees who had facilitated cluster activities for many years. In 2008, a review of benefits provided by the cluster was undertaken, involving two focus group meetings (one government group, one

	client firm group). Ten client firms at different stages of evolution were interviewed by telephone (typical duration 30 minutes) to identify what benefits they had obtained over time from what activities. Subsequently, four Advisory Board meetings were attended.
2. Austool - technology diffusion centre	Austool provided access to Board meeting notes covering its first four years of operation, and subsequently to its annual reports. Interviews were held with three founding Board Members to identify pre-curser activities. Access was provided to documents relating to four multi-year projects undertaken by Austool. Personal observations were made and some informal member viewpoints noted from attendance at ten network events over a five-year period. Informal one-hour interviews concerning achievements and issues were held with the CEO and at least one employee at least once each year over an eight-year period.
3. GREEN Inc - business incubator	Some background information was drawn from the enterprise website. Direct observations of governance arrangements and stakeholder activities were made during attendance at meetings over the 2006 – 2010 period. Interviews with two founding Board members provided background on the establishment of the enterprise. Telephone interviews were held with university staff charged with part-time oversight of the GREEN Inc facility each year in the period 2011 - 2016
4. AMTIL - industry association	The AMTIL website was used to collect some data on the enterprise history and membership. Personal observations were made and some informal member viewpoints noted from attendance at six multi-day network events over a ten-year period. AMTIL distributes its own magazine six times a year and access to copies was provided. A one-hour interview was held with the Foundation CEO to obtain his view of precursor activities, and the ways AMTIL had changed over some 15 years of operation.

Cheng and Van de Ven (1996) studied decision events in the innovation journey of two biomedical firms over about ten years, coding each event according to three criteria. Firstly, was it a continuation or a change in the current course of action? Secondly, was the outcome regarded as positive or negative? Thirdly, was the decision point a context event driven by internal or external background factors independent from, but impacting on the particular innovation journey? We emulated this process by collecting information from multiple sources spanning a period of ten years or more, organizing the data into yearly time blocks and identifying events within each period regarded as significant by our informants. We then re-organised these events into the life cycle frame shown in Table 2 instead of an annual frame to facilitate cross-case comparisons.

Brief descriptions of each case and its regional context are presented in the first part of the following findings section.

4 Findings

The following provides an introduction to the cases, with more detail in the following cross-case observations obtained from mapping their history and from the circumstances of their client firms.

4.1 Case 1

The Western Sydney IT Cluster (WSITC) was launched in 2001 with a vision to grow Western Sydney's emergent ICT industry sector. The region had a rapidly expanding population exceeding 1.7 million people and SMEs dominated the business environment. The WSITC was supported by government department resources with the aim of growing employment. Whilst a 2009 study showed a substantial member base (300+, mostly small enterprises) had been established and employment growth was being achieved, the WSITC foundered following a cutback in government resources after the global financial crisis.

4.2 Case 2

Austool was a not-for profit technology diffusion enterprise established in concept in the late 1990's to address a number of market weaknesses in a regional (Western Sydney) toolmaking sector that emerged as global competition increased. Globalization was leading to more local competition from larger overseas companies, and at the same time larger local manufacturing firms were tending to outsource their traditional toolmaking function, which also impacted the flow of apprentices entering the profession. Despite having a member base of more than 200 individuals, Austool closed down in 2010 after it failed to win on-going government grants. But the physical infrastructure developed was repurposed as a construction industry knowledge diffusion centre, and continues to deliver regional benefits.

4.3 Case 3

Green Inc, a not-for-profit regional collaboration in Gippsland, Australia began as a partial response to the disaggregation of one of the regions primary employers, the State Electricity Commission in Victoria (SECV), under the Victorian State Government in 1994. Gippsland is a large rural economic region with a distributed population of around 250,000. Unlike the other cases, it did not have a specific industry sector focus. Construction of an incubator facility began in 1996 and, although not formally planned for, became a joint venture between Latrobe City Council and Monash University. Over time, the facility hosted 11 firms, some starting a new business and some extending their activities within the region. It was originally intended that a grant would facilitate initial operations, but this did not eventuate following a change of government. Whilst the collaborative venture is no longer active, the guiding principles and the physical infrastructure established still help to sustain the activities of some regional firms. In 2013 Federation University took over the campus and the facility, which became its Gippsland Enterprise Centre. It is now operated under the auspices of a multi-site university technology park enterprise that hosts 30 larger firms employing over 1400 people

4.4 Case 4

AMTIL (Australian Manufacturing Technology Institute Limited) is a national not-for-profit body based in Melbourne Australia, and represents the interests of manufacturing technology suppliers and users within the precision engineering and advanced manufacturing sector. It was established in 1999 as an amalgamation of two other long-running (45 years +) industry groups, and is governed by a Board comprising seven of its members and the CEO. Since formation, membership has grown to more than 200 firms and the number of services on offer has expanded. It maintains links with about 25 other professional bodies and research organisations. AMTIL maintains relationships with both State and Australian Governments, allowing it to influence the decisions made about the advanced manufacturing industry. It acts as an intermediary, facilitating the delivery of government innovation and entrepreneurship support programs to its (mainly) SME members. AMTIL draws on a network of business advisors and research connection facilitators to help deliver these programs.

4.5 Cross-case observations

In all cases the marketplace was fixed a priori with the clients being regional SMEs. At some time in the history of all cases, external political and economic events both provided windows of opportunity and created critical junctures. Whilst three of the case study organisations grew in the domination phase, only one (AMTIL) was able create a sustainable operation. The others relied heavily on direct or indirect government sponsorship, but there seemed to be a sponsor view that once suitable infrastructure was deployed and started to deliver benefits, it could become self-funding. Even though the SME beneficiaries stated that they valued the contributions of the intermediary, they were not always prepared to fund it, giving other options available to them higher priority.

SME client arrangements that made sense also depended on some temporal factors. Firstly, engagement with the clients took time, and other client operational matters took precedence where the time of key individuals was a limited resource. This meant that potential clients might seem reluctant to participate. Secondly, their need for engagement was discontinuous, and individual clients needed different support at different times. At a particular time, SME clients may have been looking for ideas to stimulate innovation, to help develop an innovation, or to help deploy an innovation. In the AMTIL, WSITC and Austool cases, this influenced the nature of group knowledge diffusion ‘broadcast’ events planned, and highlighted the value of more personalised ‘agent’ based diffusion activities with individual client interaction at a time and place that suited them (Bessant, Tsekouras and Rush, 2009).

The following subsections compare the four cases at different stages of their evolution. Concepts that have emerged from theory or coding analysis of event time series are used as a basis for comparison. Two concepts: action stimulus (what drives a need for change) and windows of opportunity (what drives an opportunity for change) are utilized in all comparisons. Both positive events creating ‘kairotic moments’; and negative events creating ‘critical junctures / tipping points’ are represented as windows of opportunity. The latter is seen as an opportunity to turn a threat into an opportunity through creative problem solving (e.g. Gilbert and Bower, 2002).

Discovery phase comparison (Table 4). A common concept was searching for a suitable enterprise model – a focus on ideas for establishing places where resources could be shared. Those adopted came from the awareness by an individual of initiatives that had worked elsewhere in the world. The idea champions were community-minded people who were motivated to act. The different kinds of enterprise models chosen related to the kinds of industry participants to be supported. The background rhythms stimulating action related to regional socio-economic factors and the globalization of manufacturing. Windows of opportunity were related to a conjunction of the political climate and a credible idea.

Table 4. Discovery phase concepts

Concept	WSITC	Austool	GREEN Inc	AMTIL
Enterprise model identification	A regional cluster providing a means of enhancing the competitiveness of many small firms.	Emulating an established Portuguese initiative linking toolmaking firms with a technology diffusion centre	Establishing a business incubator located on a university campus	Establishing a combined government lobby and innovation intermediary national organization
Action stimulus	Job creation in a growing region	The owner of a regional toolmaking firm pursuing global competitiveness	Job creation in a region undergoing structural change	Seeking global competitiveness and accessing government support programs
Window of opportunity	A regional politician had been impressed by the operation of some IT industry clusters in other parts of the world, and had responsibility for regional growth	The industry champion was also a member of a State Government industry innovation panel, and promoted the idea to government	A perceived political opportunity to stimulate SME growth as a way of compensating for the downscaling of a large State employer in the region	The merging of two regional industry associations that failed to sustain adequate scale was seen as a viable alternative to closing them down completely

Development phase comparisons (Table 5). Unlike the situation in an established enterprise that may allocate resources to develop an idea, our cases were more like start-ups that might initially draw on in-kind resources. But they all had a need to access to funding / infrastructure to achieve their goals – establishing resources at their chosen place to implement their idea. Three of the cases relied on government support, and

were significantly influenced by the ebb and flow of policy and program directives. The other case, AMTIL, was influenced by the ebb and flow of global and local manufacturing industry dynamics. Austool and AMTIL were established as commercial companies. WSITC and GREEN Inc were established in the style of virtual enterprises operating under a brand name. The background rhythms stimulating action were a focus on regional SME economic sustainability and governments seeking mechanisms to better engage with SMEs. The windows of opportunity came from a conjunction of government policy interventions and buy-in by a core of industry SME champions.

Table 5. Development phase concepts

Concept	WSITC	Austool	GREEN Inc	AMTIL
Establishing a resource base	A collaborative virtual enterprise was hosted within a government department and supported by two allocated staff members with in-kind contributions from industry and other government departments. Participation protocols were developed.	A physical technology diffusion centre within a technology park was to be established by the State on unused government land. An industry-driven not-for-profit enterprise would operate the centre, drawing income from sub-letting the facility	A physical facility was to be an interaction space constructed on a local university campus, but separated from the university and run independently. Construction was funded via an Australian regional development grant, and operations were to be overseen by a community-based Board.	Head of a steering committee set up to oversee amalgamation was appointed CEO. A core team was established in a rented office facility. Funding was from member firm subscriptions, from an annual technology exhibition, and advertising in a new bi-monthly magazine
Action stimulus	The primary development focus was on knowledge sharing and networking to facilitate SME growth in the region.	A synergistic critical mass of toolmaking enterprises was to be drawn to the technology park. Austool appointed a CEO who was initially hosted by the Champion's firm	Industry/academia cooperation was an anticipated benefit where the technical skills of the university staff could be matched with business needs, and research could be exploited to develop new businesses.	The initial focus was finding scale to be self-sustaining and present as a credible voice of the industry to governments.

Concept	WSITC	Austool	GREEN Inc	AMTIL
Window of opportunity	A State government policy initiative with industry inputs via a steering committee	In parallel with facility development, Austool bid for funding under a variety of Australian government SME development grants available at the time.	The political climate approaching an election stimulated the provision of a government grant to build an incubator facility	Expanding beyond the original two State membership to attract national membership and government grants supporting expansion of services

Deployment phase comparison (Table 6). Two concepts evident at this stage were sub-elements of the place element of figure 1: the need to engage effectively with more client SME firms (marketplace) and the (quite different) mind-sets of the particular case study enterprise (culture).

Table 6. Deployment phase concepts

Concept	WSITC	Austool	GREEN Inc	AMTIL
Market engagement	State Government employees facilitated SME engagement, linkages with research institutions, and with other government departments networking events at a government conference facility were organised under the guidance of an industry advisory board.	Events were initially held in local community facilities. When the technology diffusion facility was finished it was an empty shell, but two providers of advanced technology were persuaded to set up there, and grants were obtained to demonstrate some advanced IT tools.	Five tenants moved into the newly constructed facility. There were two formal networking events each year where launch tenants could share background knowledge and identify opportunities for collaboration, and potential tenants could ask questions.	Members are both advanced technology providers and users. Engagement was through networking events and the widely circulated magazine. A technology expo with around 200 exhibitors and thousands of visitors was held annually in Melbourne or Sydney
Mind-set	Understanding individual client needs and knowledge	Program delivery and knowledge	Client project brokering	Technology diffusion and market knowledge

Concept	WSITC	Austool	GREEN Inc	AMTIL
	sharing	broadcasting		broadcasting
Action stimulus	Deployment was rapid as the WSITC used established connections and infrastructure to enact policy directions and support SME client growth	Austool won a substantial grant to introduce some emergent technologies to toolmaker SMEs and to help establish collaborative project ventures.	A political change restricted on-going support. The university provided some administration support and members of the Board encouraged engagement through their social networks.	The need to deliver value to members and government stakeholders in a changing business environment stimulated a pragmatic business focus.
Window of opportunity	Client windows of opportunity were created through networking events (see note)	There was a 2-year delay in establishing the planned technology park and the physical technology diffusion facilities which impacted operations (see note)	The planned incubator facility was constructed on time, and tenants moved in.	The annual technology expo and magazine aricles provided opportunities for the member firms to engage with both established and potential new customers

The background rhythms at this stage were the need to build credibility with both sponsors and clients. Windows of opportunity were created for both the enterprises and their clients through personal networking and organizing different kinds of networking events intended to stimulate kairotic moments for the SME clients.

WSITC Deployment Note. It was found that different WSITC participating firms had different needs, depending on their own stage of development, and three kinds of events were organized. The first was a networking event where firms shared stories about their development journeys and ideas facilitating enterprise development. This kind of event was well supported by small firms, but their engagement was intermittent. It was subsequently established that this was not due to a lack of interest, but because they were consolidating what they learned before re-engaging. The second kind of event was intended to stimulate technology diffusion, primarily from research organizations. This attracted firms that were looking for ideas to stimulate a new growth phase. The third kind of event was focused on export market development that was of interest to firms that had developed novel technologies.

*Austool Deployment Note***.** Austool was faced with a critical juncture at this stage. The delay in physical facility development had a significant impact on the original idea. Firstly, the toolmaking firms that had planned to set up in the technology park could not wait, and went elsewhere. Secondly, the plan to sub-lease parts of the facility to technology providers was further compromised by a downturn in economic conditions. This forced Austool to focus on winning a succession of competitive government grants.

Domination / Scale-up phase comparison (Table 7). What we have called the domination phase (making an impact) is generally represented as on-going continuous improvement in the innovation management literature. It is assumed that the business plan supporting development and deployment of an idea is enacted. Following successful engagement with an initiating client base, our case study enterprises pursued opportunities to increase the scale of their client base or the scope of the services they could offer. Not all succeeded, and it is our observation that assumptions embedded in the original plans had to be reconsidered due to changing business dynamics (matters of timing). The entrepreneurship literature is more oriented towards finding windows of opportunity under these conditions than the innovation management literature. In our case studies, the main concepts noted from our event coding at this stage were expanding influence, with a value proposition having a significant impact. This proposition had to make market (i.e. SME clients) and investor (client firms and governments) sense to support a sustainable operation.

Table 7. Domination phase concepts

Concept	WSITC	Austool	GREEN Inc	AMTIL
Expansion of influence	Membership grew to about 300 firms over many years. Personal facilitator meetings with smaller firms were an essential component of its success. As the facilitators were government employees there seemed to be information exchanges with small firms that may have not happened otherwise due to their practice	Austool participation grew after the physical facility was established, with a membership list of around 300, supporting more networking events. This seemed impressive, but in part was due to Austool allowing individual membership, e.g. by university students. However two small firms became rent-	GREEN Inc failed to grow as a collaborative venture, despite in-principle support from local government authorities. More regional start-ups grew independent of GREEN Inc as they could access more support resources from a State Government department in major cities throughout the	AMTIL expanded its services in three ways. An on-line portal (Industry Link) was established to connect customers with its members. AMTIL became a research partner on behalf of its members in some collaborative technology research ventures (see note). AMTIL hosted more government programs

Concept	WSITC	Austool	GREEN Inc	AMTIL
	of protecting IP through a trade secret strategy.	paying tenants	region.	facilitating SME development.
Client and Sponsor Value Propositions	SME Client viewpoint: low cost of participation (no membership fees), new ideas, new opportunities. Sponsor viewpoint: job creation, export market facilitation	SME Client viewpoint: low cost of participation (no membership fees), new technology and collaboration ideas. Sponsor viewpoint: effective intervention program delivery, building SME absorptive capacity	SME Client viewpoint: reasonable rent, convenient position, access supplementary facilities. Sponsor viewpoint: University engagement opportunities, rental income	SME Client viewpoint: modest membership fees, ideas and connections to enhance competitive positioning. Sponsor viewpoint: achieve industry client objectives and offer an effective government / SME interface
Action stimulus	Government sponsor guidelines – expanding engagement drove the facilitators. Changing IT sector technologies and business conditions drove members	Government grants supporting SME capability enhancement. Competition from some related industry association bodies	Establishing economically sustainable working arrangements to keep the incubator facility open.	The impact of the Global Financial Crisis and Australian manufacturing industry rationalization saw the demise of some member firms and other industry associations.
Window of opportunity	Windows of opportunity were created for client firms: see note below	Opportunities to secure government grants dried up after the Global Financial Crisis. Some limited opportunities were created for client firms: see note below.	Transfer of physical facility ownership from the government to Monash University independent of the GREEN Inc collaboration	Broadening the member base flowing from the demise of some other industry associations also facilitated access to different kinds of government grants

WSITC Domination Note. Many medium sized firms attributed their growth to ideas and help they got from WSITC engagement. However, unlike the situation observed in other industry clusters, very few multi-member collaborative projects were initiated, only the development of some preferred supplier relationships. For those firms that had grown and were pursuing export markets, working with the appropriate government department and sharing their experience was valued. A survey indicated that significant employment growth was attributed to WSITC participation, and those firms that had grown became staunch supporters of the WSITC. The technology trend towards cloud computing provided windows of opportunity for some firms and difficulties for others.

Austool Domination Note. Austool's attempts to establish collaboration amongst its members met with limited success. In contrast with the WSITC case, Austool members did not share their experiences at networking events for fear of revealing some form of trade secret to their competitors. Membership of all associations in this industry sector fell as a result of industry restructuring. The two technology provider tenants remained in the Austool building for a period of time, but the State Government owner decided to re-purpose the building.

Green Inc Domination Note. In its early stages the GREEN Inc regional collaboration entered a period of rapid network growth that was also characterised by inconsistent strategy implementation, as well as tensions regarding its specific role within the community. Some university research groups were located in the incubator facility, but this arrangement was not maintained. There were broader concerns about the viability of the Campus. Temporal issues were central to GREEN Inc's erratic development, as it was anticipated that the facility would be able draw businesses to it and act as a catalyst for innovation from within an extensive area of rural Victoria. Innovation and incubation within Gippsland was a regular occurrence, but industry was not prepared to relocate to a facility that could be up to several hundred kilometres from its markets.

AMTIL Domination Note. The Australian Government had a well-established Cooperative Research Centres program, but had experienced some difficulty in sustaining SME participation. Centres were funded for periods of 7 years, but most SMEs could not sustain a burst of applied research activity for that time, so AMTIL became a research participant organizing individual SMEs to participate in shorter, very focused projects.

Displacement phase comparison (Table 8). A displacement phase is not commonly considered in the innovation management literature, although it does appear in literature on project-based organisations and entrepreneurship. The common displacement phase theme in our cases was seeking new ways to build on the assets accumulated.

Table 8. Displacement phase concepts

Concept	WSITC	Austool	GREEN Inc	AMTIL
Re-framing asset utility	A number of SME client firms formed a WSITC not-for-profit company, but have put it into	Austool was forced to shut down after it failed to secure on-going government	GREEN Inc was abandoned as a collaborative venture. The physical facility	AMTIL has not entered a displacem ent phase

Concept	WSITC	Austool	GREEN Inc	AMTIL
	hibernation rather than abandon the idea. A particular member concern was the ability to retain 'trade secrets' without the independent government involvement.	grants. The physical facility was re-purposed as a construction industry education and technology transfer organization run by a regional Vocational Education Training organization.	is supported by a few rent-paying tenants and has been integrated with an industry engagement strategy successfully operated elsewhere by its new University owners.	
Action stimulus	In the late 2000's the global financial crisis impacted the smaller member firms and there were funding cuts that saw the withdrawal of the government facilitators. Residual SME supporters were unable to self-fund and put time into an on-going enterprise	After the 3-year embargo period, the Austool technology park rapidly filled up, creating significant local employment. So from the State Government point of view, the investment returned their original capital outlay and supported a viable skill enhancement facility	An intention to better leverage the established facility as a University regional engagement asset. This is a significant change from the original idea, where the foundation university (Monash) was a supporter of an independent initiative.	Regular reflection on current and anticipated business conditions
Window of opportunity	Some of the social networks that were built have continued to engage with a local government "Smart City" initiative that has included establishing a small IT incubator facility.	It was reported that some individuals who met whilst training in the re-purposed facility have started new businesses together.	A re-structuring of Victorian university regional campuses through the creation of Federation University has provided coherent governance arrangements	Not Applicable

5 Discussion

Our research question was: What innovation contextual factors condition an ability to explore and exploit windows of opportunity?

Our first hypothesis (H1) was that viewing past or anticipated influential events in time as windows of opportunity can provide insights into innovation evolutionary pathways. We framed macro-level events relevant to innovation management in the expanded life-cycle view outlined in Table 2. We suggest this brings together innovation management and entrepreneurship orientations, with the former tending to focus on the earlier stages and the latter on later stages. There is a different emphasis at each stage, starting with the idea, then resources, then the marketplace and an emphasis on timing and alignment with external conditions supporting scale-up. In three of the four case studies we were able to observe a displacement stage, which introduced some important discussion points. The preceding section of this paper maps four cases over this life cycle– so what did we learn?

The Ancient Greek concept of kairos we have embraced is about events in time, which we have characterised as windows of opportunity in an innovation context. In our case study enterprises, entrepreneurial idea champions sought windows of opportunity to attract government support to establish the WSITC, Austool and GREEN Inc. Soon after formation Austool and GREEN Inc's original plans were compromised as resources they had planned on were not delivered as anticipated by their government sponsors - potential windows of opportunity had closed. At a later time government support for the WSITC was withdrawn in favour of alternative investments. Whilst this provided a window of opportunity for some of the members to continue the enterprise, they could not attract the level of resourcing needed.

In the AMTIL case, its two forerunner organisations had reached critical junctures, where their displacement supported the formation of AMTIL. This pattern was repeated again at a later time. Some members of other industry associations that had closed down following the Global Financial Crisis or global manufacturing industry restructuring joined AMTIL. This had a number of effects. Firstly, it maintained a serviceable membership base, as these members tended to be survivors too. Secondly, it broadened the industry base supported. Thirdly, it positioned AMTIL as a credible partner to help deliver government SME support programs.

Our case study enterprises sought to offer windows of opportunity to their clients to stimulate kairotic moments - flashes of inspiration - through formal events and personal networking. This was achieved with varying degrees of success, and some examples follow.

In the WSITC case a high-tech start-up firm was persuaded to enter a regional innovation award competition, which it won, attracting the attention of a succession of large clients. Another member firm was persuaded to attend an international trade show in Dubai, where it identified a global market niche for its product, again supporting growth. In a third instance, a firm that had just patented a new idea was reflecting on where and how to best apply it, when this was mentioned to a government export facilitator at a network event. The suggestions made by this facilitator, combined with other information accumulated led to a 'kairotic moment' – a flash of inspiration about 12 months later, and subsequently to rapid deployment of the idea. Our survey of

WSITC members indicated the respondents had all experienced a flash of inspiration at some time, but there were often years between such events.

In the Austool case most members were individuals rather than firms, and few kairotic moments were recorded. One member decided to import an advanced 3D metal printing machine and install it in the Austool facility. This attracted a lot of attention, as 3D metal printing was still an emerging technology, but still a relatively expensive proposition. The results hoped for were not realised, as it was a matter of wrong place, wrong time.

In the GREEN Inc case, one founding tenant grew, and took over several offices in the building. This firm persuaded one of its international suppliers to move into the building to better support its growth, and undertook an environmental process improvement initiative in conjunction with another tenant.

AMTIL provides member windows of opportunity in a number of ways. It holds several networking events each year at different locations. Many are co-badged with other organisations, increasing the number of events available. The national trade show AMTIL runs over several days each year offers members (and non-members) a place to both market their products and learn about emerging technology. The show attracts thousands of visitors, and also hosts an 'opportunity cafe' where researchers, industry and government exhibitors can explore cooperative possibilities.

Three kinds of dynamic that conditioned events in time were observed in the cases:

- Background macro-economic and technology trends - in particular the globalisation of manufacturing, the global financial crisis, changing government support priorities, e.g. promoting environmental innovation, and the trend towards the internet of things and cloud computing.
- The interplay between case study enterprise stage of evolution and its perception of and response to macro-trends. Some macro-trends stimulated case enterprise establishment (see Table 4), but could also lead to their demise.
- The interaction between case study enterprise client industry clock-speeds (e.g. Nadkarni and Narayanan, 2007), and responses to background rhythms:
    - WSITC - relatively fast IT sector clock speed, but customers may be from lower clock speed sectors such as health.
    - Austool - Toolmaker members primarily influenced by automotive sector project clock speed, but all clients want fast turnaround associated with their new product development initiatives
    - GREEN Inc – long-term incubator client firms were influenced by their low clock speed industries (forestry and health) and the distributed nature of their operations.
    - AMTIL - members from multiple sectors with varying clock speeds - food, automotive, aerospace & defence, mining & resources, medical, plus renewable energy and clean technology. AMTIL dedicates one issue of its bi-monthly magazine each year to each sector. Working with multiple sectors may soften the impact of low demand from a particular sector, but may generate a huge demand for services if they all peak at the same time.

This has two implications. Firstly, opportunity time windows will vary, both in their duration and frequency with faster responses being required in faster clock speed

sectors, as observed by Souza et al (2004). Secondly, there will be times when the smaller firms may not have the capacity to participate, as they are too busy. This brings up the notion of time being an aspect of absorptive capacity (Beckett, 2008).

The case study enterprises organised events in time to facilitate knowledge diffusion and SME innovation capability development. Bessant, Tsekouras and Rush (2009) researched the development of innovation capability in SMEs, noting four different mind-sets: (a) unaware / passive not seeing a need to innovate; (b) reactive, with limited resources or knowledge, (c) strategic, with procedures in place, but may have difficulty beyond current boundaries; and (d) creative with established capabilities and prepared to pursue windows of opportunity. They refer to 'broadcast', 'agent assist' and 'peer assist' forms of intervention to build innovation capability. Our case study enterprises formally adopted a 'broadcast' strategy, but informal 'peer assist' activities were observed in the WSITC and AMTIL cases. Informal 'agent assist' strategies were found necessary in working with micro-firms in the WSITC and Austool cases, fitting in with time windows that suited such firms. AMTIL have more recently adopted a formal 'agent assist' by engaging a network of business advisors and research connection facilitators to help deliver a government innovation / entrepreneurship support program. These facilitators have to fit in with time window considerations of the member clients.

In table 2 we characterized the life-cycle of an innovation in terms of some generic stages, and we used this as a framework in section 4.5 to compare the cases, however each of these stages also has its own life-cycle, as do transitional events between stages. Viewed as events in time, a particular stage or transition may take months or years to complete, with significant events occurring within this time. It has been suggested elsewhere (GERAM, 2000) that life-cycle models have recursive properties, so for example we could look into the discovery stage of a particular case and again use the events in table 2 to explore that stage in more detail. In reflecting on what inspired the search for an idea, we might consider regional context in more detail, and our more detailed coding of our source data indicates there are certainly stories to tell about such a question. Whilst this process helped us explore past events in a structured way, it is suggested here that using the events of table 2 as prompts may also help explore possible future scenarios in the same way. Further discussion of this observation is beyond the scope of this paper, and may be a topic for future research.

Our second hypothesis (H2) was that four primary factors frame event context that shapes the most appropriate course of action: place, idea, resources and time, and there are multiple interactions between these elements. So what observations can we make here?

Separate from the case study work we have discussed the combination of right time /right place in some of our post-graduate management classes and with some our consulting clients, and it makes immediate sense to such practitioner groups. When it comes to a means of anticipating the right time and place, things get complicated, but introducing the model shown in figure 1 facilitated further discussion. There are potentially more than 100 questions that might be asked about interactions between the 12 sub-elements shown in the model. We observe that firms reduce this complexity by assuming that one element is fixed and concentrate on matching other elements. For example: a firm understands its organization, its culture and marketplace (place), but

wishes to match an idea with the requisite resources. Fewer firms make matters of timing their primary viewpoint, despite its perceived importance. Our case study enterprises assumed matters of place and their central idea were clear, and they could focus on resource aspects. In Table 9 we have presented some observations from the cases from a temporal viewpoint with other sub-elements of our model, providing context.

Table 9. Mapping Case study elements of context

Element of Context	Temporal Viewpoint		
	Window of opportunity	Life-cycle	Background rhythms
Market place	Case study clients valued the identification of marketplace windows of opportunity	Client marketplace maturity and industry clockspeed influenced the nature of opportunities	Client market trends (growing / shrinking, nature of competition) influenced the types of innovation undertaken
Organisational space	Client internal windows of opportunity facilitated by new capabilities	Understanding client organisation maturity and individual project stage-specific capabilities needed	Trends in scale and scope of organization activities
Mind-set	Entrepreneurial mind-set imagining possibilities	Combining divergent and convergent thinking at different life-cycle stages	Influential trends in government policy and community norms
Type of idea	Opportunities for a particular type of innovation	Relative maturity of idea	Trends favouring particular kinds of ideas
Idea generation process	Concept identification networking	Exploration process maturity (e.g. R&D capabilities)	Ideation process trends (e.g. open innovation)
Creative problem-solving process	Solution-seeking networking	A focus on learning - what is known and what is unknown	Problem-solving tool trends (e.g. use of six sigma)
Financial resources	Grant and investment	Budget and investment	Global financial architectures, local

Element of Context	Temporal Viewpoint		
	Window of opportunity	Life-cycle	Background rhythms
	opportunities	lifecycles	policy interventions
Infrastructure resources	Opportunities to access new technology, supply chain and complementary assets	Technology maturity and accessibility of infrastructure	Infrastructure development and investment trends
Knowledge resources	Opportunities for collaboration	Established or emergent knowledge and absorptive capacity supporting a learning 'spiral'	Knowledge flow patterns (big data?) and focus areas (technology, markets)

The entries in the Table 9 'windows of opportunity' column resonate with the observations of O'Donnell (2014) on 'purposeful networking' where she observed entrepreneurial SMEs creating a variety of links for different purposes at different times. Relative maturity and accessibility influencing a capacity to act are common themes in the life-cycle column, which resonates with the observation of Louis Pasteur that 'chance favours the prepared mind'. Entries in the background rhythm column resonate with the use of foresight tools and PESTEL analysis. One possible implication of these observations is that whilst SMEs may not be specifically thinking about the three temporal factors suggested here, they may be indirectly preparing for future possibilities through networking, building dynamic capabilities, and reflecting on the external environment from time-to-time. For example, in our set of case studies, Austool undertook two technology roadmapping studies in parallel with its networking event activities. How useful they were was not explored.

It is suggested here that the case study enterprises could have improved their position by scanning the rows of table 9. For example, WSITC, Austool and GREEN Inc did not directly offer their members market opportunities – was this a fatal flaw? Is it understood that different enterprise and community mind-sets may have to be harmonized? Is a particular type of innovation best suited to a particular group of clients? The three kinds of networking events that evolved within the WSITC stimulated organizational innovation, technological innovation and market innovation would suggest do. Are specific opportunities for client firm collaboration to share knowledge assets identified? Where this was attempted in our cases, it met with mixed success, but perhaps that could be explained by considering dominant client mind-sets.

The term value proposition emerged from coding of events in the domination/scale-up phase. Idea, resources and temporal factors may combine in different ways in different markets to deliver perceived value. In our case studies, the intended clients were SMEs, and we observed different behaviours in the four cases, partly related to client firm size

and partly to the case value packaging. In the WSITC case, 60% of the members were micro-firms with a limited capacity to pay for anything. In the Austool case, the majority of members were individuals who also had limited financial capacity. In both cases, there were no subscription fees, so the members did not have to work too hard to benefit from their engagement, and many were not prepared to pay fees when circumstances changed. In the GREEN Inc case members paid rent for using the facility, which had to make business sense for them. In the AMTIL case, where members were commonly medium sized firms, they paid a significant annual subscription, paid to exhibit in the annual exhibition, and paid for magazine advertising (albeit at discounted rates). However all the activities were clearly targeted at increasing revenue or reducing costs. The message here is that getting the timing right may be important, but you also have to deliver something that is valued. Whilst three of the original enterprises stopped trading, their government sponsors got value for money in terms of jobs created and the establishment of facilities that could be re-purposed and continue to support regional growth.

6 Concluding Remarks

We started with the viewpoint that 'timing is everything' (Bowen, Rostami and Steel, 2010). But the timing of what? The timing of an idea? The timing of resource availability? The timing of market entry? The timing of business expansion? The timing of the displacement of an innovation or a technology? These are all seen as aspects of innovation management, and we have framed such events as windows of opportunity, noting the different context of specific events, leading to our research question - *What innovation contextual factors condition an ability to explore and exploit windows of opportunity*?

Consistent with the observations of others (e.g. Cheng and Van de Ven, 1996) we noted that that windows of opportunity may be anticipated or may emerge from the conjunction of internal and/or external context factors at different times. Whatever the stimulus, one has to learn from past experiences and imagine the subsequent possibilities. The first contribution of this paper is to outline ten generic events in the lifecycle of an innovation, constructed from an amalgam of innovation, entrepreneurship and enterprise development literature viewpoints (Table 2). We have used this in the paper to compare four innovative case study enterprises at different points in their evolution. We have also suggested this life-cycle framework may be used in a recursive way to look into events within a particular stage.

Adopting a temporal perspective of mapping events in time, we draw on the Ancient Greek notion of kairos to identify elements of context. Kairotic moments are associated with the intention of taking specific action - implementing an idea when the time and place are right. One has to creatively use requisite skills and resources to achieve an effective outcome. Combinations of idea, resources, place and timing frame the context, and there are interactions between them. The conjunction of background factors may also lead to a kairotic moment of enlightenment – an 'aha' moment that stimulates later action. This concept leads to the second contribution of the paper, a contextual factor interaction model, shown in figure 1. We note that one of these elements may take precedence at different stages in the exploration and exploitation of an innovation. We

also note that firms may reduce innovation management complexity by fixing one or more elements, for example utilizing established resources to service specific markets, but this may not position them well if markets and/or dominant technologies change. Each element of our interaction framework is broadly outlined as followed:

- **Idea**. Whilst innovation starts with an idea, some attributes of the idea and its origins influence what has to be managed. Is it an idea for a new product or process, or for an organizational change or a new way of serving a market? Has it emerged from research – an idea looking for an application, or has it emerged from the identification of an unmet need – a market need looking for a solution.
- **Resources**. What kinds of resources are needed to develop and deploy the idea? What financial support is required, what technological and supporting infrastructure (e.g. ICT, logistics) is needed, and what knowledge assets have to be accessed.
- **Place**. Where will the idea be applied and where do we look for ideas (marketplace)? What kind of organization is needed to progress the idea and where should it be located (organization)? What kind of culture supports innovation, and what are the norms of potential users (mind-set)
- **Time**. What kinds of background socio-economic rhythms and technology trends might support or inhibit progression of an idea? What life-cycle stage is the idea / market /technology at – what is its relative maturity? What is the target industry clock-speed, and what is the nature of accessible time windows;

We have raised a number of questions in this outline of the four primary and twelve sub-elements of our model. More than 100 questions might be asked by considering pairs of sub-elements, which highlights some of the complexities to be dealt with in innovation management. For example, where should we look for new ideas, and what knowledge is needed at each stage of development to progress an idea. In undertaking this research we have observed there are bodies of literature dealing with questions relating to particular combinations. For example Tushman and O-Reilly's (1996) ambidextrous organization concept argues that the combination of idea (radical or incremental), mind-set (supporting or inhibiting risk-taking) and organization (separation or integration) needs to be harmonised to deliver reliable outcomes.

Four cases are analysed in the paper using the time window and theoretical influence factor interaction models presented. All case enterprises aimed to establish an innovation intermediary organisation in a particular place with various levels of government support to stimulate job creation. Each focused on a different client market sector and had a different dominant mind-set. Three supported clients in large metropolitan areas, and the other in a less populated rural area. In two cases, a virtual enterprise was established drawing on existing facilities and a network of supporters. In the two other cases operations were based in a purpose-built physical facility. The target clients were SME firms at various stages of evolution looking to grow or survive in a turbulent business environment. The focus was on enhancing client knowledge resources or providing access pathways to specialist knowledge. Both the case study enterprises and their clients had limited financial and infrastructure resources and had to access what was externally available. For the intermediaries, this meant winning government support, generally in the form of a succession of relatively short-term competitive grants, and this proved unsustainable for three of them as macro-economic

conditions changed. It also meant that at some points in time, the effort of bidding for new grants could detract from the level of services provided. In the cases serving clients in a large metropolitan area there was good access to technological, communication and logistics infrastructure. This was more problematic in the case located in a rural area having about 15% of the population of the other cases. In two of the cases, investment was made in physical infrastructure, which has been repurposed in some way following closure of the founding intermediary organisations.

Using an extended innovation life-cycle view, the cases could be compared, even though events took place at different calendar times. All drew on ideas that had worked well in other places at other times, but the translation to an Australian context was only partially successful. Background macro and microeconomic rhythms and government policy changes both positively and negatively impacted the establishment and sustainability of the case study organisations at different times. It was observed that client engagement could seem intermittent, but closer examination showed that when a client learned something new, this could be followed by a period of absorption and consolidation. On re-engaging, the client would be better positioned to consider the next opportunity, or may seek support of a different kind. In one case, this lead to the evolution of three kinds of knowledge diffusion events. One was a peer group show and tell, sharing experiences. Another was show and tell by associate research and commercialisation providers. The third was oriented towards export market access. Viewed from another perspective, each kind of event targeted different stages of the innovation life-cycle.

In this paper, we contend that the impact of timing in innovation management is linked to the identification of and response to windows of opportunity. It is suggested that four primary aspects of context will influence the ability to anticipate and react to windows of opportunity. The research has two limitations. Firstly, we have only analysed four longitudinal organizational innovation case studies. It is intended this should be supplemented by different kinds of cases, e.g. product or process innovation longitudinal studies. Secondly, our studies have looked at events in time retrospectively. It is suggested that future research may focus on anticipating windows of opportunity as an innovation management-oriented form of scenario planning. For example, at different stages in the evolution of an innovation, decisions are made to stop researching and start developing, or to stop developing and get into the marketplace. Drawing on our model, we should ask questions like where should we develop / deploy? What resources will be needed and will we have to develop infrastructure in parallel? What application ideas do we have? What is happening in the background and what timing is appropriate? These may well be questions an experience innovation manager might ask, but we believe our list of more than 100 questions is likely to be more comprehensive.

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Company Value Creation through Effective Innovation Process Management

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Abstract. Company value creation is considered a significant metric to measure corporate success. One possible method is the launch of innovative products that potentially attract new customers and capture a reasonable market share. This discussion highlights examples wherein heightening innovation activities through incremental increases in Research and Development spending, the number of innovative products in the sales funnel, as well as those innovative products in the marketplace impact company value. Yet, another company value driver, worthy of consideration, is the effective management of innovation processes. The Stage Gate Control Process embodies a recognized framework for effective innovation process management. Central to this manuscript is the case of PharmaComm, a pharmaceutical company that developed a customized version of the Stage Gate Control Process. By this way PharmaComm accelerated new products development and shortened time to launch. In adapting this methodology, it multiplied company value during the acquisition process.

Keywords. Stage Gate Process; innovation; company value; stock valuation.

1 Introduction

A basic strategic goal is to gain competitive advantage to surpass competitors and generate shareholder value. To do so, a company possesses key competencies as fundamental factors to generate competitive advantage. These competences are unique and difficult to imitate. One of the most significant is the ability to innovate. Investments in strategic innovation require a positive return on investment resources. In addition, management not only envisions innovation but also creates and once deployed, measures its effects. Strategic innovation is complex and combines four processes that comprise strategy, entrepreneur, change and investment processes (de Witt and Meyer, 2014). For innovation to generate customer value, it is essential to be properly designed and launched in a timely fashion. To meet these demands, the company establishes functional and effective innovation-related activity management. In this regard, the authors propose two research questions. The first being, if a formalized process is conducive to effective innovation management. The second, if the intensity of Research and Development (R&D) activities expressed in terms of the number of R&D projects impact the increase of company value. If the company

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respects the aforementioned premises, it creates conditions to better attract future investors. Investors consider such firms less prone to risk and their interest in investment support increases company market value. Once such a process is operational, the company proceeds with the prescribed and defined steps that result in the delivery of the project respecting both time and budget (Stage Gate International, 2015). The terms innovation(s) and innovation(s) management are related with the concept of the innovative company and are addressed throughout this discussion.

2 Research Methodology

Recognizing that the examination of issues and circumstance is often based on qualitative research, a case study serves as foundation to this discussion. Case studies are frequently used as qualitative research methodologies (Yazan, 2015). The characterization of a case study has evolved over the past two decades with varying definitions. Yin (2014) defines case as "contemporary phenomenon within its real life context, especially when the boundaries between phenomenon and context are not clear and the researcher has little control over the phenomenon and context!" Thus according to Yin, the case study is an empirical inquiry that investigates the case by means of addressing the "how" and "why" of the phenomenon of interest. Stake (1995) hesitates to provide an exact definition of a case study. He views case as a specific, complex and functioning thing, more specifically an integrated system that possesses boundary and working parts. He also mentions four definitive characteristics of qualitative research that are equally valid for qualitative case studies. These characteristics are holistic, empirical, interpretive and emphatic (Yazan, 2015). Merriam (1998) views the case as a thing, a single entity, and a unit around which there are boundaries. Accordingly, a qualitative case study is an intensive, holistic description and analysis of a bounded phenomenon such as a program, an institution, a person, a process, or a social unit. Qualitative methods concern meaning rather than frequency of phenomena. Emphasis is placed on case study design. It follows the basic logical sequence that connects the empirical data to the initial research questions and finally, to its conclusions (Yazan, 2015). Generally, the case study is a legitimate research strategy that resolves complex research problems. A case study becomes a foundation on which the theory is built. Such a process begins with the research question definition. The a priori identification of variables or constructs from the extant literature guides the research process. Tentative themes, which emerge from the fieldwork are compared and contrasted with the literature. The idea is to systematically compare and contrast theory and data, iterating towards a theory that accurately reflects the data. The comparison of the emergent themes and theories with the literature is crucial, given the limited number of cases that are studied (Eisenhardt, 1989). Theoretical development from case studies relies on non-statistical sampling. Given the limited number of cases to be studied and processed, it is essential to select critical, extreme and relevant cases in which the phenomenon is transparently observable (Eisenhardt, 1989). Furthermore, the non-random sampling incorporates a factor of subjectivity within the case study approach. For this reason, the multiple-case approach renders this methodology more reliable.

3 Innovations as value drivers

According to Drucker (2008), a company has two sources for growth, marketing and innovation. Moreover, Pitman (2003) proves that enduring company value growth remains the best indicator of the quality of corporate performance. The impact of innovation on company growth remains significant to many researchers. Mañez et al. (2013) as well as Rochina-Barrachina et al. (2010) examine the effect of process innovation on productivity growth with the emphasis on company size. They conclude that innovation augments company productivity no matter the size of the organization. On the other hand, the duration of company growth was different for small and large firms. While for the former, productivity growth was contemporaneous whereas, for large firms, long-lasting. The reason for which, process innovations in small firms is incremental and easy to imitate while process innovations in large firms are of a radical character and therefore unique. Similarly, large companies introduce more complex process-dedicated innovations that become common knowledge subject to a longer delay. Rosenbusch et al. (2011) observe relationships between innovation and company performance and determine that this association is ambiguous and context dependent. Factors such as the age of the firm, the type of innovation and the cultural context affect the impact of innovation on performance to a significantly larger degree.

Additionally, there is the opinion that both time and resources are required to learn how to apply innovative technologies effectively. Based on this perspective, productivity growth is often slower than expected as companies employ more resources to determine how to use and to reorganize to benefit from the new technology. This phenomenon is recognized as the Solow Paradox (Baily, 2004).

Strategic innovation requires resources and within this context, considered an investment to the company´s future potential. Morris (2003) proposes that there exists a proven correlation between R&D expenditures and chemical companies share price increase during the period 1998–2002. Figure 1 indicates the causality between European chemical companies´ relative expenditure expressed as R&D/sales and share price in the chemical industry. It confirms that the higher proportion of R&D to sales, the higher the share price. Further research demonstrates that the dependency between R&D expenditures and share price need not be linear as with the case of larger chemical companies. Kwon (2014) examines a similar type of dependency in SMEs and determines that this dependency is non-linear. Moreover, the character of this dependency is associated with the firm´s characteristics and market structure. It is also reported that even non-profit SMEs generate tangible and intangible value (Huarng and Yu, 2011).

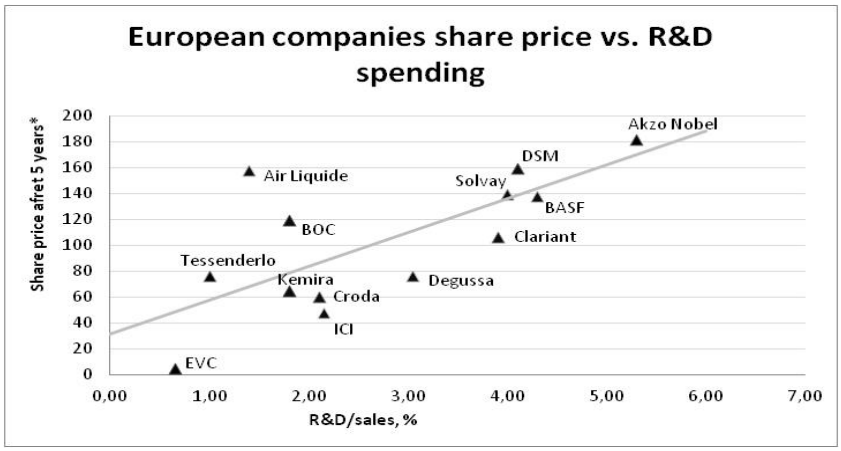

Fig. 1. Dependence between share prices and R&D spending in chemical companies (Morris, 2003)

Between the increase of market capitalization and the implementation of innovative solutions, exist many almost exclusively stochastic dependencies. Demonstrated by the pharmaceutical industry, such dependencies are exhibited with the periodical disclosure of pharmaceutical research results, not mentioned if positive or negative, significantly influences the fluctuation of share indices. There are no exceptions given that refusal to approve a new drug by the respective regulatory authority, such as the US-based Food and Drug Administration (FDA), immediately infers a significant decrease in the share price index. A recent example, the American pharmaceutical company Genta Inc. lost significant market capitalization upon FDA refusal to commercialize the skin-cancer drug Genasense. Consequently, the NASDAQ registered a significant slump in share price from 15 USD to below 2 USD (Feurstein, 2010).

In addition, company stock assessment is influenced by rival R&D activities. The latter effects company stock valuation both positively and negatively and is termed as positive and knowledge and negative spillover respectively. Asdemir (2013) examines the impact of a rival´s R&D expenditures with the conclusion that positive spillover is usually prevalent. He further reveals that the impact of industry R&D on stock valuation is higher where R&D is concentrated among a few firms. In contrast to these conclusions, Koku (2010) questions positive spillover between R&D expenditure and company profitability within American pharmaceutical companies. He argues that not all innovations that are produced as the result of R&D are commercialized. The innovation-related spillover effect in the pharmaceutical industry does not permit firms to capture all the benefits that result from their innovation. The issue becomes whether the announcements of innovative projects impact company stock valuation. Kelm at al. (1995) conclude that the stage of the R&D process moderates the relationship between the wealth effects and technology, and market variables. The former are more important than market variables during the innovation stages and both are important during commercialization. Similarly, Korean research suggests that the impact of company innovativeness on brand value reinforcement implies customer value increase (Kim et al., 2015).

4 Stage Gate Control Process (SGCP) as a formalized approach to management of innovations

Stage Gate Control Process (SGCP) is a conceptual and operational road map that enables the transition of a new product from conception to final launch (Cooper, 2008). Originated in the 1980s, Cooper (1986, 1990) gathered corporate best practices that had a proven track record in innovation. He subsequently developed a formalized process that includes, an idea capture and handling system; doing voice of customer research work that includes "camping out" with customers and working with innovative users; generating scenarios, and holding major revenue-generating events (Cooper et al., 2002; Cooper, 2008). Reasoning behind the process is to systematically and prudently evaluate the merits of a product or service concept before, rather than after it is launched (Cooper, 1990). He postulates that the SGCP assists firms to minimize the risk of new product failure and managers develop differentiated products or services with superior value (Barringer and Gresock, 2008).

SGCP consolidates and bundles tasks and decisions into activities known as a stage. The innovation effort is then divided into distinct stages to render project supervision more effective. The transition of the innovation from one stage to another is contingent upon criteria achievement and the approval of management gates termed as gate keeping (Barringer and Gresock, 2008).

In practice, project teams complete predefined cross-functional activities in each stage prior to gatekeeper approval to proceed to the next stage of product development. The gatekeeper is usually a cross-functional team of managers and experts. This formalized process facilitates the innovation process through the stages, establishes milestones and recognizes critical success factors. Once the stage is completed, the project is critically reviewed against the metrics that specify the level of readiness, known as gate control, for the next stage. The level of rigidity of the gate control is based on the type of innovation. Radical innovations require a more relaxed stage assessment as compared with incremental innovations (Schmidt, 2009). Roberts (2007) concentrated on SGCP principles and developed a “generic” model. This model includes opportunity recognition, idea formation, problem solving, prototype solution, and solution utilization and commercial development. With the occurrence of special circumstances, some stages are merged. There is no recommendation as to the exact number of stages but rather is derived from the typology of innovation. A simple rule applicable to real processes, is that the higher investment into the innovation and the lower project risk acceptance is assumed, then the higher number of stages are involved. On the other hand, the more radical the innovation project, the lower number of stages is required. For radical innovation projects, three stages are recommended (Chiesa et al., 2009). It is reported that almost half of the companies that undertake new product development applied a form of SGCP (s2m™, 2015). However, reservations towards SGCP do exist. SGCP supports a sequential development process and underrates various parallel activities that are often essential for the timely completion of the project (Verworn and Herstatt, 2002). Another shortcoming is that SGCP inherently forces fundamental project decisions to be made earlier than necessary. Thereby, it restricts flexibility to respond to change and raises costs (s2m™, 2015). The lack of idea generation and creativity are considered

deficiencies. In view of these perceived weaknesses, Cooper (2014) developed the next generation model known as the Triple a System: adaptive and flexible, agile and accelerated. The reliability of which has been endorsed by companies such as 3M, Procter & Gamble and other European firms (Cooper, 2015). Moreover, the SGCP concept expanded outside the constraints of the classical innovation scheme and produced a new open innovation model (Grönlund et al., 2010). Current research suggests that SGCP has not fully exploited its potential and that future developments are foreseen (Cooper, 2014).

5 Management of innovation activities - generic drug business insight

It is both the opinion and experience of the authors that the generic pharmaceutical industry focuses on product commercialization, for which patent protection has expired. Such a protection ensures the patent holder to enjoy product usage or process for the next 20 years and secures long-term competitive advantage. No sooner are other companies permitted to market the same product under its brand, the patent expires. If the basic managerial paradigm in commodities is to be the cheapest and through a low cost strategy out-performs competitors, then rapidity may be regarded as the basic paradigm. This, in turn, combined with a high speed of innovation enables the company to shorten the innovation cycle and become the first applicant to patent. Such being the case, the company protects its intellectual property by patents and dominates the market. Conversely, if the company produces generic drugs as with the PharmaComm case study, then it drives the generic product into the market immediately after the expiration of the existing patent. In both cases, if the company hastens its innovation activity, there emerges a flatter market penetration.

The development of unique unknown products or procedures or incidentally known products with significantly different utility value is enormously demanding and costly. Needless to mention that only three out of ten drugs that reach the market generate revenues that meet or exceed average R&D costs (Gassman, O. and Reepmeyer, G., 2005). Only large global multinational companies can embark on the development of innovative pharmaceutical products while others proceed with generic drugs development. The development of generic drugs does not signify that the company is not innovative. The company may develop its own unique route to a generic drug that may be entirely or partly protected by patents. As a consequence, competitors then seek alternative technologies that are not in conflict with existing patents. The competitor inevitably incurs additional costs and worsens its competitive position. It illustrates the importance of the innovation effort within the generic pharmaceutical industry, which affords an opportunity to capture at least a part of the generic drugs market. Notwithstanding the lower development costs, the development of these products is correspondingly demanding and time consuming. The trigger for this development is patent protection expiration usually supported by customer demand for distribution. The results of basic research may also act as another impetus for development. Such conditions necessitate the company to cope with the technology that guarantees the generic copy to be identical with the original. Due to complexity and demands of innovation within this industry, new generic product

innovation combined with their product launch are regarded as breakthrough or radical innovation. This challenge is ranked among the key competences that create the basis to win the competitive edge over market rivals.

Challenging conditions occur wherein the nature of the innovation is relatively inexpensive and simple but the industry regulator imposes complex governing restrictions on the execution of change. It is not uncommon that these impositions prevent the company from implementing the incremental innovation process. Over the past decades, management of radical and incremental innovations in the pharmaceutical industry has been subjected to various principles. However, Cardinal (2001) proposes that the management within the pharmaceutical sector are more consistent than previously suggested. However despite decades of intensive research experts in pharmaceutical management are still a long way from solid guidelines for the manageability of pharmaceutical innovation costs (Gassman and Reepmeyer, 2005).

6 Case Study: PharmaComm as an example of innovative company

The case study typifies a mid-size Czech pharmaceutical. The actual name of the company has been modified due to privacy considerations. The company which employs more than 90 employees is focused on the production of hormone-based Active Pharmaceutical Ingredients (API). Thanks to its specialization in hormone-based API development and production the company plays a unique role in Czech API business. From the European perspective the company represents a respected competitor in the branch.

The case study describes how the adoption of formal strategic management within the product portfolio enabled market value growth and the rise of investor interest to support this trend. The SGCP approach is used once modified to accommodate its specific environment. The Roberts´ Model of SGCP corresponds to the innovation process of this mid-sized pharmaceutical. One of the more significant reasons to opt for the Roberts' model rather than the Cooper is that the former reinforces the idea generation phase (Roberts, 2007). The basic requirement for the case study elaboration was the knowledge of internal sensitive data to compare calculated market value with actual investor proposals.

PharmaComm focuses on the development, production and sales of active pharmaceutical ingredients. The company is engaged in hormonal products development. Both development and final launch are intensive activities. New product development requires the exploration of multistep technology, its optimization and validation. To minimize failures, the company established a formalized innovations management process, which bears resemblance to SGCP.

Stage 0 - discovery: Activities are oriented on opportunities discovery and new ideas generation about the product. The innovation process is initiated by ideas collected both from internal and external sources. Ideas generators are typically R&D or marketing personnel. The output of this stage is the critical assessment of ideas from various perspectives such as, the environmental impact of technology, accessibility of

key sources, preliminary technical feasibility, and others. If the results substantiate a further analyses of the idea, then the topic is moved to the next stage subject to preliminary laboratory examination. The gatekeeper in this stage is an expert panel composed of R&D managers and specialists, Quality Assurance and Technical Managers.

Stage 1 – scoping and laboratory exploration: A comprehensive assessment of technical and financial benefits and market prospects is performed. This stage operates with variant and scenario approaches. This critical stage must prove that the technology projected is technically feasible. In addition to an irrevocable confirmation that the company is capable to accomplish the technological aspect, it is necessary to examine if the technology provides an actual generic form of the original drug. To avoid potential intellectual property infringements, preliminary laboratory development considers only those technologies apparently patent free. The output of this stage is the Opportunity Study approved by the gatekeeper executive management team and the Managing Director.

Stage 2 - development: Development plans are transformed into concrete deliverables. Plans are divided into several phases, each substantiated by a comparison with the predefined milestones. Technological development and engineering are performed to their full capacity and include scale-up, technology placement, ancillary operation assurance and pilot production tests. In addition to technological development, marketing, logistic, quality assurance, operating and above all, financial plans are elaborated. Finally, the test plans for the next stage are defined. The output of this stage is the Feasibility Study approved by the gatekeeper Board of Directors.

Stage 3 - testing and validation: Process(es) testing and validation are activities ranked among the most important. The purpose of this stage is to perform validation of the entire project and includes process validation and testing methodology validation. Both types of validation are prerequisites to obtain final approval from the regulatory authorities. In addition, customer acceptance of the product and the economics of the project are subject to final verification. R&D and Quality Assurance Directors must be cognizant of project parameters with regulatory standards. These standards are addressed in the regulatory authority guidelines, typically the State Institute for Drug Control in the Czech Republic (SUKL); the Food and Drug Administration in the United States (FDA), and various other Pharmacopoeias (European, US, Japanese Pharmacopoeia). The output of this stage is a validation report. Gatekeepers are R&D and Quality Assurance Directors.

Stage 4 - final process audits: Final process audits are critical milestones, which qualify the process for commercialization. Successful completion of these audits is a precondition for product commercialization; otherwise, the company is not authorized to market the product. The audits focus on several key topics:

Health and Safety – audit is performed by Regional Hygienic Station to confirm that the new technology is safe.

Environmental Compliance – technology complies with 2008/01/ES or its Czech equivalent 76/2002 Sb. When implementing new technology, companies submit updated versions of the Integrated Prevention and Pollution Control (IPPC). Approval is granted by a Regional Office which judges whether the Best Available Technology (BAT) was actually used and environmental pollution is within the prescribed limits.

Compliance with Quality Assurance Standards –the most challenging of the approval process. Auditors examine whether compliancy exists between the company's Quality Assurance System with the codified standards as well as the principles of Good Manufacturing Practice (GMP) on new technology at full scope. If the company fails to meet the GMP standards, the company is prevented from pharmaceuticals production. Gatekeepers are both internal and external auditing bodies: internal auditors, SUKL, FDA, Regional Hygienic Station or Regional Office. Internal mangers are responsible for preparedness for final audit while the external regulator auditors have the integral authority to grant final approval to market the product.

Stage 5 –Innovative product launch: Any pharmaceutical product has to be registered by customers who eventually register the product with the respective national health authorities. Therefore, it is necessary to provide customers with intensive support. To expedite the registration process, it is necessary to provide all available data to avoid customer redundant work. The registration process, dependent on the demands of the registration authorities, is often protracted. Unfortunately, unless the registration process has been successfully completed, the commercial production cannot commence. Therefore, it is the intention of the producer to be conducive to the customer in that both parties work together to commercialize the product in the shortest time. From the legal perspective, it is necessary to execute all sales contracts, arrange for logistics as well as other tasks. Gatekeepers are internal company managers responsible for an effective cooperation with the customer and implementation of the necessary procedures.

7 Case Study Implications

The empirical correlation between the level of innovativeness expressed by the number of products under development and company value is exemplified within the PharmaComm case. Over the past decade, the company did not have a strategic plan to support innovations as no new product was envisioned. Given these circumstances, external investors were reluctant to bid more than 1M Euro for PharmaComm. This despite the owner's expectation of approximately 4.8 M Euros. To resolve this dilemma, it was necessary to seek appropriate tools that would over a three-year period increase company value to the anticipated level. In this context, the company judged innovation as the most efficient leverage. As the company is not listed on a stock exchange, only one way was available to measure, monitor and communicate company value to the owners. The adopted approach was based on the comparison of the bids indicative of the potential investors' 'willingness to pay' for the company. Although there was a lack of innovative projects that feasibly could be completed over the three-year span, it was surprising to observe how even unfinished innovations without any tangible economic result, increase the company market price. Table 1 illustrates the dependency between the number of innovative products as sales opportunities and the company market price expressed as actual bids submitted by investors.

Table 1. Dependence between number of products under development and company value (own research)

Year	2005	2006	2007	2008
Number of new products in the pipeline	0	1	3	4
Actual bids for the company offered by investors (M Euro)	1.8	3.4	5	5.4

Due to its research strategic goals, PharmaComm accomplished the reengineering of its product portfolio thus permitting the product´s life-cycle to be observed and managed. During that period, the company had ten products in its portfolio. Four products serve as cash cows and provide the greatest turnover. Potential sales opportunities of innovative projects include research associated with three additional products. Over 90 % of the entire production is identified for export to global markets such as, Russia, USA, India, Australia and several South American countries, where the demand to fulfil requires testing conditions for market penetration. Sales growth has a potential of 3 – 7 %, due to the successful introduction of newly developed products.

In 2012, the firm's market value substantiated by investors, represented 21 M Euros, determined by the DCF and MVA methodologies. Within five years, PharmaComm, through the implementation of its version of SGCP became one of leading companies in the industry (Klicperová, 2012). The company reinforced its competitive position to capture a larger market share for its new products and to approach new customers interested in an innovative product. Due to effective management the company expanded its product portfolio and thus to diversify company business. Almost immediately, customers considered the company to be more stable and reliable as a business venture. Even prior to profit identification sourced from the new products, potential investors increased their bids.

The correlation between the number of new products as potential sales opportunities and company market price is observed through the investor initiatives. Similarly, the ability of the company to innovate is an inherent part of company goodwill manifested by the investor interests to acquire the company. This conclusion is in consonance with the findings of Gassman, that the drug development pipeline is a key value driver for pharmaceutical companies. Moreover market valuations of pharmaceutical companies are usually based on prospected new drugs approvals and expected new drug revenues costs (Gassman and Reepmeyer, 2005). The company was finally sold to a new investor who recognized the hidden potential of effective innovation management. The final bid and execution price more than quadrupled the company book value. This example demonstrates how effective innovation management process impacts company value through reinforcing its competitive position.

8 Results

Research and innovation activities management becomes a part of its strategic management. The rate of future success and competitiveness depend on the effectiveness of its internal innovation processes. This explains why data are connected with value analysis and factors to create value derived from innovation activities. Information of this nature is corporate sensitive and is not readily available to the public to formulate analysis or comparisons. Typically, it is related to company sale proposals. The methodology deployed for this research is based on the analysis of a case study. In turn, the case study involves an actual entity, which enabled the authors to analyze sensitive data. Barriers to research of topics of this nature are the volume of statistical data available, the number of companies concerned, the fact that a part of data remain soft based on qualitative parameters, forecasts and investor´s behavior. This decreases the applicability to statistically process.

The data and information used for this discussion were obtained through personal research with data usage within the actual company. The case study proves that implementation of a formalized access to strategic management of innovation and research processes does have a positive impact to value creation, which reflects investor interest to grow and support such projects and companies. At the same time, investors view such investments as investments of relevant risk, which effectively decrease operating capital costs (Klicperová, 2012).

Additional in-depth research dedicated to the assessment of the impact of selected types of innovation such as, product, marketing, process and organizational innovation, on company performance or value creation is recommended. There is of course, the limitation to execute a large scale research project in view of the confidential character of the data and the low comparability levels.

9 Conclusion

The authors demonstrate how efficient innovation contributes to company value generation. The company ability to innovate is considered as one of the most powerful value drivers.

Companies strive to exceed competitors and therefore, seek tools to accelerate the innovation process and generate higher customer value. Companies improve their competitive position through the capture of larger market share for innovative products, the acquisition of new businesses with innovative products and diversification of company's product portfolio.

A formalized structured innovation process methodology also permits to gain competitive advantage and the subsequent company value growth. The Stage Gate Control Process and its customized adaptation to particular business environments is proved as a flexible and usable methodology. Despite the prevalent use of SGCP by established companies focused on large-scope innovation projects, even mid-size and small companies can use a formalized innovation management methodology. These companies may address all internal particularities so that the process operates at optimum level. Using a formalized innovation process derived from SGCP is

exemplified by PharmaComm case study. Not only did the company benefit but also attracted investors who recognized its potential, sophisticated innovation management and in turn, bid for the company four times the book value. The company succeeded to obtain and maintain a competitive edge over its rivals. The findings explored in this manuscript are consistent with previously published results.

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Coopetition at Elevator Pitch Events? A Case Study of Micro-activities at a Business Innovation Event

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Abstract. Although coopetition studies often focus on innovations and knowledge creation, these studies often ignore three perspectives: coopetitive micro-activities, short-term coopetitive activities and short-term coopetitive micro-activities, especially as sources of innovations. This study takes the initiative to fill this gap using a case study example of the first (elevator) pitch event held in Finnish Lapland. The outcomes imply that management and innovation studies should also consider the importance of short-term innovation events and micro-activities in the coopetition and knowledge creation processes. These types of short-term collaborative and coopetitive micro-activities and practices might have long-term effects in the innovation paths of business.

Keywords. start-ups; coopetition; duration; micro-activities; (elevator) pitch event; knowledge creation; innovation.

1 Introduction

Contemporary business life is becoming more and more hectic and turbulent (Hannon, 2013). This feature emphasizes the speed of communication and decision-making in business. Innovative elevator pitch events are an example of hectic business practices and environment, where the presentation of a business idea typically lasts only a few minutes—and the whole event several hours (see Jourdan et al., 2010). These events are an important channel for market entry for start-ups (Hochberg et al., 2006). Pitch events are based on networking and collaboration between the event stakeholders, such as the competitors, jury and audience (Friedland & Jin, 2012). Generally, the collaboration between competitors is called "coopetition" or "co-opetition" (Brandenburg & Nalebuff, 1996; Bengtsson & Kock, 2000).

This paper focuses on the coopetition features of pitch events by using one event, the HWB pitch event (pseudonym), as a case study example. This study fills several research gaps in the coopetition literature. While focusing on innovative pitch events, this paper studies coopetitive micro-activities, short-term coopetitive activities *and* short-term coopetitive micro-activities, especially as sources of innovations. These perspectives provide the most important contribution of this study since they are lacking in the coopetitive discussions.

Typically, coopetition studies have focused on long-term relationships between firms and organizations (Bengtsson & Kock, 2000; Zineldin, 2004; Rusko, 2011) and have

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not considered the potential importance of short-term micro-activities and relationships between individual actors. This study provides new initiatives for these coopetitive perspectives. Leaning on the experiences and outcomes of these coopetitive features at an innovative pitch event, especially the case study event, this study also provides general implications for these coopetitive features.

Coopetition discussions have several typologies and classifications. Perhaps the most important division in contemporary discussions is based on dyadic coopetition versus multiple or multifaceted coopetition, which is based on value net with the win-win-win feature (Walley, 2007; see also Bengtsson et al., 2010; Rusko, 2014), whereas dyadic coopetition follows the win-win or even the win-lose structure—at least in the case of value appropriation (cf. Ritala, 2010). One interesting research question is the manifestation of coopetition, such as whether the observed coopetition activities in the case study innovation event lean on dyadic or multifaceted coopetition.

After the introduction, the theoretical framework is discussed, and contemporary coopetition discussions associated with innovativeness, the duration of coopetitive relationships and the level of research analysis in coopetition are introduced. The third section contains the research design with the case introduction. Then the outcomes of the study, about which reflections are included in the discussion section of the paper, are discussed, and finally, concluding remarks are presented.

2 Innovations, duration and micro-activities in Coopetition discussions

Traditionally, business actions and relationships between companies have been viewed as co-operation or competition, alternatives that seem to be opposites and cannot occur simultaneously as competition between partners has been seen as a harmful factor for cooperation (Bengtsson & Kock, 2000, 412). Both concepts are widely recognized and researched in business sciences, but the combination—coopetition—has not yet received similar attention (Padula & Dagnino, 2007; Rusko, Merenheimo & Haanpää, 2013, 2). However, this phenomenon, called coopetition, was identified during the 1980s to describe a situation in which companies cooperate, such as research and development (Luo, 2007, 1).

Although various coopetitive perspectives and the long research traditions of coopetition many perspectives are, at least partly, underdeveloped or completely neglected. This section contains, based on the research literature, three coopetition perspectives: innovations and coopetition, the duration of the coopetition activities and the level of the coopetition activities. The main contribution of this study is the discussion of these themes based on a case study.

2.1 Innovations and coopetition

Knowledge creation and innovations are becoming popular research subjects in coopetition (see, e.g., Park et al., 2014; Yami & Nemeh, 2014; Wu, 2014; Yang et al., 2014; Tsai & Hsu, 2014). According to Gnyawali and Park (2009, 308),

> *Small and Medium-Sized Enterprises (SMEs) face tremendous*

> *challenges in their attempt to pursue technological innovations… co-opetition strategy—simultaneous pursuit of competition and collaboration—helps SMEs to develop their ability to effectively pursue technological innovations.*

Park and colleagues (2014) investigate to what extent coopetition impacts a firm's innovation performance. In addition, Yami and Nemeh (2014) study which form of coopetition favors which type of innovation. Wu (2014) investigates the relationship between cooperation with competitors and product innovation performance, Yang et al. (2014) focus on the question, are knowledge exchange and knowledge protection conflicting or complementary? Tsai and Hsu (2014) examine the relationships between knowledge integration mechanisms and competitive intensity. Yami and Nemeh (2014) observe in a study of five projects that coopetition may occur as incremental and radical innovation. They divided coopetition features into two categories: multiple coopetition, which is especially suitable for radical innovation, and dyadic coopetition, which is suitable for incremental innovation. Thus, there is a connection with the type of coopetition and the type of innovation. Practically, the division between multiple coopetition and dyadic coopetition is in line with the division between multifaceted and dyadic coopetition or the division between contextual and procedural coopetition (Bengtsson et al., 2010; Rusko, 2014). However, according to Rusko (2014), in the smartphone industry, for example, this division is partly ambiguous because of the overlapping types of coopetition: Multifaceted coopetition, for instance, might contain nuances of dyadic coopetition at the same time.

Wu (2014) finds a bell-shaped relationship between R&D coopetition and product innovation. In other words, low and high R&D cooperation intensity contributes a low number of new products. However, midlevel cooperation intensity (coopetition) produces the highest number of new introduced products. Park and colleagues (2014) find the same outcome for competition and collaboration. These outcomes imply that there might be a productive balance point or equilibrium between cooperation and competition (see also Park et al., 2014). In addition, Tsai and Hsu (2014) partly confirm the same outcome: Competitive intensity seems to have a negative influence on the performance effects of cross-functional collaboration and knowledge integration mechanisms. In other words, achieving efficient knowledge creation and integration is impossible without collaboration intensity.

The type of coopetition in innovation competitions, such as pitch events, represents the same type of coopetition as innovation projects, which can be called "horizontal coopetition" (Ritala, et al., 2009), whereas, according to Lechner et al. (2014), vertical coopetition describes a situation in which a firm has a vertical exchange relationship with a direct competitor. Innovation events could be a source of these types of coopetitive relationships although these events do not last long.

2.2 Duration and coopetition

Typically, coopetition studies focus on long-term relationships among firms and/or organizations, such as multiyear projects (Mariani, 2007; Kylänen & Rusko, 2011) and alliances between competing firms (Bengtsson & Kock, 2000; Rusko, 2011; Park, Srivastava & Gnyawali, 2014). Coopetition studies that emphasize short-term activities, such as innovation events, are rare.

The management literature provides definitions for long-term and short-term relationships. Riemer and colleagues (2001) define short-term and long-term collaboration in the following way:

> *The duration of collaboration means on the one hand short-term collaboration in one single project, where the partnership is dissolved after the end of the project … On the other hand long-term collaborations with strategic character and close linkages between partners exist (e.g. strategic alliances)*

This definition, which links short-term collaboration with the duration of a typical project, supposes the duration of short-term collaboration is long: The project might even last several years. The present study emphasizes noticeably shorter periods in the context of short-run collaboration.

Often, coopetitive firms behave opportunistically in their strategic actions. This might also mean fast changes in coopetitive strategies. The win-win strategy and value creation of coopetition might change depending on the value appropriation during the changes in the "coopetitive advantage" (Ritala, 2010). These kinds of changes in strategy are based, perhaps, on the emergent strategies of the firms, where strategies change relatively fast because of the underlying changes in the business environment (cf. Mintzberg et al., 2005).

Innovation events, where the duration is especially short, provide an interesting platform for studying short-term coopetitive relationships. This perspective provides new outcomes for coopetition discussions and new perspectives on short-term coopetitive relationships.

2.3 Coopetition and levels of analysis

Scientific perspectives are often divided into three levels of analysis: micro, meso and macro (Mohan, 1996). The definitions of these levels vary among studies and contexts. For example, according to Nhemachena and Hassan (2007), in agriculture in the adaptation of climate change, micro-level analysis of adaptation focuses on tactical decisions and the availability of formal institutions for smoothing consumption, whereas macro-level analysis focuses on strategic national decisions and policies and their long-term effects. Livingstone (1998) observes that meso-level analysis focuses on units between the individual and the institution, such as the household, family, community, and a range of other informal groupings.

In coopetition discussions, these levels are also considered. According to Rusko (2015, 576):

> *In addition to firms, coopetition is also possible between other types of organizations, such as public organizations or between different units of organization. The latter one is called "intra-organizational coopetition." Thus, coopetition is a multifilament perspective which is suitable tool for considering micro, meso and macro level interactions within and between organizations or networks.*

However, mostly "the phenomenon of coopetition applies in particular to structures that operate in economic mesosystems, such as clusters, industries, sectors." (Figiel et al., 2014, 27). In this sense, elevator pitch events with coopetitive micro-activities provide

fresh perspectives on the coopetition discussions focusing on the micro level.

3 Methodology

3.1 Research method

This study follows the case study strategy, an appropriate method for studying innovations of SMEs (Halcon, 2011; Gardet and Fraiha, 2012). According to Edralin (2000) and Baxter and Jack (2008), an *event* is, similar to patterns, individuals or groups, a typical research object of the case study in business research (see also Halcon, 2011). Thus, a case study might be a suitable method for studying pitch events.

The case study strategy enables, at same time, several methods are used at the same time to find answers to research questions (Yin, 2013; Eriksson & Kovalainen, 2008). According to Halcon (2011), three suggested data-gathering techniques for a case study are archival analysis, direct observation and participation leading to field notes, and structured or semi-structured interviews among key informants as respondents of the study. In other words, case study techniques are based on documents, ethnography (cf. Hammersley, 1992) and analysis of key informants.

This case study on an innovation event included three techniques: 1) *documents*, such as e-mails and memorandums of several meetings to construct Table 1, which concludes the project communication and activities during the planning period for the HWB pitch event; 2) *field notes* based on participation in planning (and direct observation); and instead of interviews and 3) *content analysis* based on the written documents about the event, based on 10- to 20-page reports written by seven students out of 50 spectators. Furthermore, the analysis was completed with a short questionnaire, which the participants filled out while they were leaving the event.

Table 1. Project communication activities during the planning period for the HWB pitch event.

Month	Activity	May	June	July	Aug.	Sept.	Oct.	Nov.
Meetings	Steering group meeting	1						
	Planning meeting		2	1		1	2	
	Sparring event							1
E-mails	Between organizers	6	26	3	6	3	64	32
	To pitchers						45	68
	To speakers and investor judges						21	27
	Others		2				76	46
Others	Facebook updates						13	8

This case study focused on one (elevator) pitch event, which followed the typical features of pitch events, and therefore has generalizable elements about innovation networks in the form of an innovation event. The case study is a suitable framework for studying a pitch event, because the different types of events are among the most typical research objects of case studies (Yin, 2014).

The aim of the study is to find new perspectives on short-term coopetitive micro-activities associated with innovation and knowledge creation. Innovative pitch events contain these kinds of features, which reflect the various types of tension between competition and collaboration. At the same time, this paper studies the importance of duration in business coopetitive activities.

3.2 Case description

Although the authors have participated in and arranged several innovation events, the case study example is based on one event, the HWB pitch event, the first (elevator) pitch event held in Finnish Lapland. The extraordinary position of this event caused stronger consequences compared with "ordinary" innovation events. The planning process, for instance, was exceptionally long and lasted more than half a year. The planning period included eight official meetings, 393 e-mails and 21 Facebook updates (Table 1).

Preparation for the event began in April 2013 by the authors. The plan was completed in May 2013, and partners were found by the end of May. During the spring, the action plan was refined by the steering group, but implementation was delayed until the following autumn due to financing shortfalls. Most of the work was completed in October and November 2013. The speakers were booked by the ELY Centre, and the rest of the arrangements were mostly the authors' responsibility. This article is based on the experiences of three members of the project team and the documented interaction between the organizers, pitchers and other participants.

The planning team carefully familiarized themselves with the traditions of (elevator) pitch events. The venue, for instance, followed the traditional layout consisting of two halls: a hall with a stage and another hall for important small talk and a buffet. The panelists (potential financiers) were situated at the front (right-hand side) of the stage. The pitchers and organizers were mostly placed in the main areas of the hall (Fig. 1).

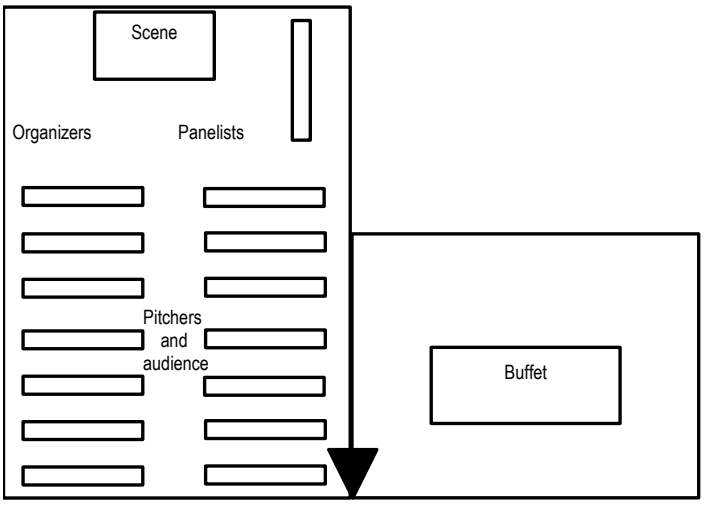

Fig. 1. Illustrative layout of the event.

The HWB pitch event was held on November 2013 in Rovaniemi, Finnish Lapland.

The event attracted business professionals, early phase entrepreneurs, people interested in entrepreneurship and students from the University of Lapland as well as from the University of Applied Sciences of Rovaniemi. The program was divided into two parts: In the morning, there were lectures on incorporeal rights, enlarged value added and experiences of immaterial property rights in practice in Lappish companies; and after lunch, the rest of the day was reserved for the pitches. The 11 pitchers had varied backgrounds ranging from experienced entrepreneurs to students with just a vision of a business idea as well as innovators who planned to establish their own businesses. The idea of the event was not primarily to attract investment, and the panel's purpose was to comment and give valuable feedback and advice to the pitchers and their business ideas. The panel members came from different positions: sales and marketing, corporate acquisitions, business startups, as well as successful exits. Some also had intellectual property right experience in the private and public sectors.

After the final pitch, we asked the panelists to give their overall feedback to the pitchers. In general, the panelists found the pitchers' enthusiasm, clear intent and entrepreneurial spirit positive and inspiring as well as the diversity of the pitches and scale of ideas. The panelists also thanked the pitchers for their creativity and positivity and for their ability to take into account immaterial property rights and other legal issues to support the development but not restrict it.

In addition, after the event every participant was asked to fill out a feedback questionnaire to give the organizers suggestions on what was successful and what should be critically considered next time. Altogether, about 70 people registered to participate in the event and the final level of attendance was about 80 percent, including the organizers, pitchers, speakers and panel members. The exact number is not known, since the doors were open to everyone and participation was not controlled except for university students for whom participation was included as part of an entrepreneurship course. In addition to university students, the event attracted participants from local and national entrepreneurship support and finance organizations, local companies and other schools. Thus, networking and collaborative relationships dominated the event.

Based on the conversations on the spot, most of the participants seemed very pleased with the event (Table 1). They especially were grateful that an event like HWB had finally been organized in Rovaniemi; in many larger cities, such events are held on a monthly or even weekly basis. The feedback via the questionnaires indicated the same kind of results. On scale of one to five, one meaning very bad/unlikely and five very good/likely, the event received the following scores (based on 35 returned forms).

Table 1. Summary of the feedback based on the questionnaires.

N=35 (70 %)						
The success of the event						
Value	5	4	3	2	1	Mean
Amount	9	23	3	0	0	**4.2**
Did the event meet expectations?						
Value	5	4	3	2	1	Mean
Amount	9	19	6	1	0	**4.1**
Probability of re-participation						
Value	5	4	3	2	1	Mean
Amount	19	9	6	1	0	**4.3**

The questionnaire included several open-ended questions to help the organizers find out what was done well and what features should be developed in the future. In general, the atmosphere of the event was praised as well as its novelty value. In addition, the opportunity to network and find out that there is a vibrant start-up scene in Rovaniemi region was one of the benefits.

4 Outcomes: Coopetitive elements of the event

The outcomes are based on the experiences of the authors as organizers during the one-day HWB innovation event, 10- to 20-page feedback reports written by seven students, results of a short questionnaire about the event filled out by 35 respondents (filled at the end of the event), notes and the authors' emails. The underlying features of the outcomes are innovation, short-term relationships, and micro-activities because the outcomes were based on one short-term event, which was arranged in a relatively small place, which enables personal relationships and conversations, that is, personal micro-activities, during the presentations and breaks. Thus, the coopetition results actually consider the aims of the study: to investigate short-term coopetitive micro-activities. The results are divided into two subsections: collaboration-based and competitive-based coopetition micro-activities (cf. Bengtsson & Kock, 2000).

4.1 Collaboration-based coopetition

Since the HWB event was the first open pitch event in Finnish Lapland, the decision was made not to limit the business ideas of the presentations to any particular field of business. Because of the lack of local traditions in (elevator) pitch, getting enough pitchers was challenging. Thus, pitches from all branches were welcome in this event. In many cases, pitch competitions focus on certain industries, which is a very good way to ensure that the interests of panel members or investors are met. In the case of specific pitch themes, the competitive tension between pitchers is higher. Now the degree of competition was lower and the degree of cooperation among the pitchers was higher due to inclusive themes. In practice, many of the business ideas focused on one area, however: ICT (Information communication technology).

The HWB innovation event was not a "competition." Although potential investors attended the event, the participants did not compete with each other for prizes. The advantages for the pitchers were based on the financial and networking opportunities the event provided.

Because of these challenges associated with publicity and IPR (Intellectual property rights), the pitchers needed a training session beforehand. This session was organized on 7 November 2013 to familiarize the participants with pitch and help them refine their presentations. The ELY Centre of Lapland recruited a consultant for this need. This meeting increased the pitchers' presentation skills but also decreased the fellowship among pitchers a bit, perhaps due to the collaborative tension among them. This horizontal cooperation increased the cooperative tendency of the entire pitch event.

Some of the audience, seven students out of 50 spectators, wrote reports on the event.

These reports emphasized collaboration. However, some comments show competition and cooperation existed simultaneously:

> *The cooperation between innovators, organizations and sponsors of the competition has become general instead of the typical idea of planning a competition with a "winner-takes-all" emphasis. (Student 4)*
>
> *Whether one of the standpoints of event is to bring about new entrepreneurship and GNP? However, there is still a lot to learn how competitions act practically according to doctrines of economy, strategy, organization theories, and innovation. We need an analysis that will integrate all these in competition in the practice. The competition itself will not create any incremental value. The incremental value will become in the context of the competition event, only if it provides possibilities to innovate, arrange, network, and to get financing so, that it actually creates incremental value to the market. (Student 7)*

These comments emphasize the importance of the business environment, stakeholders and networking in the context of competition. An innovation event is not a separate event but is connected to the business environment. The first comment, in spite of its collaborative tendency, discusses the competitive win-lose structure or value appropriation in the sense of coopetitive advantage and opportunism (cf. Ritala, 2010). The second comment contains the word "competition" several times, but mostly in the sense of innovation competition (though HWB was not actually a competition event) and emphasizes the importance of networking. This commenter sees innovation events as a source of value creation and especially incremental value.

The following features increased the collaboration-based elements of the HWB event: 1) the themes of the pitches were inclusive, 2) the pitchers participated in the training session beforehand, which increased the collaboration tendency among the pitchers, 3) the pitchers did not compete for prizes at the event, 4) the general character of the elevator pitch event was based on networking among different stakeholders of the event and 5) the elevator pitch event provided joint incremental value to different stakeholders. These five collaborative-based elements were based on the features of the HWB event. However, three of the five elements (2, 4 and 5) are very typical of an elevator pitch event, and only two were based on the special characteristics of the HWB event.

The observed elements, such as networking, the general incremental value of the event and the pitch training session beforehand, might be typical of elevator pitch events. The lack of prizes and all-round themes of business ideas were special characteristics of the HWB event, which increased the collaboration-based coopetition of the event compared with most typical elevator pitch events.

4.2 Competition-based coopetition

One defining decision of the event, following traditional (elevator) pitch, was to keep the whole event public (Hackbert, 2009). This means that all pitches were presented publicly in front of the panel and the audience. Many of the participating companies or ideas were in an extremely sensitive phase in the product development and immaterial right, and finally, two of the original 13 participants had to cancel their presentations.

Beforehand, this openness raised a lot of conversation and questions between the pitchers and the organizers to find a compromise between what they could and could not say during their presentation. The publicity of innovation competitions and pitch events is a challenging feature. Although the HWB event was not recorded, which would have increased the publicity, the pitchers were allowed to listen to all of the pitches. Because most of the pitches focused on information technology, this publicity increased the competitive-based tension between pitchers as they tried to share their business plans without revealing information that could be misappropriated.

Inclusive pitches decreased the competitive element of the HWB event. Originally, 13 pitchers signed up, and the participants varied, representing industries ranging from ICT and the games industry to cleantech and basic industries (see Appendix 1) and very different stages of business life cycles. However, many of the business ideas considered ICT one way or another, which in turn increased the competitive-based coopetition.

Many respondents who filled out the questionnaire at the end of the event criticized the schedule dragging on as well as the layout of the room and its classroom-like shape, although the location was standard for small or middle-scale pitches. Based on the organizers' critical assessment of the event, one of the biggest issues was the panel's role as they were not purely investors or neutral advisors but local entrepreneurs who could have used the information they gained from the pitches to serve their own interests. This feature increased the competitive tendency of the event.

Two interesting situations, which increased competition-based coopetition in the event, also occurred between the pitchers and panel members. Both situations were caused by the fact that the panel members did not act as private equity investors, but as entrepreneurs in certain businesses. In the first case, one pitcher's concept clearly competed with the business of a panel member, whose feedback for the pitch embodied the competitive tension between them. In his answer to the feedback, the pitcher tried to express the possibility of cooperation between their businesses. The second case's setting was very similar to the first, but ended up with the panel member and the group of pitcher setting up a meeting to explore the chances of exploiting each other's know-how. In this case, the tension was competitive-based but changed gradually towards coopetitive (Fig. 2).

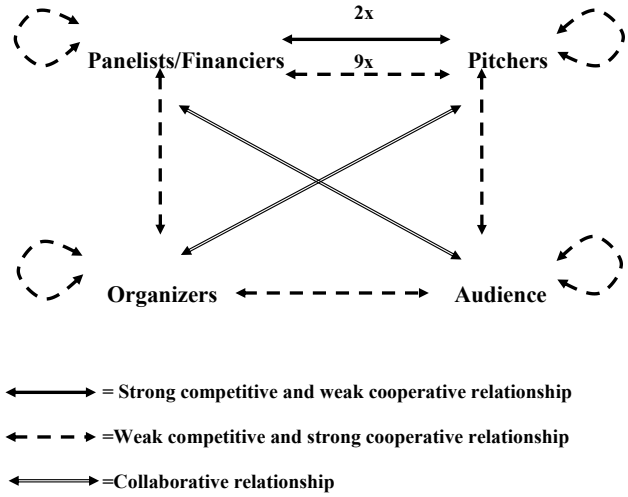

Fig. 2. The types of relationships between actors at the HWB event.

Fig. 2 takes into account the observations connected with the HWB event. Although no prizes were awarded, the competitive element was strong. Between the pitchers, the competitive elements became important due to the facts that innovations focused on the same branches and challenging expectations of audience, which generate social pressure for a successful presentation. This competition element increased because of economic, financial, and personal (social) reasons. Surprisingly, there were also competitive elements in two cases between panelists and pitchers. This was not the organizers' intention. At least one of the cases ended with a collaborative outcome. These two situations had nuances of dyadic coopetition (Bengtsson & Kock, 2000) and unintentional coopetition (Kylänen & Rusko, 2011; Rusko, 2011; 2014; Mariani, 2007).

The HWB event contained three significant features, which increased emphasis on competition-based coopetition. These features are typical of elevator pitch events: publicity, the importance of ICT and the threat of competing firms.

However, the main tendency associated with the case study event was collaborative. The planning, organization and implementation were full of networking actions. The audience acted collaboratively following good habits during short breaks and meal times, which reflect consumer coopetition (Walley, 2007). However, the audience consisted of several competing organizations in business, education and research, which perhaps has tacit and unintentional coopetitive reflections (Okura, 2007; Kylänen & Rusko, 2011).

5 Discussion

Pitch events include the elements that Gnyawali and Park (2009) mention: The participants are entrants, that is (future leaders of) SMEs, who try to launch and develop their business ideas and innovations at the events, which are intentionally based on a

framework that contains simultaneous competition and collaboration. Actually, pitch events provide temporal proximity between potential stakeholders in start-ups. Stakeholders of the event gather in the same small place, which provides, in addition to public discussions, the opportunity for face-to-face discussions between stakeholders. This "geographic" proximity is only temporal, but the event itself is the arena for long-term collaborative and coopetitive relationships, where the proximity is not only temporal and not only based on the same place. At elevator pitch events, start-ups consider the role of the social and cognitive dimensions of proximity (cf. Presutti, et al., 2011).

Traditional pitch events contain several stakeholders, who cooperate within the pretext of competition event. Innovation competition is not based on dyadic coopetition: It contains several types of participants, who have competitive and collaborative relationships (Fig. 2). Thus, it is the reverse, based on multiple, multifaceted or contextual coopetition (cf. Bengtsson et al., 2010; Rusko, 2014; Yami & Nemeh, 2014) but not so much on vertical (transactional) coopetition in the sense of Lechner et al. (2015). Coopetition activities, which innovation events enable, are more like value net types of coopetition, introduced by Brandenburg and Nalebuff (1996), where stakeholders are involved in coopetitive relationships. However, perhaps the most fruitful coopetition associated with an innovation event is between potential financiers and pitchers during the dyadic additional discussions *after* the innovation event. In other words, an innovation event provides a general coopetitive framework, which is based on the value net type of coopetition (Brandenburg & Nalebuff, 1996), where the participants increase the value of the event, that is, the incremental value, but under the value net framework are opportunities for dyadic coopetition, introduced by Bengtsson and Kock (2000) between different participants. Thus, elevator pitch events provide a multifaceted opportunity to entrants to network with competitors and with other business stakeholders. Networking is also an essential tool for different kinds of marketing activities (O'Donnell, 2014).

According to Yami and Nemeh (2014), radical innovations are suitable for multiple coopetition and incremental innovations occur during dyadic coopetition. The present study showed that typical innovation and pitch events, which focus on potential entrants, and therefore, especially on radical innovation, are constructed in a multiple or multifaceted coopetition environment, value net. The potential entrepreneurs need to network to secure financial and other types of support in order to further develop their business; in other words, they need multiple coopetition. However, the deeper development work of the business idea takes place after the innovation event via dyadic discussions and coopetition. Thus, this study partly supports the findings of Yami and Nemeh (2014): The presentations of innovation events are based on radical innovations, which need contacts and networking, and which innovation might provide. However, more concrete R&D activities happen after the event, where radical innovation meets other completing ideas, in other words, incremental innovations. Innovation and pitch events are arrangements, where the organizers are *intentionally* creating circumstances for *multiple coopetition, where the entrants have the main role in the play*. The elevator pitches have to be innovative, but one of the aims of pitching is to get financing and advice from the panelists (Zidek, 2010) in order to develop the innovation further for the market (Rusko, Härkönen & Petäjäniemi, 2016)

Although the preparation phase of the innovation event might be long, the event itself is very short. Typically, one pitch lasts five minutes, which was the case at the HWB event, and the panelists' comments lasted the same amount of time. Furthermore, the breaks and possible evening entertainment provide more possibilities for small talk and initial business negotiations. However, elevator pitch events, which are short, might be an extraordinary important possibility for new entrepreneurs. From the point of view of coopetition discussions, coopetitive events have an exceptional duration: Ordinary coopetitive relationships, such as multiyear projects (Mariani, 2007; Kylänen & Rusko, 2011) and alliances between competing firms (Bengtsson & Kock, 2000; Rusko, 2011; Park, Srivastava & Gnyawali, 2014) are long-lasting. Generally, coopetition studies on focus on long-term relationships between firms or organizations. However, in addition to long-term coopetitive relationships, the business life contains several short-term relationships between firms.

Table 3 shows the features of an innovation event and two dimensions: the duration of the relationship (or activity) and the state of the collaboration-coopetition-competition in the relationship. Outcomes of the study showed that the elevator pitch event has collaborative and competitive elements simultaneously, which means that the event was between these alternatives. Thus, the HWB event was a coopetitive event. The HWB event was short, one day. Thus, this event and its relationships, and actually nearly all of the other elevator pitch events, can be placed in Table 3 as short-term coopetitive relationships.

Table 3 contains six positions. Typically, coopetitive activities in management research can be placed as *long*-term coopetitive activities, such as alliances and projects between competitors. Generally, all alliances are based on long-term relationships. If an alliance is vertical, it is a long-term collaborative relationship without any significant competitive elements.

Table 3. Elevator pitch event among the dimensions of duration and different types of relationship.

Type of relationship	Duration	
	Short	**Long**
Collaborative	**A** Short-term cooperation between vertically integrated firms	**B** *Dyadic or multifaceted discussions after elevator pitch event,* e.g., *between the pitcher and a potential financier (or another stakeholder of the event in the form of vertical or diagonal collaboration)* Vertical alliance Vertical multi-year project Planning and preparation of innovation event
Coopetitive	**C** *Elevator pitch event* Short-term cooperative action between competitors	**D** *Dyadic discussions after elevator pitch event, e.g., between the pitcher and competing panelists or another pitcher or a potential financier (or another stakeholder of the event)* Alliance between competitors (Or diagonal alliance between firms) Multi-year project between competitors Long-term (virtual) innovation competition
Competitive	**E** Competitive bidding	**F** Typical relationship between competitors in the market

Short-term actions in business are based on a typical exchange of goods and services between firms, transactions. Market transactions are trivial business activities, which are also possible between competitors, which is the case of vertical coopetition (Lechner et al., 2014). In business, there are also other short-term cooperative activities. Short-term innovation events, such as HWB, are one example.

Coopetition studies have considered R&D coopetition (Rusko, 2014; Tsai and Hsu, 2014; Wu, 2014), which are typically long-term coopetitive relationships. An elevator pitch event is in this sense exceptional: It has a short duration and focuses on the development of a business idea, where R&D activities take place (State C in Table 3). However, the outcomes of this study showed that after the innovation event, some participants might continue coopetitive (and collaborative) discussions in order to develop the business idea further in the long run (states B and D in Table 3).

The features of an elevator pitch event cover at least three positions in Table 3: B, C and D. Table 3 also shows other positions of the introduced framework, though they are not the focus of this study.

Potential other reasons for short-term coopetition are as follows:

1. To avoid general threats from the business environment (standards, legal changes, threat of new taxes)
2. To promote or to progress the whole industry in the business environment (e.g., new standards, lower taxes, marketing campaigns, cf. Okura, 2007)

In other words, short-term coopetition might not occur in the context of innovations or knowledge creation but while using together publicity in order to avoid or promote something important to the whole industry.

Thought its character of funny and entertaining event, literature of management, innovations—and especially coopetition discussions—have to take seriously the phenomenon of elevator pitches because of its financial importance and its particular focus on SMEs, start-ups and potential entrants. Although the duration of the pitch event is short and the effects are based on micro-activities and face-to-face relationships, it provides similar possibilities for an innovation network as innovation hubs (cf. Gardet and Fraiha, 2012): A successful pitch event provides networking possibilities for pitchers (SMEs) with other entrants, with a selective audience containing other SMEs, mature firms, potential financiers and panelists (potential financiers and co-partners). These relationships are collaborative but also coopetitive—especially the more focused the pitch theme. The element of competition—and coopetition—is highest in innovation competitions with specific themes.

6 Conclusions

The aim of this paper was to study the features of short-term coopetitive micro-activities using one innovation event, the HWB pitch event (pseudonym), as a case study example. The aim of the study was based on short-term and micro-level perspectives, which are lacking in coopetitive discussions.

The outcomes show that innovation events contain several collaborative and competitive features, which are based on official and unofficial opportunities for the stakeholders of the event to meet and to network with each other. In the case study, coopetition appeared, collaboration-based coopetition instead of competition-based coopetition. This emphasis might be based on specific features of the HWB event: This innovation event did not provide prizes to pitchers, and the event was inclusive without restrictions on the industries of the pitches, although the business ideas emphasized ICT.

The HWB event contained several simultaneous collaborative and competitive elements, which are typical of innovation events. Elements that increased collaboration tendency were networking, the general incremental value of the event to all stakeholders and the pitch training session beforehand, which increased the collaboration level between pitchers. The features that increased the competition characteristics were publicity, the importance of ICT business among the pitches and the threat of competing firms. This threat was observed in the analysis twice between pitchers and panelists. However, the general tendency of the innovation event was very collaborative, which was also observed in the high scores among the questionnaire results.

The coopetition of innovation events is more like value net-based multiple or multifaceted coopetition, where several stakeholders are involved in a coopetition network instead of dyadic coopetition. Innovations events contain business ideas with radical innovations, which cause problems because of publicity. However, the discussions after the event often follow the dyadic coopetition framework, where improved R&D activities are based on incremental innovations.

This study showed the general importance of short-term coopetition. Short-term events, such as HWB, might provide a suitable short-term platform for R&D coopetition. Furthermore, this study revealed that micro-activities, such as face-to-face discussions at this kind of event, might be a fruitful source for important coopetitive activities, which might also have long-term reflections in the further development of business ideas. Thus, this paper encourages future coopetition studies to focus more on the short-term activities and micro-level activities of coopetition. These perspectives provide several opportunities for further studies.

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Appendix 1 The pitcher in HWB event

Business field	Description	Participants
Open data (project)	A project aiming to improve open data services in Lapland	2
Advertising agency activities	A creative collective producing brand management and image marketing	1
Data processing, hosting and related activities; web portals	Online information services.	1
Wellness industry	Manufacturing natural products and producing wellness services	1
Computer programming activities	Augmented reality services for business	1
Landscape service activities	3D modeling, visualization, and virtual worlds	1
Manufacturing of metal products	Manufacturing enhancement devices for tree-like material combustion	1
Computer programming activities	360° spherical panorama application	1
Remediation activities and	Online oil analysis	1

Business field	Description	Participants
other waste management services		
Manufacture of computers and peripheral equipment	Manufacturing Unix-based computers	6
Data processing, hosting and related activities; web portals	Social media memorial service	1

Appendix 2 Responsibilities and original Schedule

Action point	Responsible (planned)	Responsible (realized)	Deadline
Tendering and booking premises	Financier 1	Financier 1	Week 36
Booking speakers	Financier 1	Financier 1	Week 36
Preparing marketing material	Financier 1	Organizers	Week 36
Approval of budget and costs	Financiers 1 and 2	Financiers 1 and 2	Week 36
Booking investor judges and solving costs	Financier 1	Organizers	Week 36-37
Finding pitchers (entrepreneurs)	Financier 1	Financier 1 and organizers	Week 37-38
Finding pitchers (students)	Organizers	Organizers	Week 37-39
Creating Facebook event	Organizers	Organizers	Week 37/as soon as the marketing material is ready
Preparing a press release	Organizers	Organizers	Week 36-38/As soon as the venue and speakers are confirmed
Choosing pitchers	Financier 1 and organizers	Organizers	Week 40-41
Marketing and registrations	Financier 1	Organizers	Week 36-38/As soon as the venue and

(entrepreneurs)			speakers are confirmed
Marketing and registrations (students)	Organizers	Organizers	Week 36-38/As soon as the venue and speakers are confirmed
Training event for the pitchers	Financier 1 and organizers	Financier 1 and organizers, external consultant	7.11.2013
Preparing the premises	Financier 1 and organizers	Organizers	13.11.2013

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Mapping and Benchmarking Technological Innovation of Three International Petrochemical Companies

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Abstract. Mapping technological innovation in organizations is one of the important activities that help companies to identify where organizations are clustering their innovation efforts, and where their unexplored innovation spaces are. Current published innovation mapping models do not take into consideration the comparison and benchmarking between organizations in one model. The objectives of this paper are to map innovation in three international petrochemical companies: Gulf Petrochemical Industries Company (GPIC), Saudi Basic Industries Corporation (SABIC), and Dow Chemical; compare and benchmark the results; and explore the possible areas for their innovation opportunities. An innovation mapping model was developed. Innovation data covering three years (2010-2012), were collected, analyzed and mapped on the model. The results showed that the three companies introduced a total of 194 innovations; 53% by Dow Chemical, 38% by SABIC and 9% by GPIC. Product innovations were the dominant type as they presented 57% of total innovations, where 54% of these were introduced by Dow Chemical, 46% by SABIC, and none by GPIC. Position and paradigm innovations were the least innovation type produced, where only 3% of the total innovations were in position and 1% in paradigm. The results also showed that multi-dimensional innovation represented 23.7% of total innovations, where 67.5% of these were produced by Dow Chemical, 28% by SABIC, and only 4.5% by GPIC. Product-process innovations represented 50% of the total multi-dimensional innovations. During this period only 5.7% of the total innovations were radical innovations; these were all introduced by Dow Chemical. The benchmarking results showed that product innovation was the strength in SABIC; process innovation was the strength in GPIC; and product, radical, product-position, process-position and product-paradigm were the strengths in Dow Chemical. For GPIC there are possible innovation opportunities in product, product-process and process-position innovations; for Dow Chemical and SABIC, in the process area. There are possible opportunities in radical innovation in GPIC and SABIC and plenty of innovation opportunities in the position and paradigm areas for

the three companies.

Keywords. Technological Innovation; Innovation Mapping Model; Petrochemicals; Benchmarking Innovation.

1 Introduction

Mapping innovation is one of the important topics in innovation management, where it helps organizations to examine their innovation efforts, to determine the current innovation focus, and to explore where it should focus in the future. Mapping innovation also helps the companies to ensure their incremental improvement is keeping them competitive or they should explore more radical improvements. Nowadays, organizations need to value all types of innovation; they need innovation in all types of innovations in order to survive in an ever-changing challenging environment (Abdel-Razek and Alsanad, 2014). In his study (Knight, 1967) described innovation types as being: product or service innovation, production process innovation, organizational structure innovation, and people innovation. In other study that was done by (Bower and Christensen, 1995), innovation has been classified to disruptive and sustaining. According to Cooper model, the innovation can have several aspects of each type, and has divided innovations into: product, process, administrative, technological, radical, and incremental. This model was called a multidimensional integrative model of innovation (Cooper, 1998). In study that was conducted by (Hovgaard and Hansen, 2004), innovation had been classified to product, process, and business systems innovation. Also, (Trott, 2012) classified innovation to product, process, organizational, management, production, commercial (marketing), and service innovation. According to Oslo Manual (OECD, 2005) the innovation types can be distinguished as: product, process, marketing, and organizational innovation. (Francis and Bessant, 2005) stated that innovation can be classified into four types: product, process, position, and paradigm; (Apax Partners Ltd., 2006) classifies innovation types as: architectural (using existing technologies in new ways), radical, incremental, and modular innovation (creating new technologies to solve existing problems). In his study (Abdel-Razek, 2014) proposed a framework for the classifications of technological Innovation and stated that there are interrelationships between the different types of innovations. In their frequent other studies (Abdel-Razek and Alsanad, 2013a; Abdel-Razek and Alsanad, 2013b; Alsanad and Abdel-Razek, 2016) they developed an innovation mapping model -the 10Ps model- as an outcome of merging the four types of innovations proposed by (Francis and Bessant, 2005) and by taking into account the overlap of each two types of innovations. This model classified innovation into: four one-dimensional innovation types and six two-dimensional innovations. This 10Ps innovation-type model includes: product, process, position, paradigm, product-process, product-position, product-paradigm, process-position, process-paradigm, and position-paradigm innovations. They implemented their 10Ps model by mapping the innovations in one of the largest Saudi petrochemical companies

(Saudi Basic Industries Corporations (SABIC) (Abdel-Razek and Alsanad, 2013a; Abdel-Razek and Alsanad, 2013b; Alsanad and Abdel-Razek, 2016).

The main objective of this paper is to map the technological innovation of three international petrochemical companies that are operating in GCC countries depending on classification of innovations in terms their types and degree of novelty. Moreover, to develop an innovation mapping model that is capable of mapping innovation for several organizations on the same model to compare and to benchmark each company and to determine their strengths and future opportunities.

2 Innovation Classifications

Damanpour has argued that the differentiation between innovation types is an imperative process in order to develop realistic theories of organizational innovations (Damanpour, 1987). The researchers can classify innovation in different approaches. The socio-technical system approach, classifies innovation according to where systems occur. Another approach classifies according to the source of innovation. A third approach classifies according to the attributes of innovation (Mohammed and Bardai, 2012).

The innovation process outcomes include any changes that occur in several aspects of the organizations. Moreover, the companies need to value all types of innovation, though introducing new products is an important element for organizations' success, the organizations need innovation in all aspects of the business in order to continue success in challenging environments (Kelley and Littman, 2006). There are several academic efforts to integrate all terms, frameworks, and models of innovation to formulate a classification system for innovation. In their study (Rowley et al., 2011), have provided theoretical review of models and frameworks of types of innovation, and have stated that the type of innovation is a key concept in the literature of innovation; (Miller and Miller, 2012) have attempted to develop a comprehensive classification system through describing all dimensions, types, and activity levels of innovation. To map innovation by using the 10Ps benchmarking innovation mapping model, each innovation in the organizations has been examined in terms of two dimensions: innovation type, and degree of novelty.

2.1 Innovation Types

Distinguishing between different types of innovation is important for mapping innovation. In this paper, the innovation types are divided into two sections for purpose of clarification as the following:

- One-Dimensional Innovation Type

One-dimensional innovation types include product, process, position, and paradigm (4Ps). In this study, the classification of one-dimensional innovation is based on the following aspects:

1. When the innovation is based on changing its performance capabilities,

improving its characteristics, or adding new features to existing things that are offered by the organization, the innovation is called a product innovation.
2. When the innovation is based on changing its production methods, or using new machines to produce existing things that are offered by the organization, the innovation is called a process innovation.
3. When the innovation is based on changing its availability, and serving new market segments, the innovation is called a position innovation.
4. When the innovation is based on changing or reframes its image, its way to use things, or its way to look things, the innovation is called a paradigm innovation.

Furthermore, the definitions of innovation types by (Francis and Bessant, 2005) could help to distinguish between 4Ps innovation types:

1. Product innovation: the product innovation is related to what the company introduces to its customers or market.
2. Process innovation: the process innovation is related to how the company produces product or delivers service.
3. Position innovation: the position innovation is related to which market segments the product or process target.
4. Paradigm innovation: the paradigm is related to the company frame of product and service, or to the mental model of the company's work.

- Multi-dimensional Innovation Type

Multi-dimensional innovation types include product-process, product-position, product- paradigm, process-position, process-paradigm, and position-paradigm. When innovation effects on many aspects of organizations the innovation can be considered combined innovation, which consists of two innovation types. The classification of multi-dimensional innovation is based on the following aspects. First, when the innovation consists of two types of changes mentioned previously in (2.1.1), the innovation is called multi-dimensional innovation. For example, if the company produces some products to use in its production process, the innovation is product-process. If the company upgrades the existing products to meet requirements in the new markets, the innovation is product-position. Second, (Armstrong and Kotler, 2003) divided the markets into five types including: consumer markets, business markets, government markets, reseller markets, and international markets. Each type has some characteristics and special needs. The consumer markets include those who use product for personal consumption, while the business markets include the companies that buy the product to improve their production line. Hence, their argument is useful to classify the multi-dimensional innovation (product- process). The petrochemical companies are considered "business markets", and 'industrial buyers". Accordingly, the innovation is judged from two perspectives: the customer (buyer), and the petrochemical company (seller). For instance, when the company introduces materials (product) to improve its production line (process), it is both product and process innovations.

2.2 Degree of Novelty

Degree of novelty is that level of change in the new innovation unlike existing innovation. According to (AMA, 2006) incremental innovation applied science searches in incremental improvements of existing knowledge in order to add value in existing product for existing market or, to introduce new product with small changes for new market or existing market. On the other hand, Radical or breakthrough innovation depends on exploring new knowledge, and exploiting new opportunities. Determined degree of novelty for innovations is the level of change in new introduced innovation; such change can be occurred at component or sub-system level or across the whole system. Thus, when the company presents the new grade of existing product, this innovation can be considered incremental innovation in product, unlike the radical innovation, which involves changes at the whole system or major component (Tidd and Bessant, 2009).

3 Mapping Technological Innovation

Innovation maps are the visual graphic tools that are used for specific purposes. The literature shows several innovation maps, with several objectives and scopes of applications. In general, innovation mapping can be divided according to the application scope into: innovation maps at the country level and innovation maps at the firm level. At the country level, innovation maps aim to evaluate some of the innovation indicators of the country or the world, and to describe intensity of innovation in many areas of the world. In study that was conducted by (Kuah et al., 2009), has been investigated approaches and strategies for advancing productivity, innovation and competitiveness in the three small open economies of Singapore, New Zealand, and the Republic of Ireland, through mapping the organizational innovation capabilities between 1999 and 2008. In other study, has been mapped innovation in the UK regions to select which regions are the highest in terms of high-growth firms, patent applications, and creative clusters (Raconteur report, 2013). The result showed that the south- east regions of the UK are placed in the highest areas in terms of patent applications.

At the firm level, innovation mapping can be used to achieve several objectives. Winkless and Cooney developed “mapping innovation space tool” by combining both technical and customer aspects of innovation (Winkless and Cooney, 2004). This map is used to define problems that cause product failure. Some innovation maps are used in educational innovation (Kampylis et al., 2012) that suggests mapping framework of information and communication technology enabling innovation for learning. The framework for learning innovation is mapped across five trajectories: nature of innovation (Radical, incremental, or disruptive), implementation phase, access level (local, national, or cross-boarder), impact area, and target. An additional model for mapping innovation looks at the” 4Ps diamond model” that has been developed by (Francis and Bessant, 2005). According to their study, the “4Ps” model is based

on the hypothesis that successful innovation is related to positive change in four areas: product, process, position, and paradigm. Tidd and Bessant suggested a circle model for mapping innovation by combining the innovation types "4Ps" and degree of novelty (Radical and Incremental) (Tidd and Bessant, 2009). Another model was introduced by (Alsanad, 2012; Abdel-Razek and Alsanad, 2013a; Abdel-Razek and Alsanad, 2013b; Alsanad and Abdel-Razek, 2016). They suggested a modified model for mapping innovation, and have named it "10Ps" model. That model takes into consideration the mixed area between two types of innovation. Hence, they have classified innovations into ten types: product, process, position, paradigm, product-process, product-position, product-paradigm, process-position, process- paradigm, and position-paradigm. They used the 10Ps model to investigate the innovations in one of the largest Saudi petrochemical companies (Saudi Basic Industries Corporations (SABIC)). Figure (2), (3) and (4) display the mapping innovation models that are based on innovation types and degree of novelty.

3.1 Diamond diagram

Diamond diagram had been developed by (Francis and Bessant, 2005), It provides organizations with tool that enable to take better strategic decisions in innovation management, and locate innovation activities on product, process, position, and paradigm. But it doesn't consider degree of novelty and combination between opposite pairs of 4Ps.

3.2 The 4Ps of innovation space model

The model had been developed by (Tidd and Bessant, 2009), It helps organizations to identify where to focus their innovations, to identify the future opportunities and to develop the innovation strategies. In addition, this model helps the organizations to compare maps for different organizations (competitors benchmark), or to compare maps for one organization in different periods (self-benchmark). It takes into account the degree of novelty (radical or incremental) for evaluation. But it does not provide any combination between 4Ps.

3.3 10Ps Innovation Mapping Model

The model was developed by Abdel-Razek and Alsanad (2013a) and implemented by Alsanad and Abdel-Razek (2016). The model enables mapping one and multi-dimensional innovations. In addition, the mapping process is automated. But it does not enable benchmarking process between organizations on the same model.

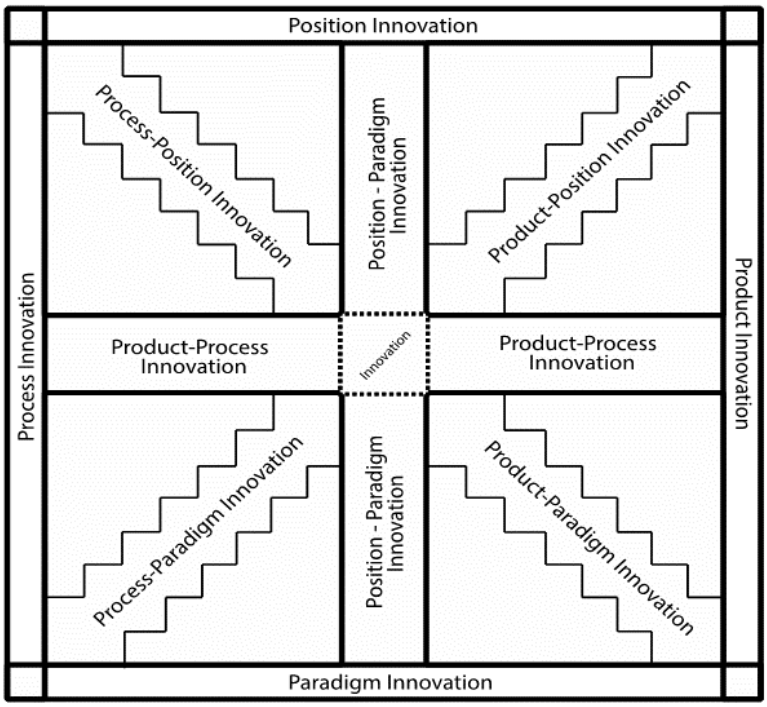

Fig. 1. 10Ps of Innovation Mapping Model (Abdel-Razek& Alsanad, 2013a, p.180)

4 10Ps Benchmarking Technological Innovation Mapping Model

The significance of this paper stems from presenting and applying the developed model of mapping innovation on the industrial organizations; especially the petrochemical companies leads to improve innovation in this sector. Moreover, Comparing several petrochemical companies helps to determine their strengths areas, to explore opportunities areas, and to develop innovations in these areas.

The 10Ps model provides the solutions for the weaknesses in the original model (4Ps) model. Where it takes into consideration the combined areas when innovations are mixture of two types of innovations. Also, it provides solutions for adjacent innovations in 4Ps model such as product- process. Finally, it makes a clear distinguishing between radical and incremental innovation, where radical innovation is represented by black circle, and incremental innovation is represented by white circle. However, the 10Ps model doesn't take into consideration the comparison and benchmarking between two or more organizations on the same model. In order to overcome this limitation, a modified model is suggested. Figure (2) shows the modified model that has been called "10Ps Benchmarking Innovation Mapping Model".

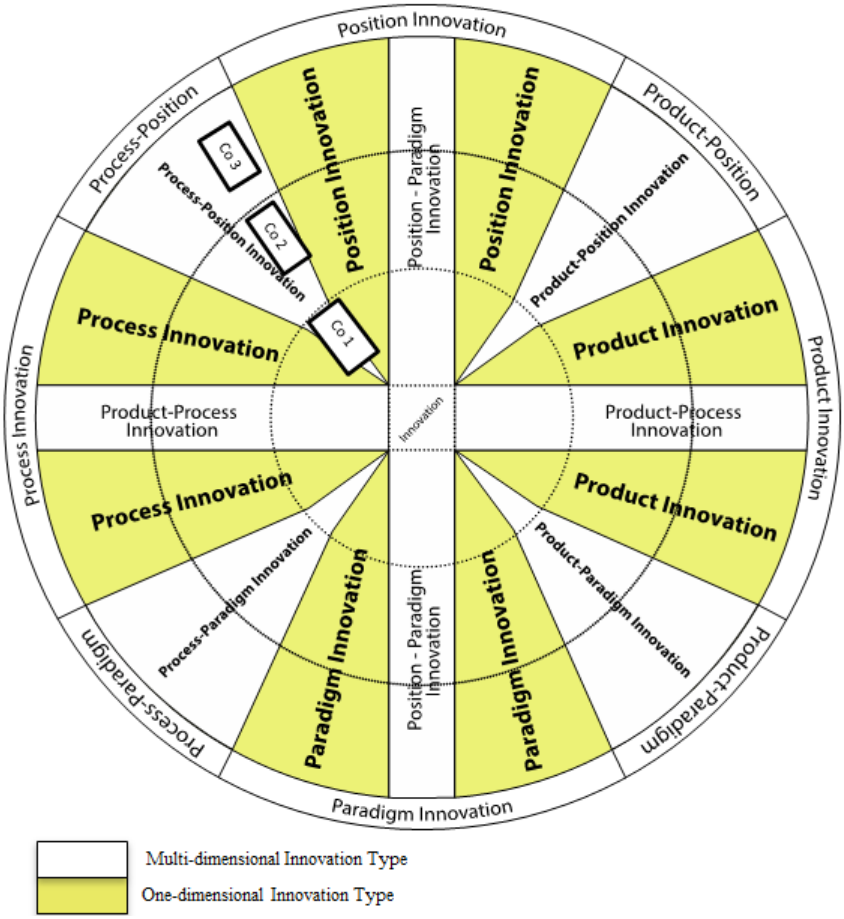

Fig. 2. 10Ps Benchmarking Innovation Mapping Model (Al-Abbas, 2014, p.26)

5 Application of 10Ps Benchmarking Innovation Mapping Model in the three International Petrochemical Companies

5.1 Innovation in the GCC Petrochemical Industry

The source of competitive advantages in the petrochemical industry is a technological differentiation, especially with the challenges that stem from the use of alternative feedstock and sustainability realities. Recreating the innovative mindset in the petrochemical industry is an imperative need (Gembicki, 2004). De Mello stated that the petrochemical industry faces challenges, such as environmental issues, unstable profits, and instability of oil supplies (De Mello, 2012). In his study, he seeks to map how petrochemical companies in Brazil are developing their incremental and radical innovation projects in order to help petrochemical companies to be more radically innovative.

The petrochemical sector in GCC countries represents the vital sector upon which the economies of those countries depend. According to (GPCA, 2013), GCC accounts for only 0.4% of the chemistry patents compared to the total number of patents issued worldwide in the past three years. An innovation survey was conducted (Gulf Petrochemicals & Chemicals Association GPCA, 2011) to investigate how do executives in the Arabian Gulf petrochemical and chemical industry perceives the role of innovation. The results showed that innovation in the petrochemical industry has an important role to secure competitive advantages, to develop proper innovation culture, and to support innovation strategies. The survey also showed that insufficient access to talents and inadequate innovation infrastructure are barriers to innovation. The study also showed that most innovative activities in the petrochemical companies are incremental product innovations.

5.2 Three International Petrochemical Companies in GCC

Two of the selected companies, SABIC and Dow Chemical, are operating in Saudi Arabia and are listed on the top ten chemical companies in the world (ICIS, 2013), while the third selected company GPIC, operating in Bahrain, is a joint venture between GCC members and is a vital economical power of Bahrain. The data needed for mapping innovation, has been obtained from annual reports and summaries of these companies' achievements. The data had been extracted that include any developmental activities for enhance the competitive advantages for the company such as a new developed products.

- Gulf Petrochemical Industries Co (GPIC)

GPIC was established in Bahrain in 1979 as a result of the cooperation between the GCC countries to use the natural gas in Bahrain and to produce petrochemical products and fertilizer. GIPC is a significant contributor to the Bahrain's national economy. Innovation, in GIPC's view, is the activation of the employees to enable the company to achieve its goals and its vision. In order to continue the successes in the future GPIC focuses on investment to upgrade the equipment in its plants and upgrade its management systems (GPIC Annual Report, 2010). The data needed to implement the 10Ps benchmarking innovation mapping model of GPIC has been gathered from the Company's Website (http://www.gpic.com), and the company's sources that include (GPIC Annual Reports, 2010; GPIC Annual Reports, 2011; GPIC Annual Reports, 2012).

Figure (3) shows the application of 10Ps benchmarking innovation mapping model in GPIC from 2010 to 2012, where the first area represents the innovations introduced by GPIC in 2010, while second area, and third area represent the innovations in 2011, and 2012 respectively. The results of mapping innovation in GPIC showed that the company had produced a total of seventeen innovations in the period from 2010 to 2012. 84% of the innovations were in process area, and 5% of them were in position. For example innovation number (2), which was added a new catalysis in the plant that can be considered process innovation (mapped on gray One-dimensional area), because the catalyst is

defined as a substance that increases the rate of a chemical reaction without itself undergoing any permanent chemical change. Furthermore, the multi-dimensional innovations represented by 11% of the total innovations, fell in the product-process area such as innovation number (1) that involved opening a new carbon dioxide recovery plant (CDR), to increase efficiency of production process through contribution to the limitation of Carbon Dioxide emissions, and to increase the production capacity of its methanol and its urea plants. Moreover, this innovation contributes to produce carbon dioxide Co2 and to use it in other plant. However, the clear gap was in other innovation types such as product, position, and paradigm. All innovations were incremental innovations that involved small improvements in existing processes (represented by white circles). The results also revealed that the largest number of innovations was produced in 2010 by 7 innovations, decreased to 5 innovations in 2011 and 5 innovations in 2012. The results also indicated that the best performance for GPIC in terms of the innovation number was in 2010 with 7 innovations, while the best performance in terms of diversity of innovation types was in 2012.

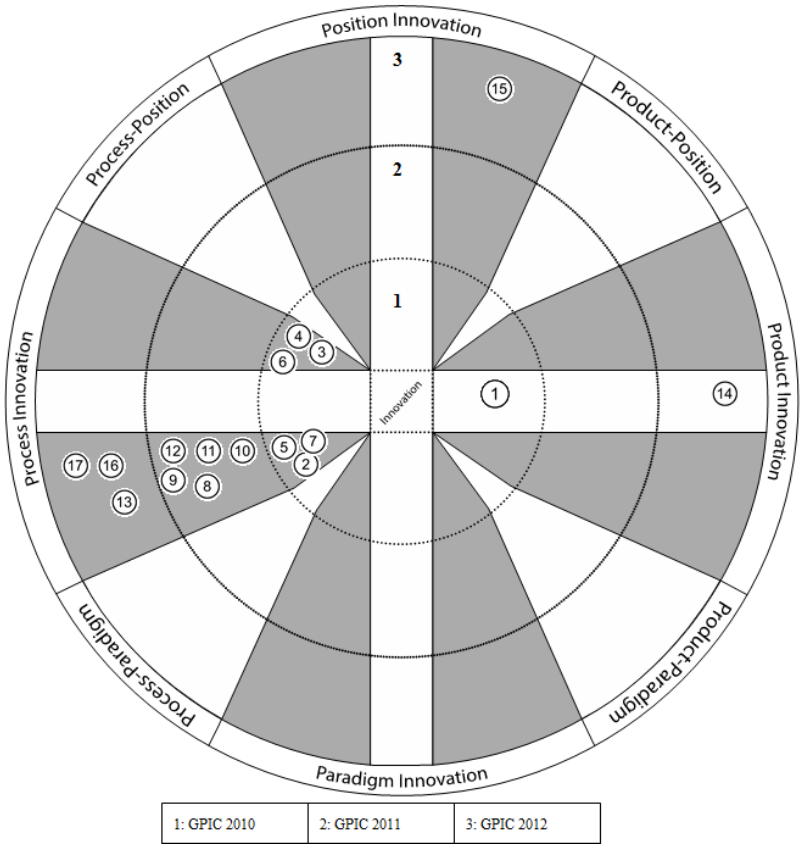

Fig. 3. Mapping Innovation of GPIC from 2010 to 2012 Using 10Ps Benchmarking Innovation Mapping Model

- Saudi Basic Industries Corporation (SABIC)

In 1976, SABIC began to benefit from natural resources in Saudi Arabia by producing petrochemical products and exporting them to other countries. Today, SABIC is the one of the world's largest petrochemicals manufacturers. In 2011, SABIC signed agreement with King Abdullah University of Science and Technology (KAUST) to build a new research and innovation center. Furthermore, SABIC is the second largest diversified chemical company in the world with 40,000 employees and more than 80 global operations (SABIC Annual Report, 2012). According to U.S-Saudi Arabian Business Council (2009) SABIC is the key player in petrochemical sector in the Kingdom of Saudi Arabia. The data needed to implement the 10Ps benchmarking innovation mapping model has been gathered from the company's sources, which include (SABIC Annual Reports, 2011; SABIC Annual Report, 2012; SABIC Sustainability Report, 2012; Company's Website (http://www.sabic.com/corporate/en/), in addition to (Al Sanad, 2012).

Figure (4) shows the application of 10Ps benchmarking innovation mapping model for SABIC from 2010 to 2012. Where first area represents the innovations that have been introduced by the company in 2010, while second area, and third area represent the innovations in 2011, and 2012 respectively. The results showed that the company had produced a total of seventy-five innovations during the three years (2010-2012). The largest contributions were in product area by 68% of the total innovations, followed by process innovation by 12% of the total innovations, and few innovations in position area by 3%. For instance, innovation number (24) involved LNP Verton Composite Forms. It was a new grade of existing product that was developed with new features, and therefore it was pointed on the innovation map on the incremental product area (represented by white circle). In other example, innovation number (40), that was a new SAP system for customer services, was considered process innovation, because it developed the system to achieve customer services effectively. Innovation number (41) was a position innovation because it expanded markets for current product (MTBE).

The results also showed that 17% of total innovations were multi-dimensional innovations, where 9% of the total multi-dimensional innovations were in product-process area, and the remaining 8% distributed between product-position by 5%, and process-position by 3%. For example, innovation number (60), that introduced UMS foam. This innovation was combined from two innovation types (Product and Process): product innovation, because it was a new chemical material with advanced performance, and process innovation, because it affected customers' production process, which helped to reduce the cost of packaging. Furthermore, all innovations were incremental innovations and none in radical innovations. The results revealed that the number of innovations increased by 25% in 2011 compared to 2010, and by 20% in 2012 compared to 2011. Moreover, the best innovation number for SABIC was in 2012 with 30 innovations, while the best diversity of innovation types was in 2011.

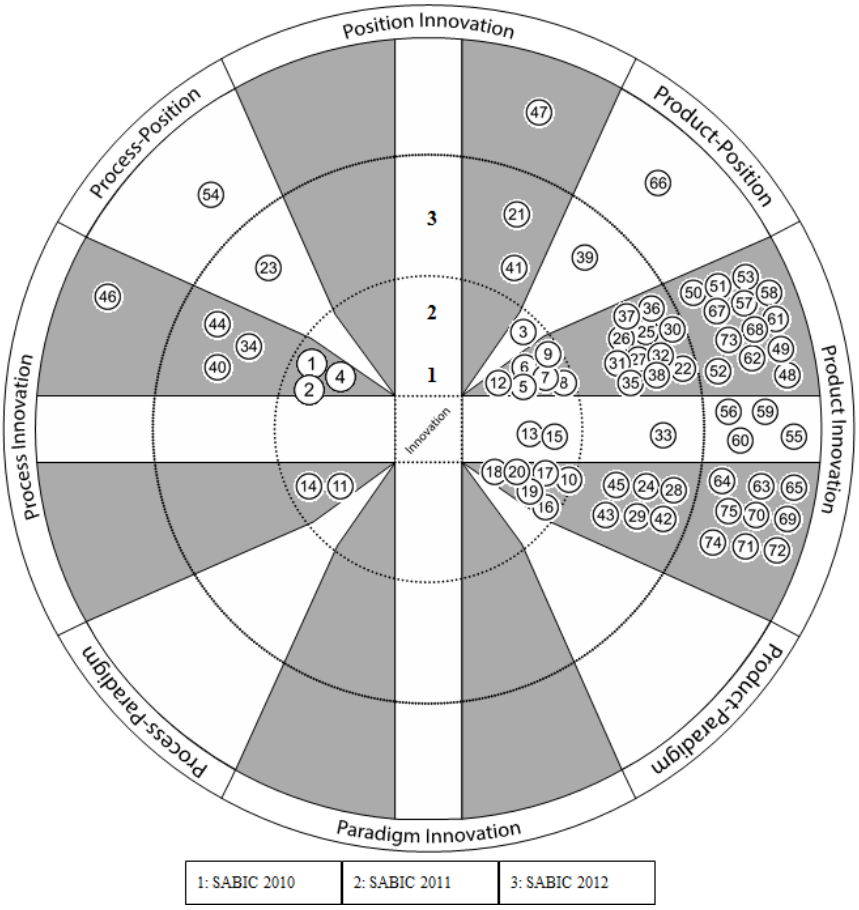

Fig. 4. Mapping Innovation of SABIC from 2010 to 2012 Using 10Ps Benchmarking Innovation Mapping Model

- Dow Chemical

Dow branch in Saudi Arabia was established in 2011. The innovation story of Dow started in 1897, when "Herbert Henry Dow" made his first discovery of the process of extracting bromine cheaply from brine. This was his first milestone of success, where his first bleach was sold in 1898 (Whitehead, 1968). Currently, the company employs about 53,000 employees worldwide**.** Dow Chemical completed more than 2000 projects and increased productivity improvement by 60% as a result of innovation in those projects (Accenture, 2007). In 2012, Dow was granted 412 US patents with an increase of 31 percent relative to 2011 (Dow Annual Report, 2012). Despite its name "Dow Chemical", Dow had been more than a chemical company. It had been consisted of six operating segments; each segment had served several industries, such as food, packaging, construction, and mining. The six operating segments had been Electronic and Functional Materials, Coatings and Infrastructure Solutions,

Agricultural Sciences, Performance Materials, Performance Plastics, and Feedstock and Energy (Dow Annual Report, 2012).

The data needed to implement the 10Ps benchmarking innovation mapping model has been gathered from the company's sources, which include (Dow Annual Reports, 2010; Dow databook, 2010; Ungerleider, 2011; Dow Annual Reports 2011; Dow databook, 2011; Dow Annual Reports, 2012; Dow databook, 2012; Company's Website (http://www.dow.com).

Figure (5) shows the application of 10Ps benchmarking innovation mapping model for Dow Chemical from 2010 to 2012, where the first area represents the innovations that was introduced by the company in 2010, while second area, and third area represent the innovations in 2011, and 2012 respectively. The results showed that the company had produced a total of one hundred and two innovations from 2010 to 2012. Most of the contributions of the company were in product innovation by 58%, and process innovation by 8%. Position and paradigm innovations represented by 3% and 1% respectively. Dow POWERHOUSETM Solar Shingle (innovation number 34 represented by black circle) was the solar panel that was placed on house roofs to provide alternative energy. Thus, it was considered product innovation (solar panel), position innovation because it targets the homeowners, and radical innovation (new to the world). Moreover, Innovation number (50), ACUSOLTM 845 Polymer, was a new grade of existing product that developed to meet customer requirements. Thus, it was an incremental product innovation. As for multi-dimensional innovation, the most contributions were in product-process innovations by 13%, and product-position by 11%. There were few contributions in product-paradigm, and process- position by 5%, and 1% respectively. For instance, innovation number (96), unlike the existing product, was developed to meet customer needs and to offer more options in industrial coatings (product). That product changed the viewpoint about coatings by exchanging it with another convenient choice of pre-mix; "low-VOC" concrete sealers (paradigm). So, it was considered incremental product- paradigm innovation. The results also showed that most innovations were incremental by 89% of the total innovations and 11% were radical innovation. The results also revealed that the number of innovations during the three years had increased by 20.7% and 8.6% in 2011 and 2012 respectively. The best performance in terms of innovation number, and diversity of innovation types occurred in 2012.

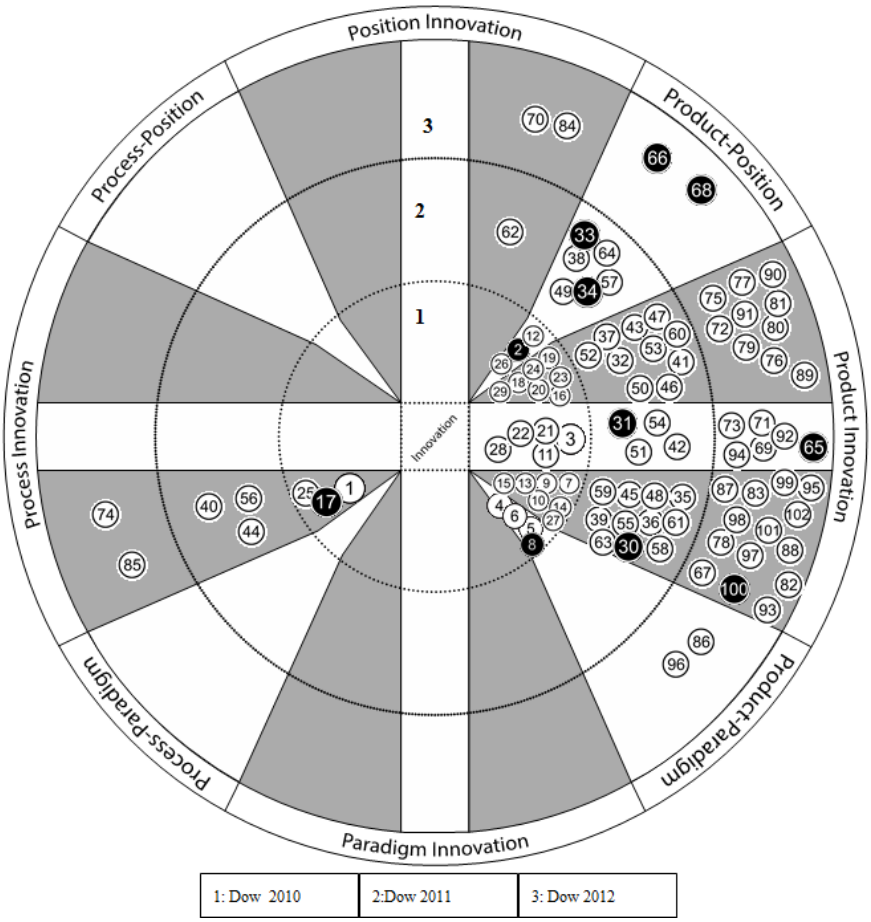

Fig. 5. Mapping Innovation of Dow Chemical from 2010 to 2012

5.3 Mapping Technological Innovation of the three Companies from 2010 to 2012

Figure (6) shows the application of 10Ps benchmarking innovation mapping model on the three international petrochemical companies from 2010-2012. The analysis showed that Dow Chemical has a highest number of innovations compared with GPIC and SABIC (102 by Dow Chemical, 75 by SABIC, and 17 by GPIC). Dow Chemical introduced 52.5% of the total innovations, SABIC introduced 38%, and GPIC 9%. The distribution by innovation types is shown in table (1). It shows that product innovations were most frequent (51 for SABIC, and 59 for Dow Chemical); process innovation was similar in each company; GPIC had the highest number of process innovations (14 innovations); paradigm innovation was the lowest recurrence; and only Dow Chemical produced paradigm and multi-dimensional innovation (product-paradigm). The results also revealed that the three companies produced 194

innovations in the three years table (1). Only 11 out of the 194 innovations were radical. The remaining 183 innovations were incremental, (91 by Dow, 75 by SABIC, and 17 by GPIC).

The results indicated that the strength of GPIC lies in process innovation, as it represents 84% of its innovations. However, the opportunities of GPIC lie in product, position, and paradigm innovations. As for SABIC, the strength area was in product and process innovations, as 68% of its innovations were in the product area, and 12% in the process area. The opportunities of SABIC lie in position and paradigm areas. The results also revealed that the strength of Dow Chemical lies in product and multi-dimensional innovation (product-process), as 58% of its innovations were product innovations and 13% for product-process innovations. The opportunities of Dow Chemical lie in position and paradigm innovations.

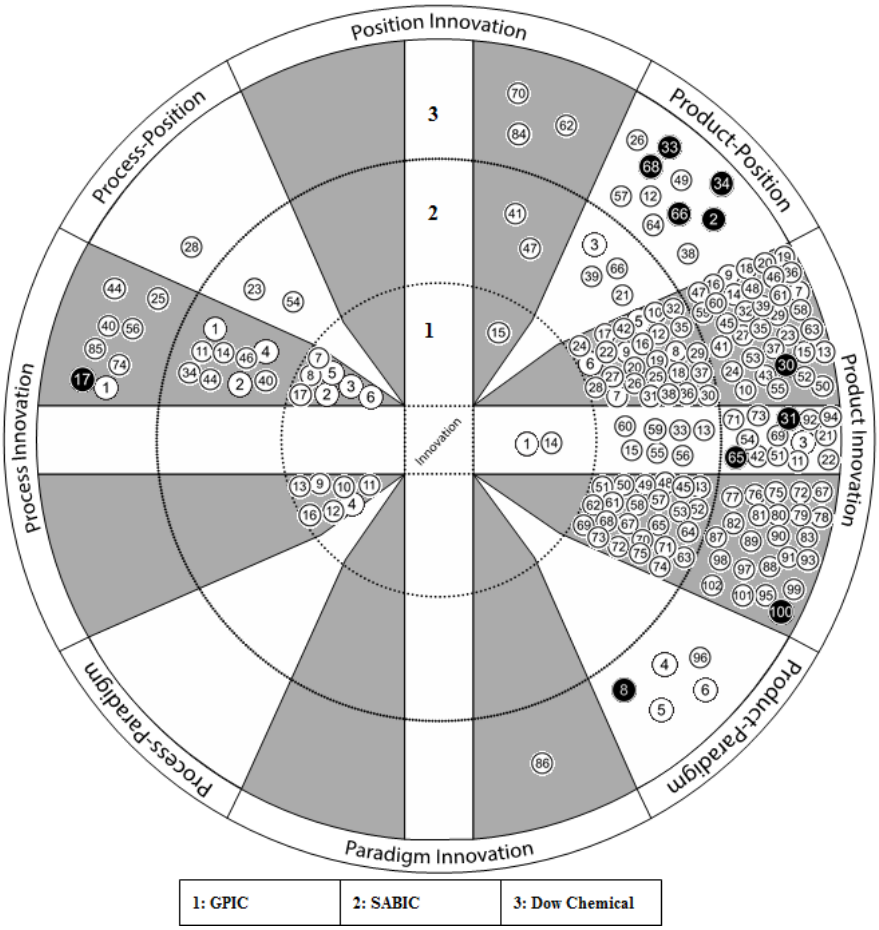

Fig. 6. Mapping Innovation of the Three International Petrochemical Companies from 2010 to 2012

Table 1. Innovation number, Types, and Percentage of change in innovations number for the three companies (2010-2012)

Company	Years	Innovation Types										Total	% Change in Number of innovations (2010-2011)	% Change in Number of innovations (2011-2012)	% Change in Number of innovations (2010-2012)
		One-Dimensional Innovation Types				Multi-Dimensional Innovation Types									
		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10				
GPIC	2010	-	6	-	-	1	-	-	-	-	-	7	-28.5%	0	-28.5%
	2011	-	5	-	-	-	-	-	-	-	-	5			
	2012	-	3	1	-	1	-	-	-	-	-	5			
	Total	-	14	1	-	2	-	-	-	-	-	17			
SABIC	2010	12	5	-	-	2	1	-	-	-	-	20	25%	20%	50%
	2011	17	3	2	-	1	1	-	1	-	-	25			
	2012	22	1	1	-	4	1	-	1	-	-	30			
	Total	51	9	3	-	7	4	-	2	-	-	75			
Dow Chemical	2010	14	3	-	-	4	3	4	1	-	-	29	20.7%	8.6%	31.03%
	2011	21	3	1	-	4	6	-	-	-	-	35			
	2012	24	2	2	1	6	2	1	-	-	-	38			
	Total	59	8	3	1	14	11	5	1	-	-	102			

P1= Product P2= Process P3= Position
P4= Paradigm P5= Product- Process P6= Product- Position
P7= Product-Paradigm P8= Process- Position P9= Process- Paradigm
P10= Position-Paradigm

6 Conclusions

A technological innovation mapping model has been developed to overcome the weaknesses in the current published models. The developed model has been

called "the 10Ps benchmarking innovation mapping model". It clearly distinguishes between one dimensional and multi-dimensional innovation types, and it can map the innovation of several organizations simultaneously. The model was used to map the technological innovation in three international petrochemical companies: GPIC, SABIC, and Dow Chemical, during three years, from 2010 to 2012. It is concluded that the modified mapping tool is useful.

The results showed that the three companies produced 194 innovations during the three years. Dow Chemical was the largest producer of innovations, generating 102 innovations (53%), followed by SABIC 75 innovations (38%), then GPIC 17 innovations (9%). The dominant types of innovation had been compared in the three companies, and the results showed that the product innovations were dominant (56%) of the total innovations, this was distributed as: (53%) for Dow Chemical, (46%) for SABIC, and none in GPIC. As for process innovation, the three companies produced 31 innovations, which represent 16% of the total innovations. The process innovations distributed as: 45% produced by GPIC, 29% by SABIC, and 26% by Dow Chemical. The position, and paradigm innovations were the lowest in terms of the number of innovations, where only 3% of the total innovations were position, and (0.5%) were paradigm innovations, they were all introduced by Dow Chemical.

The comparison also showed that the three companies produced 46 multi-dimensional innovations and they were distributed as: 67.5% produced by Dow Chemical, 28% by SABIC, and 4.5% by GPIC. The product-process represented (50%) of the multi-dimensional innovations; 60.9% of the product-process innovations were produced by Dow Chemical, 30.4% by SABIC, and 8.7% by GPIC. The analysis also revealed that there were few contributions in product-position area by (32.6%) of the multi-dimensional innovations, process-position area by (6.5%), and product- paradigm area by (11%). Furthermore, the most innovations were incremental (94.3%) and only few were radical innovation, which accounted for (5.7%), all radical innovations were produced by Dow Chemical. In the three years from 2010 to 2012, the number of produced innovations increased by 50% in SABIC and by 31% in Dow Chemical. On the other hand, GPIC witnessed a decline in innovations number by 28.5%.

7 Recommendations

The application of 10Ps benchmarking innovation mapping model on the three international petrochemical companies revealed that there are number of opportunities to improve innovations in these companies in the following innovation areas:

1. For GPIC, exploiting the opportunities in product, position, and paradigm innovation.
2. For SABIC, there are opportunities in paradigm innovation.
3. For Dow Chemical, identify the opportunities in paradigm with possible improvements in radical innovations.

4. Exploiting the opportunities in radical innovations for the three companies.

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8 Appendix

8.1 Development of a Web-Based Application for 10Ps Benchmarking Innovation Mapping Model

In order to develop an automated benchmarking innovation mapping process, web-based application were designed especially to fulfill the following benefits:

- Enables the user to map innovation on several organizations automatically.
- Easy to use for identification mapping innovation in one company, or to compare the innovation maps for 2 to 5 companies.
- Provides "Tooltip" tool, which is a description inside the application, which includes: the innovation number, title, type, degree of novelty, and company name.
- It supports Google Chrome, Firefox, and latest Internet Explorer (IE) browsers.

The following are the steps in the implementation process of web-based application for 10Ps benchmarking innovation-mapping model:

1. Open the following link http://www.innovation-mapping-model.com
2. On the user interface, register, type username and password to access the program, then click "new chart".

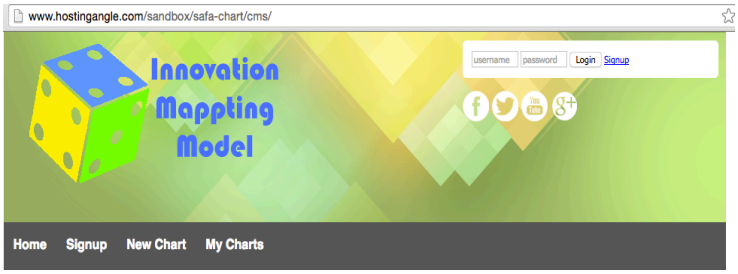

Fig. 7. The 10 Ps Innovation Benchmarking Mapping Model: Registration and Login

3. Put title of the new chart, then click "Create".
4. Start mapping innovation by inter the innovation data (innovation title, types, and degree of novelty). The data will be entered using a web form similar to as shown below:

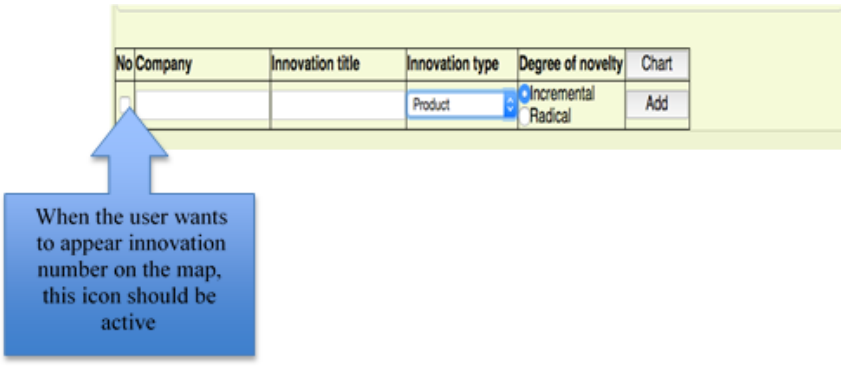

Fig. 8. Illustration of the Data Input for Each Innovation

When "add" is pressed (and all fields are filled), the data will be saved in the database, and will be shown in the table below.

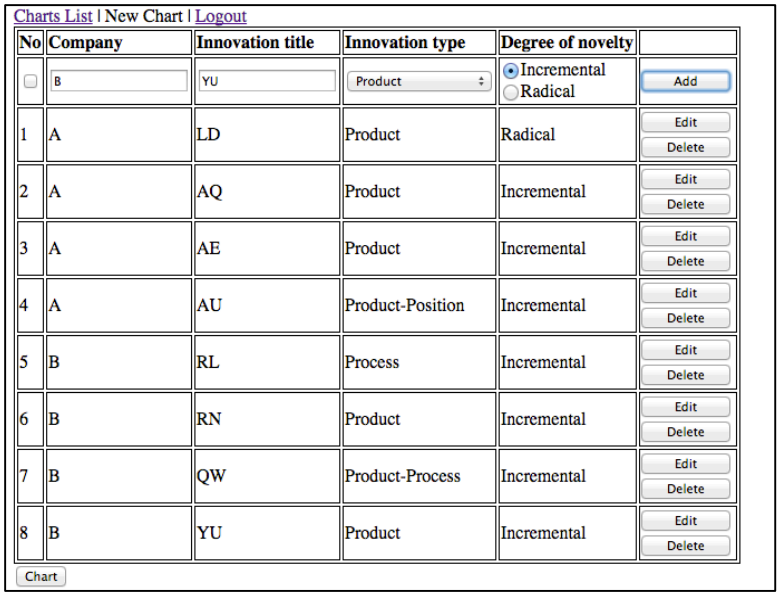

Fig. 9. Illustration of Innovations' List of the Model

5. Click "Chart" to map innovation.

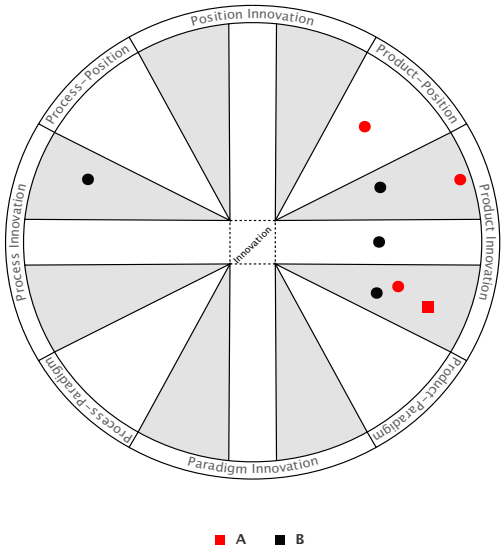

Fig. 10. Illustration of a Produced Chart of the Model

Also, when the user hovers over innovations on the map, the description inside

a tooltip will be shown and it will include: the innovation number, title, type, degree of novelty, and company name.

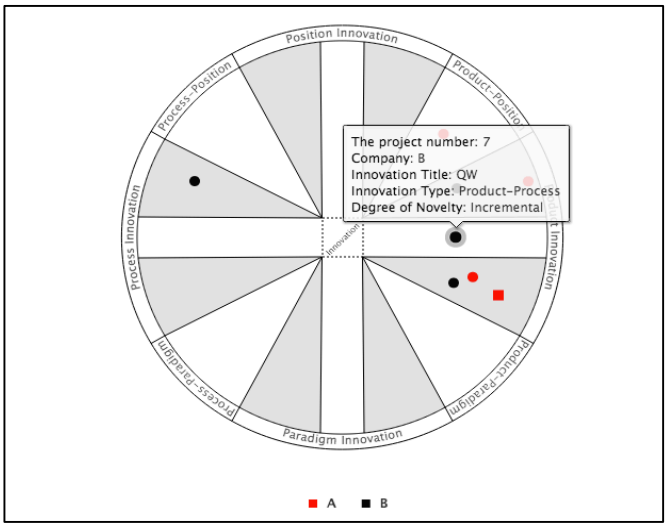

Fig. 11. Illustration of the Details Given for Each Innovation on the Chart

6. Click to print or to save the innovation map as the form that user will be choose.

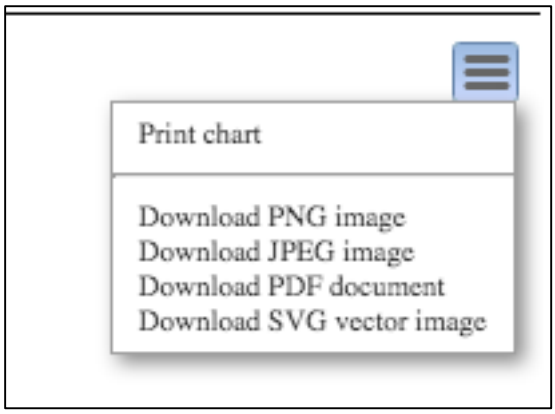

Fig. 12. Options for Saving and Printing

7. To modify innovation data click “Edit”, and to delete it click “Delete”.
8. To show the database of innovation click “Chart List”, then choose the file.