Knowledge-Driven Entrepreneurship

INNOVATION, TECHNOLOGY, AND KNOWLEDGE MANAGEMENT

Series Editor:

Elias G. Carayannis
George Washington University
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Thomas Andersson · Martin G. Curley
Piero Formica

Knowledge-Driven Entrepreneurship

The Key to Social and Economic Transformation

Springer

Thomas Andersson
Jönköping Int. Business School
Jönköping University
Jönköping, Sweden
thomas.andersson@hj.se

Martin G. Curley
Intel Corporation and
National University of Ireland
Maynooth, Ireland
martin.g.curley@intel.com

Piero Formica
Jönköping University
International Entrepreneurship Academy
Bologna, Italy
piero.formica@hj.se

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Series Foreword

The Springer book series *Innovation, Technology, and Knowledge Management* was launched in March 2008 as a forum and intellectual, scholarly "podium" for global/local, transdisciplinary, transsectoral, public–private, and leading/"bleeding" -edge ideas, theories, and perspectives on these topics.

The book series is accompanied by the Springer *Journal of the Knowledge Economy*, which was launched in 2009 with the same editorial leadership.

The series showcases provocative views that diverge from the current "conventional wisdom," that are properly grounded in theory and practice, and that consider the concepts of ***robust competitiveness***,[1] ***sustainable entrepreneurship***,[2] and ***democratic capitalism***,[3] central to its philosophy and objectives. More specifically, the aim of this series is to highlight emerging research and practice at the dynamic intersection of these fields, where individuals, organizations, industries, regions, and nations are harnessing creativity and invention to achieve and sustain growth.

Books that are part of the series explore the impact of innovation at the "macro" (economies, markets), "meso" (industries, firms), and "micro" levels. (teams, individuals), drawing from such related disciplines as finance, organizational psychology, research and development, science policy, information systems, and

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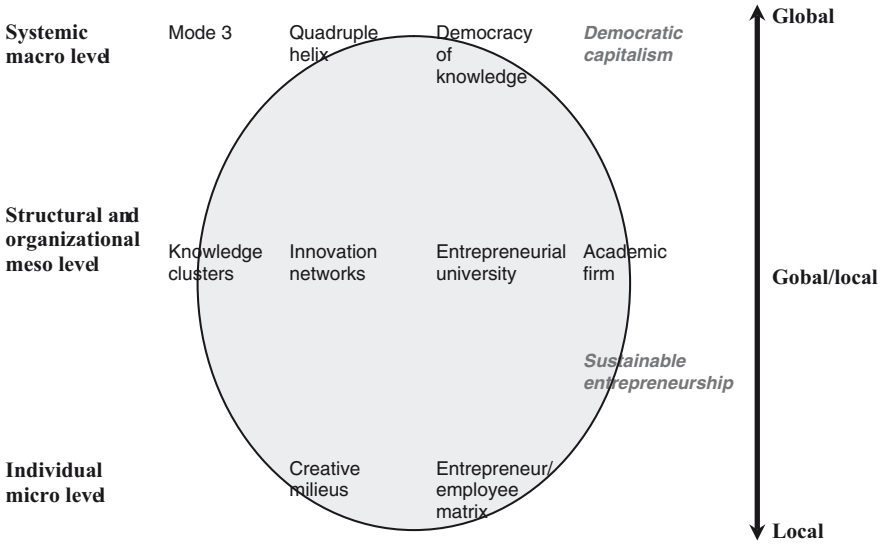
[1] We define *sustainable entrepreneurship* as the creation of viable, profitable, and scalable firms. Such firms engender the formation of self-replicating and mutually enhancing innovation networks and knowledge clusters (innovation ecosystems), leading toward robust competitiveness (E.G. Carayannis, *International Journal of Innovation and Regional Development*, 1(3), 235–254, 2009).

[2] We understand *robust competitiveness* to be a state of economic being and becoming that avails systematic and defensible "unfair advantages" to the entities that are part of the economy. Such competitiveness is built on mutually complementary and reinforcing low-, medium- and high-technology and public and private sector entities (government agencies, private firms, universities, and nongovernmental organizations) (E.G. Carayannis, *International Journal of Innovation and Regional Development*, 1(3), 235–254, 2009).

[3] The concepts of *robust competitiveness* and *sustainable entrepreneurship* are pillars of a regime that we call "*democratic capitalism*" (as opposed to "popular or casino capitalism"), in which real opportunities for education and economic prosperity are available to all, especially – but not only – younger people. These are the direct derivative of a collection of top–down policies as well as bottom–up initiatives (including strong research and development policies and funding, but going beyond these to include the development of innovation networks and knowledge clusters across regions and sectors) (E.G. Carayannis and A. Kaloudis, *Japan Economic Currents*, p. 6–10 January 2009).



strategy, with the underlying theme that for innovation to be useful it must involve the sharing and application of knowledge.

Some of the key anchoring concepts of the series are outlined in the figure below and the definitions that follow (all definitions are from E.G. Carayannis and D.F.J. Campbell, *International Journal of Technology Management*, 46, 3–4, 2009).

Conceptual profile of the series *Innovation, Technology, and Knowledge Management*

- The "Mode 3" Systems Approach for Knowledge Creation, Diffusion, and Use: "Mode 3" is a multilateral, multinodal, multimodal, and multilevel systems approach to the conceptualization, design, and management of real and virtual, "knowledge-stock" and "knowledge-flow," modalities that catalyze, accelerate, and support the creation, diffusion, sharing, absorption, and use of cospecialized knowledge assets. "Mode 3" is based on a system-theoretic perspective of socioeconomic, political, technological, and cultural trends and conditions that shape the coevolution of knowledge with the "knowledge-based and knowledge-driven, global/local economy and society."
- Quadruple Helix: Quadruple helix, in this context, means to add to the triple helix of government, university, and industry a "fourth helix" that we identify as the "media-based and culture-based public." This fourth helix associates with "media," "creative industries," "culture," "values," "life styles," "art," and perhaps also the notion of the "creative class."
- Innovation Networks: Innovation networks are real and virtual infrastructures and infratechnologies 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 coopetitive partnerships).
- Knowledge Clusters: Knowledge clusters are agglomerations of cospecialized, 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.
- Twenty-First Century Innovation Ecosystem: A twenty-first century innovation ecosystem is a multilevel, multimodal, multinodal, and multiagent system of systems. The constituent systems consist of innovation metanetworks (networks of innovation networks and knowledge clusters) and knowledge metaclusters (clusters of innovation networks and knowledge clusters) as building blocks and organized in a self-referential or chaotic fractal knowledge and innovation architecture (Carayannis 2001), which in turn constitute agglomerations of human, social, intellectual, and financial capital stocks and flows as well as cultural and technological artifacts and modalities, continually coevolving, cospecializing, and cooperating. These innovation networks and knowledge clusters also form, reform, and dissolve within diverse institutional, political, technological, and socioeconomic domains, including government, university, industry, and nongovernmental organizations and involving information and communication technologies, biotechnologies, advanced materials, nanotechnologies, and next- Generation energy technologies.

Who is this book series published for? The book series addresses a diversity of audiences in different settings:

1. *Academic communities:* Academic communities worldwide represent a core group of readers. This follows from the theoretical/conceptual interest of the book series to influence academic discourses in the fields of knowledge, also carried by the claim of a certain saturation of academia with the current concepts and the postulate of a window of opportunity for new or at least additional concepts. Thus, it represents a key challenge for the series to exercise a certain impact on discourses in academia. In principle, all academic communities that are interested in knowledge (knowledge and innovation) could be tackled by the book series. The interdisciplinary (transdisciplinary) nature of the book series underscores that the scope of the book series is not limited a priori to a specific basket of disciplines. From a radical viewpoint, one could create the hypothesis that there is no discipline where knowledge is of no importance.
2. *Decision makers – private/academic entrepreneurs and public (governmental, subgovernmental) actors:* Two different groups of decision makers are being addressed simultaneously: (1) private entrepreneurs (firms, commercial firms, academic firms) and academic entrepreneurs (universities), interested in optimizing knowledge management and in developing heterogeneously composed knowledge-based research networks; and (2) public (governmental, subgovernmental) actors that are interested in optimizing and further developing their

policies and policy strategies that target knowledge and innovation. One purpose of public *knowledge and innovation policy* is to enhance the performance and competitiveness of advanced economies.

3. *Decision makers in general:* Decision makers are systematically being supplied with crucial information, for how to optimize knowledge-referring and knowledge-enhancing decision-making. The nature of this "crucial information" is conceptual as well as empirical (case-study-based). Empirical information highlights practical examples and points toward practical solutions (perhaps remedies), conceptual information offers the advantage of further-driving and further-carrying tools of understanding. Different groups of addressed decision makers could be decision makers in private firms and multinational corporations, responsible for the knowledge portfolio of companies; knowledge and knowledge management consultants; globalization experts, focusing on the internationalization of research and development, science and technology, and innovation; experts in university/business research networks; and political scientists, economists, and business professionals.
4. *Interested global readership*: Finally, the Springer book series addresses a whole global readership, composed of members who are generally interested in knowledge and innovation. The global readership could partially coincide with the communities as described above ("academic communities," "decision makers"), but could also refer to other constituencies and groups.

Elias G. Carayannis
Series Editor

Preface

We are living in a time of extraordinary change. At this juncture, there are opportunities for radical improvement and solutions to our problems, but we are also faced with dramatic challenges and threats to our very existence. Both hopes and problems often center on the role of technology and what technology brings. Today, however, our future no longer depends on what technology can or cannot do for us. Eventually, the advancing tools of new technology will do basically what we require them to do. Today, and tomorrow, it is all about people, and what we set out to achieve – as individuals and collectively.

The key is knowledge and how we put knowledge into action. And because knowledge can be invested in so many activities, its role has become greater than ever before. Knowledge cannot be taken for granted, nor can its use. Knowledge may be disruptive, it may deteriorate, and it may be destroyed or just quietly pass into oblivion. Knowledge and its sensible management are here for us to cherish.

No one-size-fits-all approach exists. And knowledge cannot be measured on a single scale. There are different kinds and ways of using it, which in part reflect people's varying experience. Unique and novel constellations can come about as people with different backgrounds and experiences come together and complement each other.

In producing this book, we have had the advantage and privilege of enjoying the collaboration with colleagues who are able to draw on a diverse range of backgrounds but who have shared a common cause. Our backgrounds span academia, policymaking, and business. We were born and have worked in different countries and types of organizations. We have different experiences of working with decision-makers, ranging from international to national, regional and local level. Our hope is that the book and its diverse perspectives will serve as a source of inspiration for people from different backgrounds in different parts of the world but who share a common concern that we need to move toward models that are more conducive to development and the use of knowledge.

Jönköping, Sweden — Thomas Andersson
Dublin, Ireland — Martin Curley
Bologna, Italy — Piero Formica

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Introduction

Entrepreneurship is the glue that holds the knowledge triangle made up of education, research and innovation, which are key drivers of a knowledge-based society.

Martin Schuurmans
Chairman of the European Institute
of Innovation and Technology

The Knowledge Age: A Golden Future in Sight?

We have entered a new age heralded by the "enlightenment" of the "knowledge in action" revolution. Much has been written and spoken about the associated accumulation of production factors (i.e., capital, labor, and raw materials) that could help explain long-term growth potential.

The newly coined interest in knowledge as a production factor is, however, generally approached from too restrictive a viewpoint. Knowledge generation is not synonymous with scientific advances. Knowledge in action is not necessarily about diffusing scientific discovery or creating technology-based high-growth companies. Neither is knowledge a "new" factor of production.

Peter Drucker's and William Baumol's focus on knowledge and entrepreneurship, respectively, has rather thrown the spotlight on the importance of combining inputs in profitable ways. Knowledge creation and knowledge use are fuelled by the combined influence of human creativity and entrepreneurial energy channeled into innovation (Baumol 2002) in ways that enable successful, unforeseen combinations of different production factors. In turn, the effectiveness of the instrumental role played by knowledge creation is attributable to the culture of the institutions involved. An institutional environment that encourages creativity and experimentation is the ultimate determinant of economic growth and renewal.

The flow of knowledge, not technology per se, is the hallmark of technology transfer. To be effective, technology transfer therefore needs trustful and outward-looking knowledge brokers. The fact is that the knowledge revolution, caught up in its own enormous success, has in effect contributed to the rise of an economy

which, in its present format, has proven unsustainable. Major problems exist in terms of reliability and accountability in business, while governments and multilateral institutions are failing to provide satisfactory cross-border policy frameworks in a range of areas. Finally, it is important that market transactions and innovations are not merely pushed by technocrats and experts, but that they are pulled by the real needs of people, and of society, to produce better responses to real issues.

Knowing what a technology means in all its facets and how it can be transferred from its source to the user is the broker's main role. This implies that the broker should be a "cross-pollinator" who handles a chain of interactions between different professional communities of knowledge practice (engineers, patent and business lawyers, business economists, distribution agents, etc.) in various cultural contexts and countries. Care also must be taken of the interstices between them.

In a context of strong trusting relationships that are cross-functional, cross-sectional, and across borders, a threat for today's technology transfer intermediaries is that of foreordaining a conduct very similar to the behavior of professional corporations embedded in nation-states. Knowledge innovation communities, which embody the principles of the free-market economy and whose application-minded agents can relate themselves more effectively to the knowledge economy than the corporatist groups, are on sustained trends of growth improvement.

The needs of knowledge innovation communities and those of corporatist associations often do not match. The value proposition of knowledge policy is that it helps shape a new market context in which communities of free knowledge-innovation agents take a powerful step toward building a knowledge-intensive economy. Knowledge-relevant economic policy is that which empowers knowledge innovation agents who break away from the prevailing trend of corporatist routines seen from the medieval guilds up to today's professional corporations. These agents are interested in a type of policy relevant to the stimuli to change in accordance with new ideas that knowledge provides. They go with the flow of knowledge.

Economic policy that endorses corporatist pressures and disregards market signals cannot accommodate the higher potential of the knowledge economy. Professional corporations engrossed in their bureaucratic practice and attitude are not apt to seize the broader field of vision that the knowledge economy presents or to spot the interdependence of the various branches of knowledge.

Again, modern governance-building institutions have failed to put in place the prerequisites for fulfilling the potential of the knowledge era. Consequences in terms of failure are visible in a number of respects:

- Lack of an orderly framework for protecting intellectual property rights and thus for accurately measuring and disclosing the value of intangible assets, to the detriment particularly of individual innovators and SMEs with limited bargaining power.
- Within organizations, lack of leadership by management to take charge of information management. This results in weaker rights, obligations, and strategic leadership and lack of accountability, which is visible in multiple spheres – business, politics, universities.

- A "shallowness" in many activities, a thinning of professional skills and an expansion of meaningless or even destructive services, as observed in areas ranging from legal services to manual work.
- Lack of verifiability and accountability in data governance, feeding cybercrime and fraud, and also contributing to weakening oversight whose consequences are all too visible in the performance of the financial services industry over the last decade.
- When there is lack of orderly conditions there is also failure to observe and take action to preserve and manage resources that generate common goods for the long term, but whose protection requires investment in the short term. Many societal and environmental assets fall into this category. They include inherited cultural assets that will become more valuable when preserved for future generations (for instance, the upbringing of our young, whose full voice will be heard only later on) and critical environmental assets such as the air we breathe and the water we drink.

The implications for public policy are clear. Policymakers have a distinct role to play in creating and ensuring the presence of sound institutions that can support effective markets. Corporatist policy, on the other hand, is damaging to the efficient operation of knowledge markets and hence to the knowledge economy as a whole. Incumbent organizations become vested interests. They try to boost embedded costs and what they already take pride in. Genuine experimentation and renewal requires openness of product and factor markets for newcomers to make entry.

Following this view, the struggle of the open economy, which is a vehicle of knowledge innovation, against the closed economy, which debars the flow of energy, remains at the heart of the debate on knowledge-relevant economic policy.

Entrepreneurship in the Knowledge Age

Entrepreneurs of different nationalities and backgrounds are creating start-ups, which are instrumental to the development of the knowledge age. They build "alumni" communities of entrepreneurs that combine their efforts to overcome the limitations of the established national boundaries and mindsets with the aim of igniting and propelling the flow of knowledge to form international start-ups.

This growing phenomenon is rendered possible by globalization, human mobility, and by the increasing force of the so-called creative class. It is further propelled by the obvious advantages it conveys, given orderly conditions. Naturally it need to be accompanied by orderly regulatory frameworks in support of transparent markets and financial transactions, societal and environmental protection, competition law, orderly multilateral frameworks to underpin intellectual property rights, etc. Again, a lot of this is simply not in place. We are facing a crisis when it comes to the ability of governance mechanisms to deliver on many of our most important issues.

We cannot expect the answers to come from to fall like manna from heaven. Unlike in the economics textbooks, there is no altruistic government that looks to

the common good of society as a whole. The policies of government are well known to reflect political processes, where vested interests exercise disproportionate influence and the timing of elections influence when popular (and unpopular) decisions are made. Scientific discovery, and new knowledge more broadly, can of course translate into public opinion and thereby influence government policy. That link is not exogenously given, but – in the knowledge economy – any government with an ambition to take and implement decisions needs a thorough communication policy, as does any private company or university for that matter.

The way in which new knowledge is diffused in media and society until it translates into generally accepted knowledge is an area of study in itself, however, subject to its own logic which in turn are changing as the information revolution changes the media and as we devote our attention to different media. The traditional monopolistic position of the public TV channel is now all but gone, and with the convergence of the Internet with cellular technology and other means of communication, we are destined to witness increasingly cutthroat competition. The view of what constitutes reliable and attractive sources is in a state of flux. The readiness of the media to highlight a particular topic is also not a given, as it will depend on what can be "sold" as news. On this basis, there is today a systematic tendency for the sudden event to take preeminence over creeping realization. There is the pressure for all the actors – business people, analysts, financial journalists, newspaper owners, TV channel owners, and so on – to share in this distorted presentation of how the world evolves.

But while the impulses for action and for knowledge generation cannot in a general sense come "from above," a fundamental feature of the knowledge era is the scope it creates for bottom–up initiative. Here, entrepreneurship is a key aspect.

Widespread entrepreneurial activity is a universal necessity. This was always the case and is so more than ever. Entrepreneurialism and technology are central to a country's economic growth and social health. A culture of entrepreneurship helps to diversify the economy and make it more entrepreneurial. Entrepreneurial economies – those with a high rate of conversion of new ideas into fast-growing enterprises – display superior macroeconomic performance.

The quality of company formation is crucial. The difference between small and entrepreneurial businesses is ultimately attributable to innovation. Policy actions have to be conducive to the creation of innovation-driven firms.

A direct link exists between the entrepreneur and the innovation process. Innovation is knowledge turned into action through creative endeavor that rests heavily on the willingness of individuals to start new firms. International entrepreneurship, which takes advantage of globalization, accelerates this process by increasing the opportunities for the successful commercialization of innovation. From the supply side, innovative goods and services can be extended to new geographical markets. From the demand side, diversity in demand (i.e., increased demand for tailor-made and individualized goods and services that are the outcome of cross-cultural influences and regional, social, and cultural differences) can be satisfied.

Attitudinal differences related to both local and individual cultural features result in divergent performances when building and sustaining cross-border and cross-

cultural firms. As with international entrepreneurship, the world is our community. Intellectual exchanges and the mobility of human capital are qualifying elements of the international dimension of entrepreneurship. In particular, student mobility – a notion that is at the same time new and traditional – is the product of matchmaking by education institutions in different countries. These institutions should reflect more thoroughly on how to respond to the new meanings of entrepreneurship and to the new challenges that the start-ups incubated in their environments will face in the years to come.

Knowledge communities are central to the formation of a culture of international entrepreneurship that helps to diversify the economy and make it more entrepreneurial. In low-context communities, interpersonal collaboration across multiple boundaries – across cultures, functions, rivalries, geography – creates the right atmosphere for the rise and spread of broader and fresher insights from newcomers. In this respect, all sorts of organizations, supported by policy interventions and integration, must encourage both physical and virtual mobility across national, cultural, and ethnic boundaries.

Policymakers must take action to help fuel international entrepreneurship. A borderless entrepreneurial economy leads to progress, development, and prosperity for citizens and society as a whole. Society and its actors – government, public and private organizations, universities, and higher education institutions, companies, and political and economic development leaders – are called upon to participate in the creation of the next breed of entrepreneurs in a more active, direct, and leading capacity. All actors must be committed to developing an entrepreneurial culture, raising students' awareness of entrepreneurship as one of many alternative career paths, encouraging cross-border and intercultural entrepreneurial behavior, and boosting international start-up undertakings.

Because potential entrepreneurs face the choice of whether, and with whom, to collaborate when setting up their own business, they need to take account of the impact that an international team of founders would have on the likely success of their new business.

International teams are better suited to competition in the global marketplace because international entrepreneurship is a mechanism that makes available the right partners required by nascent entrepreneurs to establish relationships that increase the flow of ideas and provide the institutional settings conducive to the formation of multinational and multicultural teams of entrepreneurization.

This book introduces and emphasizes the relevance and importance of high-expectation entrepreneurship as a driver of economic growth. Entrepreneurial ventures differ dramatically from the process of expanding existing businesses since little is known and much has to be assumed. Using a translational innovation approach, the book borrows paradigms from experimental research and medical practice as vectors for accelerating the experimentation and validation of business models associated with high-expectation entrepreneurship. The ability to transpose, test, and iterate new business ideas and models in a laboratory environment has significant potential. Emerging software platforms, which can simulate markets and consumer reactions or help predict demand for new products, when coupled with approaches such as

Discovery Driven Planning (McGrath and McMillan 1995), can lead to rapid learning, iteration, and preliminary validation of a new business idea, risk mitigation, avoidance of potential costs, and maximization of revenue potential.

We are all on the move into the era of the knowledge economy. Knowledge was always vital to human activity, but now its role is becoming pervasive. How knowledge is developed and put to use is critical for setting the stage in terms of the progress and prosperity that countries and economies can achieve. Arguably countries and regions need new socio-economic models, one's which are sustainable and do not depend on ever increasing growth and consumption of resources. Knowledge Driven Entrepreneurship may be a key contributor to the development of such models and their effective operation thereafter, success cannot be taken for granted. Outcomes will critically depend on the extent to which societies and institutions are able to create conditions that enable innovation and entrepreneurship.

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Notes

[1] We define *sustainable entrepreneurship* as the creation of viable, profitable, and scalable firms. Such firms engender the formation of self-replicating and mutually enhancing innovation networks and knowledge clusters (innovation ecosystems), leading toward robust competitiveness (E.G. Carayannis, *International Journal of Innovation and Regional Development*, 1(3), 235–254, 2009).

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Part I
Knowledge

Chapter 1
Scenario Setting

The idea that knowledge is something anyone can acquire is recent: for most of history knowledge has been rare and secret, and this esoteric heritage, with its dream of mastery and mystery, survives in the jargon with which every profession protects itself. Knowledge is still a serpent eating its own tail.

(Theodore Zeldin)

We live in the fast-moving times and discontinuous changes of the new age of knowledge, information and access (see Appendix 1), when nimbleness, speed, transparency and local sensitivity have become absolutely essential to success.

The transition from the machine-age to the knowledge-age has raised an awareness of the need to replace the old guard of atom-based firms with a new breed of counter-cultural, digital-rooted companies. They employ brains instead of hands, invest in new concepts and contents rather than in new machines, accept fast change as a constant, and behave as coopetitors who collaborate and compete with other companies at the same time to generate new market spaces, instead of fighting for existing markets.

The Industrial Age relied upon scarce resources. Land, labor and capital were the drivers of progress in the industrial economy, with knowledge essentially of the type incorporated in machines and other tangible or physical assets. The knowledge economy relies upon the asset of human knowledge. In the knowledge economy, the main source of value creation resides in the hyper-mobility of knowledge, which controls access to opportunity and advancement (see Appendix 1 for prima facie evidence of a divide between the Industrial Age and the knowledge economy).

Knowledge is a human process dealing with mental objects, and requires awareness and intuition. In today's most technologically advanced countries, knowledge is the primary factor determining the standard of living.

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Exhibit 1: Knowledge Economy

A knowledge-based economy is focused on generating and using knowledge to create value through activities such as:

- Investments in R&D
- Leveraging emerging technology directions (see Appendix 2)
- Patenting
- Development of scientists and engineers

Some of the more advanced applied thinking about the instantiation of a knowledge economy has been performed by the European Commission. Knowledge lies at the core of the European Union's Lisbon Strategy to become the "most dynamic competitive knowledge-based economy in the world." A knowledge triangle comprising research, education and innovation has been conceptualized as a core factor in European efforts to meet the ambitious Lisbon goals. Numerous programs, initiatives and support measures are carried out at the EU level in support of knowledge. The EU Seventh Framework Programme (FP7) bundles all research-related EU initiatives together under a common program playing a vital role in attempting to reach the Lisbon strategy goals of growth, competitiveness and employment. This FP7 program is one of the world's largest open innovation programs creating research priorities, infrastructure, resources and funding to enable a knowledge economy. Although at the time of writing the EU is well behind its objective of reaching the Lisbon goals, the Lisbon strategy remains one of the more ambitious and well-conceived plans to enable a knowledge economy across a broad geographic region.

A sustainable knowledge economy is achieved only when entrepreneurs create products and services that are useful and value-adding and delivered at price points that participants (consumers, enterprises, and public sector bodies) in different markets are able to afford and willing to purchase. Indeed in the knowledge economy, consumers may transition to become prosumers actively participating in the creation of knowledge and become an integral part of the knowledge chain process (ISTAG 2009) with the social production elements involved in YouTube and Wikipedia being present day mainstream examples of this.

A key opportunity for the knowledge economy is the concept of "dematerialization," where as the cost of information continues to fall it is increasingly substituted for other resources in the physical value chain such as labor and raw materials (McInerney and White 2000). Dell's use of a streamlined IT-enabled value chain allows it to build PCs to order rather than making to stock, avoiding building costly inventory which has a short half-life. Likewise the provision of automated answering systems and online self help for IT services and products replacing human operators is another example of substituting bits for atoms.

The broader use and availability of knowledge and the ability to move it more quickly will enable key societal shifts such as moving from resource intensive

(continued)

Exhibit 1 (continued)

living to a sustainable lifecycle, and moving from geographically-based communities to virtual communities (ISTAG 2009)

Much of the growth in labor productivity outside the agricultural sector is concentrated in knowledge-intensive activities, with business and ICT services currently accounting for the bulk of labor productivity growth (OECD Science, Technology and Industry – 2003, Scoreboard, http://www.oecd.org/sti/scoreboard).

Indeed, a big ongoing change in business is the attempt to move to service models. Companies that historically were producers are trying to move away from a one-time purchase to an annuity stream by providing a service. And inevitably that is enabled by IT. Rolls-Royce, which is now trying to sell "power by the hour" is a prime example. Instead of selling an aircraft engine and maybe a maintenance contract on top of that, Rolls-Royce can use automated telemetry to offer something that is completely different.

Increasing competition for the factors that generate knowledge is accompanied by rapid integration of the Internet into everyday life, and global integration of economic activities.

Knowledge is not information. The latter is an inert resource or a static activity of reading, duplicating and broadcasting news. The former is a purposeful and dynamic process of selection and interpretation of information, and of face-to-face interactions through which knowledge is continuously recreated and meanings are assigned to facts that otherwise would remain unintelligible. There is no information without rendering it explicit. Conversely, there is knowledge although not explicit (Sveiby 1997).

The producer of knowledge, unlike the manufacturer of a physical product, still keeps it, once knowledge has been surrendered in exchange for money. This raises two points.

From one point of view, knowledge goods are, in economic parlance, "nonrival" (that is, they can be used by their vendors and buyers simultaneously). "Knowledge – as knowledge experts say – is not given up in exchange for money in the same way as a cream cake. You can't eat your cake and have it, but you can sell your knowledge and keep it" (Hampdem-Turner and Trompenaars 1994). Conversely, things made up by mass or energy are "rival" in that they cannot be used by two or more persons at once (Bailey 2000).

From another point of view, knowledge is not a limited-resource market like agriculture, mining and bulk goods, where a fixed-resource constraint is put on their trading. Knowledge markets are not affected by a short supply of ideas: the potential for finding new ideas is infinite.

Exhibit 2: Distinctive Attributes of Knowledge and Information

Knowledge	Information
Mental tools that make sense of things	A message that reduces uncertainty
An evolving set of beliefs about the world	
A crucial production factor that changes old Knowledge makes mere information valuable	
Dynamic	Static
Dependent on individual	Independent of individual
Tacit	Explicit
Analogue	Digital
Must be recreated	Easy to duplicate
Face-to-face communication	Easy to broadcast

Source: Leonard (1998), Sveiby (1997)

Exhibit 3: Rival and Nonrival Goods

Paul Romer, the founding-father of the new growth theory, divides the economy into ideas or "nonrival" goods, which can be stored in a piece of string, and things or "rival" goods with mass or energy. For example, cars are rival goods; recipes, formulas and techniques used to rearrange things are nonrival goods.

Increasingly, the knowledge economy has moved in a direction in which at least some kind of knowledge is put to work (in tools, processes and products, and in knowledge itself) for innovation with a short life-cycle.

Exhibit 4: Innovation, Innovation Life Cycle and Knowledge Innovation

Innovation, the tool of the entrepreneur (Drucker 1993a), is the introduction of something new which creates value for the organization that adopts it (Curley and Baldwin 2007).

Traditional perspectives have viewed innovation as closely related to science and technology. Mastering the expanding opportunities in scientific and technological progress is indeed becoming an increasingly important source of generating high value-added innovation. On the other hand, innovation can take many forms, including commercialization of science and technology as well as the development and implementation of new ideas more generally, as in the form of organizational change or inventing new ways of doing things. Innovations that enhance attractiveness and accessibility to customers and users are often essential

(continued)

Exhibit 4 (continued)

for commercialization. Further, innovation is the key not only to economic progress, but also to identifying new solutions to pressing social issues, such as an ageing population or environmental degradation. Innovations may be categorized in different ways, including product and process innovations, although there is no clear-cut dividing line between the two.

Innovation must not be conceptualized as a one-dimensional, linear process leading from certain input factors. Innovation is the result of efforts by multiple actors, and is enhanced by their constructive interactions. No single actor generally manages all the skills that are useful, but complementary competencies are crucial, allowing a continuous flow of impulses from both the supply and the demand side to meet. Fostering conditions that are favorable to innovation may require reforms in various areas.

The outcome of interactions that are conducive to the exchange of knowledge, innovation arises from ongoing circles of exchange where information is not just accumulated or stored, but created.

Therefore, innovation is knowledge in action that translates something originating in an experiment into something newly introduced in the marketplace. It leads to changes in the way of doing things that are perceived as positive by those organizations or individuals who make use of it.

The innovation life cycle is represented by an S-shaped logistic curve consisting of the three distinct phases that – as has been illustrated, for example, by Howard and Guile 1992: 12 – refer, respectively, to "emergence (the development of the product or service, its manufacturing capabilities, and its place in the market), growth (where the product family pervades the market), and maturity (where the market is saturated and growth slows)."

As George Kozmetsky has observed, "The life cycles of economic goods and services that are digital in form and heavily dependent on knowledge are often short, due to intense product development. As new and advanced products are launched in the market, the earlier generations become obsolete. Typically, the new generation of a product embodies not only upgraded technological and marketing characteristics, but also a wider array of attributes. Defining a product by the vector of services it delivers, the dimensionality of this vector increases all the time. Products become more complex" (Voice of the Entovation 100, 2002).

Knowledge is generated anew from connections that were not there before. Knowledge Innovation®[1] refers to the creation, evolution, exchange and application of new ideas into marketable goods and services for (1) the success of an enterprise, (2) the vitality of a nation's economy; and (3) the advancement of society (Amidon 2001).

Disruption is the essence of knowledge innovation. In fact, it establishes entirely new compelling performance trajectories whereby forays into new market segments or new businesses look very attractive. Disruptive innovation sweeps away the traditional competitors whose products or services are hit by irreversible

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