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STRATEGIC KNOWLEDGE SERENDIPITY AND ARBITRAGE & INTELLECTUAL VENTURE CAPITALISTS: AN EMERGING BREED OF KNOWLEDGE ENTREPRENEURS AND PART II: GLOBAL AND LOCAL (GloCal) KNOWLEDGE LOGISTICS FOR INNOVATION AND COMPETITIVENESS

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STRATEGIC KNOWLEDGE SERENDIPITY AND ARBITRAGE &

INTELLECTUAL VENTURE CAPITALISTS:

AN EMERGING BREED OF KNOWLEDGE ENTREPRENEURS

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An intellectual capitalist is someone who puts a price on the knowledge he's accumulated for a world of possible buyers beyond his organization.
Peter Drucker

It has been said that in the knowledge economy the marketplace is not divided into towns and regions, but into affinity groups that descend from a high propensity to sociability (also known as the *invisible networks of peers* **(Carayannis and Allbritton, 1997)** and which are also structured by knowledge creation, diffusion and use modalities (what we also call "*knowledge-ducts*" along which flow "*knowledge nuggets*"[1]) such as *innovation networks*[2] and *knowledge clusters*[3] **(Formica, 2003; Carayannis, GWU Lectures, 2000-2005; Carayannis et al, 1999; Carayannis et al, 2000; Carayannis et al, 2003a; Carayannis et al, 2003b; Carayannis et al, 2004; Carayannis et al, 2005; Carayannis et al, 2005a; Carayannis et al, 2005b; Carayannis et al, 2006a; Carayannis et al, 2006b; Carayannis et al, 2003c)**. Newton and Goethe called this affinity (*Elective Affinities* - Goethe), "catalytic" in that two substances combine to form a third

[1] We consider the following quote useful for elucidating the meaning and role of a "***knowledge nugget***": "People, culture, and technology serve as the institutional, market, and socio-economic "glue" that binds, catalyzes, and accelerates interactions and manifestations between creativity and innovation as shown in **Figure 1**, along with public-private partnerships, international Research & Development (R&D) consortia, technical / business / legal standards such as intellectual property rights as well as human nature and the "creative demon". The relationship is highly non-linear, complex and dynamic, evolving over time and driven by both external and internal stimuli and factors such as firm strategy, structure, and performance as well as top-down policies and bottom-up initiatives that act as enablers, catalysts, and accelerators for creativity and innovation that leads to competitiveness" [**Elias G. Carayannis and Edgar Gonzalez, 'Creativity and Innovation = Competitiveness? When, How, and Why', in Larisa V. Shavinina (ed.), *The International Handbook on Innovation* (Amsterdam: Pergamon, 2003), 587-606, especially on 593**].

[2] Innovation Networks are real and virtual infra-structures and infra-technologies that serve to nurture creativity, trigger invention and catalyze innovation in a public and/or private domain context (for instance, Government-University-Industry Public-Private Research and Technology Development Co-opetitive Partnerships) **(Carayannis et al, 2005; Carayannis et al, 2005a; Carayannis et al, 2005b; Carayannis et al, 2006a; Carayannis et al, 2006b; Carayannis et al, 2006c).**

[3] Knowledge Clusters are agglomerations of co-specialized, mutually complementary and reinforcing knowledge assets in the form of "knowledge stocks" and "knowledge flows" that exhibit self-organizing, learning-driven, dynamically adaptive competences and trends in the context of an open systems perspective **(Carayannis et al, 2005; Carayannis et al, 2005a; Carayannis et al, 2005b; Carayannis et al, 2006a; Carayannis et al, 2006b; Carayannis et al, 2006c).**

one. In a truly and openly global economy one country is no longer able to dominate the others and such an economy consists of knowledge-driven economies and knowledge-based societies that materialize only in an atmosphere of community.

The transition to that state of social, political and economic affairs is full of challenges as well as opportunities and in that context, even advanced industrial economies struggle to capture the potential benefits of the modern-day knowledge society, economy and polity. The path towards a new age of prosperity through knowledge to business is full of pitfalls that can trigger socio-economically regressive trends and patterns (from the nouveaux pauvres to the fundamentalists of all hues including the neo-ludites **(Carayannis GWU Lectures, 1996-2005)**.

The industrial culture mainly focused on the production of 'things', static objects, is a contrast to the very nature of knowledge, which is that of a flowing stream. Conventional industrial notions lead policymakers to believe that the addition of a knowledge-based industry to an existing industry base makes a knowledge economy. This is not the case. Pieces of knowledge, purchased like objects, do not make a knowledge economy. What is missed is the importance of managing and synthesizing knowledge and of conducting conventional businesses in innovative ways. Capitalizing the knowledge economy requires an entirely new way of viewing the economic landscape. For example in a knowledge economy it is essential to collaborate to compete. This requires a transformation of traditional notions of competition, market advantage, and adversarial market relationships.

The development of an enterprising culture is a primary objective of all progressive nations. Entrepreneurs, and the small and medium businesses they build, are the backbone and represent as much as 70% of the economic base of first

world countries. Entrepreneurial activity creates business diversity, reduces reliance on a single industry or natural resource, and creates an enterprising culture capable of rapid response to emerging economic threats. A robust entrepreneurial climate – such as the one often present in "hotspots" of entrepreneurial activity that appear in the form of real and/or virtual clusters – is one where *people, culture and technology* converge to build entrepreneurial activities on firm foundations of *charisma*, *character* and *culture* (the three essential "C"s of entrepreneurial success **(Carayannis, GWU Lectures, 2005-2005; Carayannis, ECE Lectures, 2005)**.

Entrepreneurial activities postulate what we call the "triadic complex" of entrepreneurial energy, entrepreneurial mass made up of attributes and motivations for entrepreneurship and creativity in business, as described in **Table 1**.

While entrepreneurship may occur as a natural result of personal drive, it occurs most often, most robustly and is most sustainable in an environment designed to encourage it. Potential entrepreneurs become active entrepreneurs when the conditions are most supportive of their commercial opportunities and their business thus helping channel the two key qualities they exhibit as individuals – *obsessed maniacs* and *clairvoyant oracles* **(Carayannis, GWU Lectures, 2000-2005)** and **(Carayannis et al, 2003a)** towards the generation of sustainable wealth.

So far, entrepreneurial scholars who turn into intellectual venture capitalists by founding knowledge-driven companies remain one of the least explored specie in the territory of entrepreneurship.

Table 1– The Triadic Complex of Entrepreneurial Attributes, Motivations and Creativity in Business

E = MC^3

E stands for entrepreneurial energy

M stands for attributes of and motivations for entrepreneurship:
Attributes

- Clarity of leadership
- Openness and inquisitiveness that stimulates innovation and learning
- Creation of new value or organisational capability
- Flexibility to change
- Relationship building skills
- Ability to convince others (employees, individual investors, suppliers, and landlords) to share start-up risks

Motivations

- Capacity to think for oneself
- Self-confidence: having optimism and personal drive
- Sense of autonomy, independence and risk-taking
- Intense emotions

C stands for creativity in business, which is the combination of:
Creativity in Technology x Creativity in Planning x Creativity in Marketing

C is the equivalent of the speed of light. C in Latin is Celeritas, which means velocity.
Creativity in business is like a beam of light that spotlights one or more opportunities to be turned into businesses.

Intellectual venture capitalists (**Carayannis and Juneau, 2003**) are in essence *knowledge entrepreneurs* (**Formica, 2005**) who hold intellectual capital and are willing to undertake risks investing it towards the pursuit of larger pecuniary benefits – that is, the ability to transform knowledge and intangible assets into wealth creating resources4. They typically do so leveraging two key qualities they possess via a unique combination of *nature, talent, experience and fortune*:

- *strategic knowledge arbitrage* (the capacity to uniquely create, identify, re-allocate and re-combine knowledge assets better and/or faster to derive, develop and capture non-appropriable, defensible and sustainable and scalable pecuniary benefits) (**Carayannis,**

[4] In a broader sense, "intellectual capital refers to the total Knowledge within an organisation that may be converted into value, or used to produce a higher value asset. The term embodies the knowledge and expertise of employees; brands; customer information and relationships; contracts; internal processes, methods, and technologies" (**Prior, 2005**).

GWU Lectures, 2000-2005) and **(Carayannis et al, 2003a; Carayannis et al, 2005; Carayannis et al, 2005a; Carayannis et al, 2005b; Carayannis et al, 2006a; Carayannis et al, 2006b; Carayannis et al, 2006c);**

and

- *strategic knowledge serendipity* (the capacity to uniquely identify, recognize, access and integrate knowledge assets better and/or faster to derive, develop and capture non-appropriable, defensible and sustainable and scalable pecuniary benefits) **(Carayannis, GWU Lectures, 2000-2005)** and **(Carayannis et al, 2003a; Carayannis et al, 2005; Carayannis et al, 2005a; Carayannis et al, 2005b; Carayannis et al, 2006a; Carayannis et al, 2006b; Carayannis et al, 2006c).**

Putting knowledge in action requires the development of win/win relationships, which, in turn, are the outcome of a context conducive to negotiated exchanges (Carayannis et al, 1999). Under the perspective of relationship building, *intellectual venture capitalists* play a double role of content and context creators leading and engendering a process and dynamic leading towards artificial abundance while leveraging and replacing conditions of natural scarcity (see **Figure 2**).

HERE FIGURE 2

Intellectual capitalists are the Phoenicians of the 21st century dominated by the falling cost of transporting ideas and information. Like the Phoenicians they make geo-economic changes by navigating longitudinally (**Figure 3**).

HERE FIGURE 3

Entrepreneurial scholars, such as Marie Curie who was an enterprising woman and herself took part in the industrial application of her scientific results, show preference sets affected by the convergence of two profiles: namely, the profile of *homo scientificus* who breaks away from convention to search for groundbreaking discovery and the profile of *homo economicus* with special acumen for markets and sales. In other words, entrepreneurial scholars have a relatively clear sense of the probability of a successful commercial outcome from their curiosity-driven research. The latter evolves as a business goal-oriented work. This evolution results both in a paradigm change to adopt a new mental model and in a phase change as a transition to the entrepreneurial state.

Entrepreneurial scholars in ample supply turned into intellectual capitalists open up new perspectives for outsourcing innovation. As **Figure 4** shows, if the supply of intellectual capitalists is low, outsourcing innovation is a decision with a constrained vision: just that of a tangible assets-intensive process controlled by companies making outsourcing decisions. Those companies focus on what they know they do not know. Under this circumstances, outsourcing decisions are plunged into the sea of chartered waters. The navigation depends on knowing how to keep innovation-induced pressure on tangible assets under control.

HERE FIGURE 4

In contrast, an abundant supply entices intangible assets-intensive processes whereby companies making decisions for outsourcing innovation "learn" rather than "control". In the latter case the focus is on what companies do not know they do not know. To be brave enough to sail uncharted waters, companies have to learn how to govern the impact of leverage on intangible assets. In doing this, they rely on the performance offered by the intellectual capitalists playing as the 'merchants of light' of the Phoenician and Renaissance times who saw "into distances most could not" (Harriet Rubin, *The New Merchants of Light*, Leader to Leader, No.10 Fall 1998). Both parties' behaviour converges in making outsourcing innovation an experiment that brings to the surface of the company's business culture the importance of discovering new markets and radically transforming its organization.

Whereas reformed markets are the terrain for exploration purposes by incumbent entrepreneurs, intellectual venture capitalists redefine market boundaries and norms whereby entirely new markets emerge. In doing so, they put incumbents in peril for the revolutionary business opportunities envisioned by intellectual capitalists are not within the incumbents' range of resources, strategies and structures (**Figure 5**).

HERE FIGURE 5

Legend

1: Tangible assets (TA) such as land, labour and capital are the traditional pillars of value creation. Companies making outsourcing decisions control TA-intensive processes.

2: The value of intangible assets (IA) leads IA-intensive processes whereby companies making outsourcing decisions "learn" rather than "control"

REDEFINED AND REFORMED MARKETS

Reformed markets: Re-formulation of existing ideas.

Technologies do not change the basic structure and functioning of the market. They help to squeeze out costs and facilitate interactions. They are improvements rather than a wholesale redefinition of R&D process, marketing and sales process, supply chains, et cetera.

Incumbents have built-in advantages: Trusted brand names, reputation, customer relationships, financial depth – deep pocket.

ADAPTIVE SPECIALIST VENDORS

They sell in middle spaces made up by intermediate audiences and communities focused on common interests.

REDEFINED MARKETS

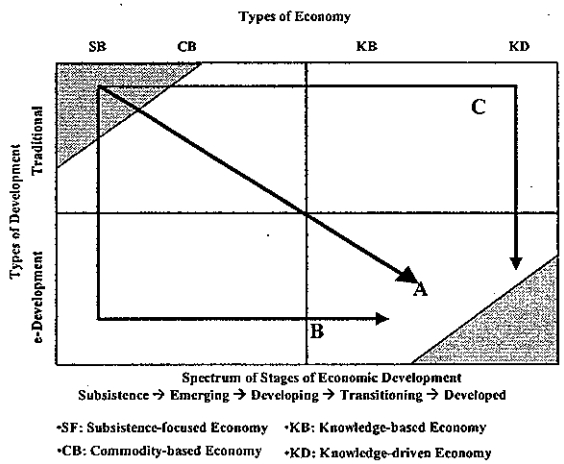
Market boundaries and norms are redefined. An entirely new market emerges.

Incumbents are in disadvantage. Their resources, strategies and structures do not allow them to envision revolutionary possibilities.

Example: Construction project management (an entirely new way in terms of efficiency and speed of coordinating the efforts of a chain of firms in different locations.

(a) Edison developed what were called invention factories, the first of which was Menlo Park in New Jersey. To this day he's known as the wizard of Menlo Park and is celebrated for creating the world's first full scale industrial research and development laboratory. It was to transform America's shop floor tradition of invention.

FIGURE 1
(ADAPTED FROM CARAYANNIS ET AL, 2005a, 2005b, 2005c)



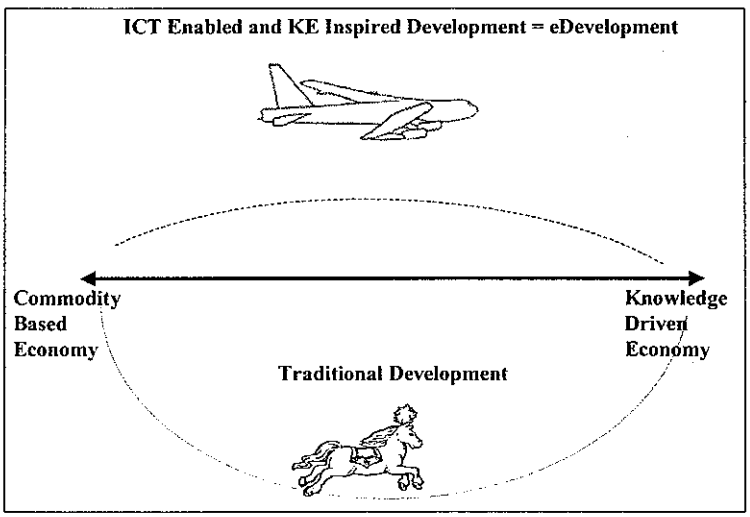
Attributes of Pathways A, B, and C:

A) Faster, easier and better way to move towards knowledge-based economy

B) Costly, slow but more common way in transitioning economies for moving towards the knowledge economy.

C) Slowest, costly and more limited way.

FIGURE 2
(ADAPTED FROM CARAYANNIS ET AL, 2005a, 2005b, 2005c)



1/9/2006 Dr. Elias G. Carayannis, ECSPF, WB 2

Figure 3 - Phoenicians: Merchants of Light

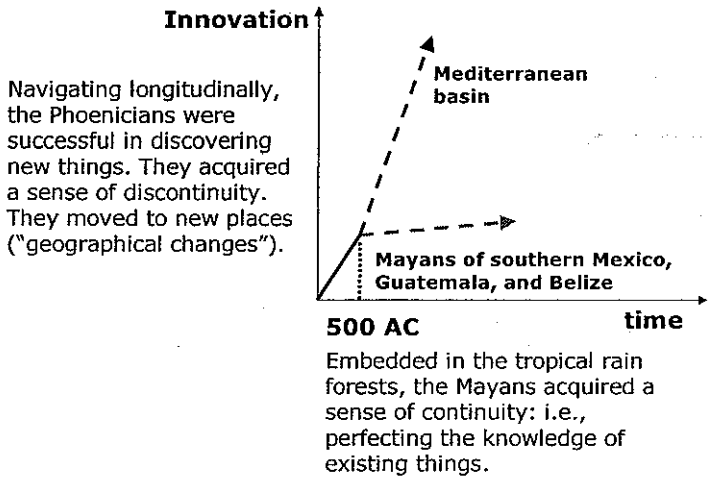
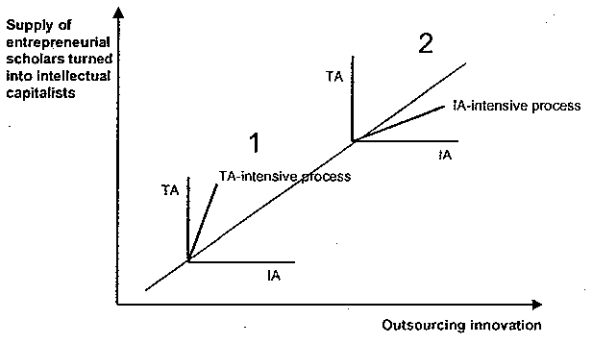
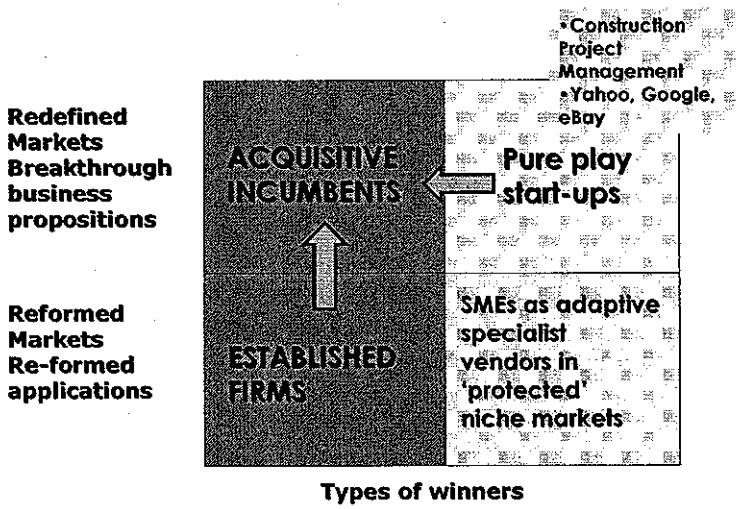


Figure 4 - Forms of Outsourcing Innovation



1: Tangible assets (TA) such as land, labour and capital are the traditional pillars of value creation. TA-intensive processes are controlled by companies making outsourcing decisions.
2: The value of intangible assets (IA) feeds IA-intensive processes whereby companies making outsourcing decisions "learn" rather than "control"

Figure 5 – Redefined and Reformed Markets



Source: adapted from Day, G. S. and Fein, A.J., Shakeouts in Digital Markets: Lessons from B2B Exchanges, California Management Review, Winter 2003

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Part 11

GLOBAL AND LOCAL (GloCal) KNOWLEDGE LOGISTICS FOR INNOVATION AND COMPETITIVENESS

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GWU EURC ACES RESEARCH PROPOSAL

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1. Introduction

The increasing engagement of firms within global knowledge and production networks and their ability to source knowledge globally as well as locally (GloCally), for the development of innovation capacities will shape the future of UK's knowledge resources and its role in the global economy. Practices such as off-shoring R&D activities are widely adopted, creating challenging, and not very well understood, issues related to cross-country and inter-firm knowledge and technology flows. We seek to address the internationalisation and networking of research and innovation activities, including the roles and strategies of enterprises, universities, research centres, governments in a cross-country and inter-sectoral way, to assess the impact and the implications for sustaining and enhancing the competitiveness of UK firms and other British knowledge producers and users.

This research is important for both theory and practice. We are witnessing fundamental changes in knowledge supply chains. Knowledge is now developed, diffused and used in networks-based alliances and relationships outside traditional firms' and countries' historical boundaries. Knowledge supply chains involve different actors at different sites. While the new supply chain knowledge gives firms sustenance of innovation capabilities and opportunities to upgrade and cross-pollinate their knowledge expertise, its international boundaryless inter-organizational nature creates fundamental challenges in terms of managing knowledge and innovation. For instance, many innovation partnerships are temporary networks of alliances that collaborate to explore and/or exploit innovative ideas by partners sharing skills, expertise and expenses, leading to critical problems when the networks are disbanded, leading to fragmentation of knowledge to different geographical locations and parts of the knowledge supply chain. Given the importance of innovation in a knowledge based economy, a failure to understand the process through which knowledge is created, transformed, mutated and used through the

knowledge supply chain may erode firms' competitiveness. Surprisingly, our stock of knowledge on the factors and dynamics that shape knowledge supply chain is very limited. We will map out the approaches and processes through which UK firms and their national and international innovation partners develop, diffuse, transform and use knowledge through the knowledge supply chain. Such an understanding will enhance UK firms' ability to achieve a better and more efficient management of knowledge supply chain.

We seek to combine the expertise of Prof. Koh (Director of Logistics and Supply Chain Management (LSCM) Research Group at the University of Sheffield) in upskilling managerial workforces and internationalising supply chains, Prof. Kamel Mellahi expertise in global strategy and Prof Carayannis (co-director of the European Union Research Center and co-founder as well as co-director of the Global and Entrepreneurial Finance Research Institute at George Washington University) on technology innovation, transfer and commercialisation in order to achieve the research aims and enhance UK-US collaboration in this area.

2. Background

At a national level, it has been reported that in the knowledge economy the marketplace is not divided into towns and regions, but into affinity groups that descend from a high propensity to sociability also known as the invisible networks of peers[1] and which are also structured by knowledge creation, diffusion and use modalities (what we also call "knowledge-ducts" along which flow "knowledge nuggets"[2]) such as innovation networks and knowledge clusters[3,4]. In a truly and openly global economy one country is no longer able to dominate the others and such an economy consists of knowledge-driven economies and knowledge-based societies that materialise only in an atmosphere of

community. The transition to that state of social, political and economic affairs is full of challenges as well as opportunities and in that context, even advanced industrial economies struggle to capture the potential benefits of the modern-day knowledge society, economy and polity. The path towards a new age of prosperity through knowledge to business is full of pitfalls. The complexity of global as well as local 'GloCal' knowledge production and flows in global knowledge supply chains, which are prone to risks and uncertainties will exacerbate the impact of innovation and dampen real value creation [23]. For instance, the European Research Area (ERA) system of innovation resembles more an archipelago of islands of excellence and less of a strategically integrated, multi-layered, multi-modal, and multi-nodal knowledge grid. This fragmentation results in substantial added value not being captured and value-adding potential not being realised in the context of the national science, innovation and technology enterprise[3] and especially the quantity and quality (i.e. defensibility, sustainability, scalability) of new technology venture formation and growth[4]. This is further exacerbated by the nature of research being highly inter-connected and non-linear as well as increasingly cross-disciplinary.

We will prototype and pilot a bottom-up response (that is, a grassroots response - where the drivers are small and medium sized (SME) firms implementing practical approaches as solutions – as opposed to top-down policy mandates) to address this opportunity. Over the long-run pilots such as the one we propose will improve the UK systems of innovation and will become more urgent as nations and clusters thereof in the rest of the world are promoting similar initiatives. Regional and other economic development strategies have increasingly focused on issues under the classification of innovation networks and knowledge clusters and the building of stronger resources, linkages and networks frequently themed as public-private partnerships. Such innovation modalities consist of a critical mass of local knowledge, expertise, personnel, and resources grouped together by related technologies and may include researchers, collaborators, competitors, partners, and other supply chain members within related technologies[5,6]. The typical regional innovation strategy is usually derived based on studies

consisting of infrastructure-dependent data collection and statistical analysis—all in an effort to define the existing state of regional innovation drivers, triggers and impediments, which are purported to be strongly correlated to the development and advancement of technology infrastructure. Typically, data is collected on R&D funding, technology transfer, role of cluster enabling organisations, size and characteristics of high-tech workforce, availability of venture capital, number of patents issued, scientific publication outputs, and so forth[7]. However, present studies merely define current or historical input conditions, but tell us little about how future technological, demand, competitive and public policy conditions might affect innovation outcomes[8,9]. This is not to suggest that an unambiguous and clear forecast of innovation environments is realistic, but it is possible and even likely that glocal strategies do not adequately address *vital risk factors and contingency planning*[10,17]. The technology innovation community concerned with implementing GloCal innovation strategies and partnerships needs to conduct a critical investigation and ascertain answers to the following research questions **(a)** how can regional technology strategies better leverage GloCal innovation networks and knowledge clusters? **(b)** How to best retain and attract knowledge experts? **(c)** What is the underlying innovation model and associated metrics used by innovation network- and knowledge cluster-based partnership initiatives? **(d)** What macro (glocal, market), meso (regional, industry) and micro-level (local, firm) socio-technical factors actually determine GloCal innovation outputs, outcomes and impacts (short, medium and long term results)?

Knowledge creation, diffusion and use, known as "MODE 3", is a multi-lateral, multi-nodal, multi-modal, and multi-level systems approach to the conceptualisation, design, and management of real and virtual, "knowledge-stock" and "knowledge-flow" modalities. These modalities catalyze, accelerate, and support the creation, diffusion, sharing, absorption, and use of co-specialised knowledge assets. "Mode 3" is based on a system-theoretic perspective of socio-economic, political, technological, and cultural trends and conditions that shape the co-evolution of knowledge with the "knowledge-based and

knowledge-driven, GloCal economy and society" [vi][i]. Innovation Networks are real and virtual infrastructures and infra-technologies that serve to nurture creativity, trigger invention and catalyse innovation in a public and/or private domain context (for instance, Government-University-Industry, Public-Private Research and Technology Development Co-operative Partnerships) [vii][ii] [viii][iii]Carayannis and Alexander, 2004). Knowledge Clusters are agglomerations of co-specialised, mutually complementary and reinforcing knowledge assets in the form of "knowledge stocks" and "knowledge flows" that exhibit self-organising, learning-driven, dynamically adaptive competencies and trends. The concept of "MODE 3" and Innovation Networks will be applied in this research to enhance the understanding of the inter-relatedness of these critical elements in a 'GloCal' knowledge logistics context.

3. Aims and Objectives of the Research

The novelty of our proposed research lies in advancing the understanding of the role of knowledge logistics in a GloCal supply chain context. It is multi-level and multi-disciplinary in the sense that concepts, methodologies and tools from management as well as other disciplines such as engineering and physics may be deployed for modelling, simulation and optimization purposes. The Forrester effect[11,12] systems dynamic (founded by Forrester in the 1950s)[13], systems thinking[14,15] and chaos theory[16] will be used to explain and model the "GloCal" knowledge logistics phenomena. "GloCal" knowledge logistics can be inferred as a complex system and it is one that is characterised with many risks and uncertainties, and hence the Forrester effect, systems dynamics, systems thinking and chaos theory are suitable theoretical frameworks to be used for understanding the dynamic behaviour of this complex system. The Forrester effect has been widely applied to explain the bull-whip effect in supply chains[17]. Systems dynamic theory has also been extensively applied for examples in the development[18] and implementation[19] of new technology, in analysing the maintenance functions towards system

performance[20] and in combination of the above[21]. Similarly, systems thinking has also been widely adopted for example in supply chain design[22], whilst chaos theory has been adapted [23]. Taken altogether these theoretical frameworks have not been applied in the context of the proposed research. The aim of this research is to: identify and profile the role of knowledge as one of the key assets in GloCal logistics designs, systems and architectures as a basis for sustainable competitiveness with the following objectives:

1. To better understand the internationalisation and GloCalisation of research and innovation activities and systems and assess the impact and implications for UK's research and innovation systems as well as its contribution to growth and competitiveness.
2. To explore the opportunities and challenges of "off-shoring" research and development internationally.
3. To study the cross-country and inter-firm knowledge and technology flows.
4. To explore how different factors shape the future of UK's knowledge resources and its role in the global economy.
5. To explore the roles, strategies and attitudes of enterprises, universities, research centres, governments or formal and informal institutions towards the phenomenon of GloCalization.

This project will develop some deliverables in the form of pilot prototypes and specifically:

- To form a "GloCal Knowledge Grid" (GKG) to enable the "GloCal Knowledge Logistics" that would serve as an empirical validation laboratory (for example, using social networking modalities to map, monitor and analyze knowledge experts mobility patterns we could provide data and information that the GKG would then transform into critical knowledge for supporting

decision by industry leaders and policy makers on the matter of knowledge expert retention and attraction).

- In this context, we aim to draw solid conclusions about the implications of the internationalisation on UK's research and innovation systems and thus develop explicit recommendations to facilitate the formation of more sustainable UK policies on its research and innovation systems and their contribution to growth and national competitiveness.

4. Programme and Methodology

4.1 *Assessment of the nature, drivers, dynamics and risks that undermine qualitatively superior designs, systems and architectures in Glocal Knowledge Logistics operational frameworks within the UK and abroad*: A critical review of the literature will be carried out by Research Associate (RA) #1 (based in the UK) and RA#2 (based in the USA) in order to develop a conceptual model listing the critical success and failure factors, and their relationships and dynamics for "GloCal" knowledge production and flows. Critical mapping of the theoretical frameworks will also be conducted to prepare for analytical grounding in explaining the behaviours and relationships conceptualised in the model. The conceptual model will then feed into the next work programme in designing the interview questions.

4.2 *Study of selected areas in terms of technology and geography within the UK (at the macro (glocal, market), meso (regional, industry) and micro-level (local, firm) levels) to provide empirical data for modelling, simulation and prototyping purposes*: A triangulation approach will be used where broadly targeted surveys will be complemented by semi-structured interviews and in-depth case studies. The surveys will be thematically, geographically and sectorially focussed to provide insights as to how and where to focus the semi-structured interviews and in-depth case studies. The in-depth case

studies method will be employed to validate the conceptual model, involving multiple semi-structured interviews by RA#1 with knowledge stakeholders (for example, universities, research centres, public organisations, private organisations and government bodies) along the knowledge supply chain. This qualitative method will give rich insights of the actual phenomena and it is deemed suitable for data collection in such complex system. The interview data will be coded and analysed with NVIVO software by RA#2; content analysis and grounded theory approach will be used to identify emerging patterns and theoretic themes.

4.3 *Simulation and analytical modelling of frameworks and solutions for supporting robust competitiveness and innovation in the UK industry*: A new "GloCal" knowledge logistics grid (GKLG) will be analytically modelled and simulated in order to integrate the frameworks, standards, validated conceptual model and route map as a unified entity. Analytical Hierarchy Process (AHP)[24,25,26] will be used for analytical modelling and the data will collected from questionnaire survey of random sample of knowledge stakeholders from diverse parts of the logistics knowledge chain. RA#2 will develop the analytical model and AHP software will be used to analyse the data, which will be used to develop a simulation model of "GloCal" knowledge logistics. By embedding uncertainty and risk factors into the simulation model, the Forrester effect, systems dynamics, systems thinking and chaos theory will be used to explain to what extent the "GloCal" knowledge logistics will perform and otherwise[27,28,29,30]. RA#2 will also develop the simulation model and analyse the antecedents required for its sustainability as well as its *competence in terms of macro, meso and micro co-opetition, co-specialisation, and co-evolution processes* and its predictive power. These processes will be captured and profiled via higher order learning models and concepts [31, 32] and will be used by RA#2 for embedding self-organizing and dynamically adapting mechanisms (neural nets and other dynamic associative reasoning and learning Artificial Intelligence tools, such as Social Networking Analytics will also be deployed. Case Based Reasoning (CBR) will be adopted in establishing references to best practices case matching[33] and

identifying the range of potential solutions for supporting firm competitiveness and innovation through the GKLG. The RA will then integrate the analytical and simulation models to form the decision support tool. The GKLG will thus be the core for a decision support tool to be created in this work programme and provide multi-dimensional visualisation interactive environments for strategic planning and decision making purposes.

4.4 *Conceptualising ways and means to introduce a more entrepreneurial culture in large firms' decision making styles for strategic allocation of critical / scarce resources (human, intellectual, financial and even social capital)*: We will leverage the simulation and visualisation modalities mentioned above to endow the leadership of large firms with risk mitigation and management devices to enable them to become more entrepreneurial while remaining properly strategic in dealing with "Valley of Death" challenges and opportunities regarding the early stage evaluation of high risk / high pay-off projects. The results and findings from the case studies and interviews, supported by the relevant literature will be used as the input into the conceptualisation of ways and means to leverage the "Valley of Death" challenges and opportunities. A route map for this will be developed through focus group and workshop methods (which will involve knowledge producers, users and brokers from diverse stakeholders of the industrial ecosystem in this study). The focus groups (within stakeholder type) and workshops (between stakeholder type) will serve as roundtable discussions on challenges, opportunities and act as a platform to enable re-engineering of processes, mindsets and behaviours of knowledge stakeholders in the "GloCal" knowledge context. We will organize 10 focus groups with stakeholders from macro, meso and micro levels which will represent government, university as well as industry sectors [34,35]. The focus groups will then be followed by a workshop aiming to consolidate the stakeholders' views. RA#1 will organise the focus groups and workshop, under the coordination of the project leaders.

4.5 *Developing conceptual frameworks and standards for better understanding on how internationalisation and networking of research and innovation activities and systems influences the UK's ability to achieve the Lisbon goals and affects its socio-economic stability*: A critical review of policy documents and interviews with policy makers will be carried out by RA#1 in order to develop a conceptual framework and standard for internationalisation of "GloCal" knowledge production and flows for innovation and entrepreneurship. The route map developed from the focus groups and workshops and the validated conceptual model will be used as benchmark for best practices in "GLoCal" knowledge logistics, subject to country specific customisation. It is envisaged that issues related to implementation of this framework and standard will be discussed and ten Senior European policy makers (i.e. ministers, ambassadors, etc.) will be interviewed.

5. Outcomes

Improved understanding as to how internationalisation and networking of research and innovation activities and systems influence UK's ability to build and sustain a leading position in the global economy

Improved understanding of the roles of enterprises, universities, research centres, governments or formal and informal institutions in the changing environment of industrial competitiveness

Provision of strategic decision making methodologies (such as DEA and simulated annealing) as well as dynamic visualisation and road-mapping tools such as modelling, simulation and optimization that allow for envisioning what the optimal choices are in a dynamic knowledge logistics context)

Facilitation of the formation of policies, networks and initiatives that would support businesses and enhance the chances of UK industries to overcome the "Valley of Death challenge (ie, the gap between financing needs and available risk capital in early stage venture development resulting into firm failure)

in their strategic resource allocation to their research and innovation systems and their contribution to growth and competitiveness

6. Project management

Prof. Koh and Prof. Mellahi will be responsible for supervision of RA#1 while Prof. Carayannis will be responsible for supervision of RA#2. Project partners will discuss the project monthly by utilising video conferencing facilities and aim to be jointly present at suitable UK and International conferences to conduct face to face meetings. Furthermore, two project meetings, one in the USA and one in the UK, will be scheduled at the beginning and close to the end of the project. In addition, RA#1 be provided training through the Sheffield Research Leaders' Programme – an initiative providing a coherent framework of leadership training, career development analysis and professional development.

7. Dissemination and Exploitation

In addition to presenting the finding in peer review journals and international conferences, we seek to disseminate and exploit the results through a variety of means:

- *A Glocal Knowledge Logistics Simulation, Visualisation and Planning Decision Support Tool* (GKL-Tool) that would enable industrialists with deeply threaded networking infra-structures to further facilitate and promote the formation of GloCal, co-operative innovation networks and knowledge clusters. In this manner, industrial firms would be able to maintain a continual qualitative upgrading of their technological and innovation infra-structures and especially their glocal knowledge logistics systems.

- We intend to pursue the commercialisation of GKL-Tool as an ASP, web-service configuration that would aim to sufficiently affordable, functional, user-friendly and effective for a wide adoption or take-up by SMEs which are typically not using such decision support modalities unlike large firms and are part of the large industrial firm's ecosystem (suppliers, customers, complementors). This would enhance the competitiveness of the entire value-adding and supply-chain of large industrial firms per the next point. Licensing of GKL-Tool to large firms could then be used to disseminate the results across the industrial ecosystem and thus establish and leverage the GKL-Tool as a competitively differentiating golden standard for next generation logistics.
- Formation of a consulting *Green Paper for UK policy* for the research and innovation systems and their contribution to growth and competitiveness.
- Establishing of a network of knowledge logistics stakeholders that will act as an experiential learning knowledge cluster via person-to-person and virtual interactions to further provide insights for continued improvement of outputs mentioned above.

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