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PRELUDE
TO THE MAPPING OF INNOVATION

It is accepted wisdom that innovation holds the key to economic growth and social prosperity; and businesses achieve advantage through acts of innovation. However a vital question deserves to be raised: **"How do we perceive innovation?"**

Is innovation merely making new products or processes? Is innovation confined to passing from invention to diffusion? Is innovation limited to performing R&D? Is innovation solely a technological matter? Does innovation embody social and cultural scopes?

The complexity and heterogeneity of innovation make it difficult to formulate generalizations, except in very broad terms. However, we must examine our views of innovation.

Our perception and understanding of the process of innovation depends largely on the paradigms and models that we implement. In understanding the process of innovation, models may have the same role as that of maps and atlases in determining our perception of the world. Map-making has always been a useful analogy to help us understand the interconnectedness of human life, and mapping is an active metaphor to study the process of innovation.

Maps, a systematic presentation of the world on a flat surface, show a view of an entire region, and visually depict its juxtaposition in relation to adjacent districts. From ancient times, humans have produced maps to depict earth distributions geographically in order to visualize them. Maps work as taxonomies, demonstrating commonalties between different areas. In addition, maps facilitate measurement by providing a scale of valuation. To be useful for accurate measurement, a map must impose a 'pertinent taxonomy', and a 'precise scale of valuation'. Maps, similar to vision tools, illustrate people's perception of their environment.

Although the current maps of the world may seem familiar, over time they have changed dramatically. The appended diagrams consist of maps of the world, which were drawn within a time frame of just a few centuries. This collection shows that early maps display very limited views of the whole world: The classification and valuation systems in such maps are primitive. Recent maps provide a more realistic view to the world. Can we delineate a comparable process for the mapping of innovation?

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EVOLUTION OF THE MAP OF THE WORLD

Diagram No. 1 shows part of a Roman road map of the 1st century AD. This road map depicts the routes between the major cities of the Roman Empire and the approximate distances along the roads. As the cartographer lacked an overall vision of the shapes of land and sea, these masses are distorted almost beyond recognition. In this part of the road map, North Africa and the Mediterranean Sea are located in the lower section. The middle section covers part of Italy (the city of Rome in the middle), and Adriatic Sea and Balkans are shown in the upper section.

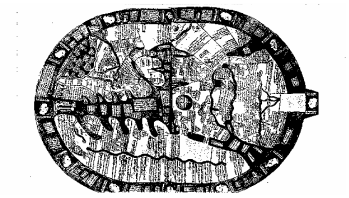

Diagram No. 2 is the Map of the world drawn in 1363 by Randulf Higden. Mediterranean Sea covers the left, Red Sea and Mesopotamia are in the right side of this map. Following the dominant belief of that time, the World is depicted flat and the Holy land located at its center. This map is primarily a representation of some territories in the Old World. There is no scale in this map, and naturally no measurement is possible to be based on it.

Diagram No. 3 is the map of the world drawn in 1520. Persian Gulf and Caspian Sea are located almost in the middle of this map. Mediterranean Sea covers the left side, and North Africa and North Indian Ocean occupy the lower part of this map. Although the knowledge of Asia, Africa and Indian Ocean is vague and fanciful, this map has a relatively accurate knowledge of the contours of the Mediterranean coastline. This map is based on the writings of the Greek geographer, Polemy, who lived around 150 AD. Polemy was the first to use a system of regularly spaced coordinates on maps to be used as a type of scale.

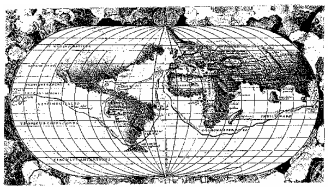

Diagram No. 4 is the map of the world drawn in 1544 by Batista Agnese. America has been inserted to the world map, however Australia and Antarctica are still terra incognita. The undiscovered areas in North America and Central Africa have been left unmarked. The Magellan's voyage, who for the first time circumnavigate the globe, is marked here. This map, which looks to Earth as a sphere rather than a flat subject, is based on presentation of a systematic scale to make measuring possible.

Diagram No. 5 is the map of the world drawn in Robinson projection. This map depicts what we commonly consider as the 'World'. Although this map may include a scale, which makes the comparison of different regions possible, its measurement for navigation is inaccurate.

Diagram No. 6, the map of the world in Mercator projection, is the widely used navigation chart. In this projection the longitudes are parallel vertical lines and the latitudes are parallel horizontal lines. By drawing a straight line between two points and using a compass, a navigator can determine the sailing direction between those points. The distances can be measured directly and easily. This map, named after its designer Gerardus Mercator, has been considered the masterpiece of navigational charts since its development in the 17th century.

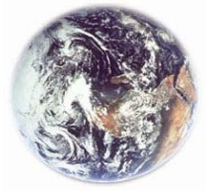

Diagram No. 7: The Earth as seen by the Apollo 17 astronauts, 1972

Referring to the maps of the world, as in the appended diagrams, if the analogy between a geographical atlas and the mapping of innovation is useful, let us assume for a moment that the current procedure is, at best, similar to map No. 1, and our goal, a comprehensive map of innovation, might look like map No. 4. To create a system comparable with map No. 4, we must pass through intermediate stages, similar to maps No.2 and No. 3. We have to understand that the development of mapping of innovation, similar to map No. 4, would take a painfully long time. An innovation atlas, similar to map No. 5, is obviously unattainable.

In a world of floating realities and contradictory maps, rewards will accrue to those commentators whose maps seem to fit their territory as closely as possible, based on the ability to yield predictable results for those who use them[1].

We need an interdisciplinary understanding of innovation, an understanding not created by current university disciplinary courses[2]; as innovation is interrelated to all the environments in which humans live. A proper mapping for innovation would provide a better view of the relationships between all the environments, for instance natural, social, and technological. Traditionally, each environment has been studied by a separate discipline; and each discipline has developed a separate set of classification and appraisal (mapping) for a given environment. Not surprisingly; current studies of society (e.g. sociology), nature (e.g. biology), technology (e.g. engineering) and economy (e.g. accounting) are mostly incompatible.

Mapping of innovation, in addition to enabling us to acquire a better understanding of the process of innovation, assists us to determine the impact of innovation on other connected topics, such as economic growth, human development and social/institutional endowment. At the corporation level, mapping of innovation is useful to develop new tools to measure innovation-related phenomena and to articulate innovation plans.

The conventional approach to the study of innovation is comparable to exploring an area on foot and without a compass, rather than providing an overview of the given region. The mapping of innovation, which must encompass more than a bird's eye view, would assist us to soar over the entire realm of innovation and cross through currently separated disciplines. While researchers of orthodox disciplines may continue to explore a given specialty, similar to traditional practitioners, the mapping of innovation would assist us to venture over new horizons and discover new vistas.

A holistic study of 'knowledge', as an independent variable, holds the core of the Mapping of Innovation. This method also facilitates the development of knowledge's role in the process of production and an architecture for knowledge. Although management literature praises knowledge and its importance, knowledge's structure and the architecture of knowledge have seldom been configured. A comprehensive architecture for knowledge and its taxonomy is the cornerstone of the Mapping of Innovation.

The ideas, which are here expressed so laboriously, are extremely simple and should be obvious. The difficulty lies, not in the new ideas, but in escaping from the old ones, which ramify, for those brought up as most of us have been, into every corner of our minds[3].

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[1] Barlow J, **The Economy of Ideas ,** http://www.nirvanet.fr

[2] Kline S, 1991, **Styles of Innovation and their Cultural Basis**, (Chemtech, August-October 1991)

[3] Keynes J, 1935, **The General Theory of Employment, Interest and Money,** Harvest HBJ, New York

Where to Go from Here

A set of interrelated reports, to be displayed in http://www.icbc.org/dma, is going to demonstrate a new vision of innovation and to explicate "The Mapping of Innovation". The reports are all consistent with the core idea of integrating "knowledge" as an element of production. The integration of knowledge, as an element of production in this collection of reports, makes it possible to articulate a new view towards the knowledge (new) economy, as well.

Sundry reports, papers and articles have already examined the role and importance of "knowledge", as a factor of production (and this point will be further discussed in "The Dynamic model of production" and "The Architecture of knowledge). However, the existing reports have rarely presented a set of models to depict the discussed relationships. This collection concentrates on the development of the mapping of innovation. Many more applications for the proposed models exist, suggesting the possibility of much broader use than merely for innovation planning.

The reports are organized into two sets: "Vision" and "Application". The 'vision' reports collectively define the background basis of the mapping of innovation, while the 'application' reports conceptualize some applications of the proposed vision. This classification may have commonalties with the classification of 'vision' and 'technique', contemplated by Joseph Schumpeter[4].

Should you like to prioritize the reports, you may start with the "Holistic Model of Innovation", and "Regional Innovation Survey for Etobicoke".

ABSTRACT OF THE VISION REPORTS

- ### Static Model of Production and the Evolution of Economics

  Economic inputs are traditionally organized into land, labor and capital, which are also referred to as the factors of production. This simple classification, being named the Static model of production, has been the basis of the evolution of economics during the last two centuries.

- ### Dynamic Models of Production and the Evolution of the Knowledge Economy

  The integration of knowledge as an element of production, with material, energy, artifact (equipment) and human resources, creates a new formation entitled the Dynamic model of production. The Interactive model of production further depicts the relations among the above five elements in the context of five environments: Nature, Society, Technology, Market and State (government).

- ### Linear Model of Innovation

  Basic Research, Applied Research and Development - R&D, altogether make a structure, referred to here as the Linear model of innovation. For almost half a century, this formation has played a decisive role in the evolution of the tacit technology

[4] Schumpeter J, 1951, **Ten Great Economists**, Oxford University Press, New York

strategies of the most industrial countries. The report studies the background, evolution and deficiencies of the Linear model in detail.

- **Non-Linear Models of Innovation**

  The report studies four non-linear models of innovation: Stephen Kline's Chain-Linked model, Ralph Gomory's Circle model, Alic-Branscombe's model, The Oslo manual and the Neural Net model.

- **Architecture of Knowledge**

  Knowledge, as a broad concept, is organized into three interdependent settings: "Information", "Knowing" (skill) and "Organization". Information, the codifiable and documentable knowledge, then classified into three groups: detailed information for specific subjects, general information for specific subjects, and comprehensive information for general subjects.

- **Holistic Model of Innovation: An Innovation Model for the Real World**

  The Linear (R&D) model of innovation dominates studies of innovation and technology development. A holistic model of innovation seeks to understand the role of knowledge, design and development capacity in the context of a dynamic interaction between markets, production, design and development (D&D), industrial research and development (R&D) and basic research.

- **Social Innovation: Integrating Technological Innovation and Social Learning**

  In industry, as well as in academy, the term 'innovation' is often assumed to mean technological innovation, often even further confined to R&D; whereas the process of innovation is more appropriately a socio-technical process, comprising both social learning and technological development. Technological innovation without social and institutional development will not improve economic or social conditions.

ABSTRACT OF THE APPLICATION REPORTS

- **Regional Innovation Survey of Etobicoke**

  Performed in 1994, this survey was developed to provide sound information on the innovation capabilities and technology development plans of Etobicoke businesses. The survey methodology is consistent with the Holistic model of innovation (re: An innovation model for the real world).

- **Industrial Survey of Etobicoke**

  This survey was performed in 1994 to provide information on Etobicoke employment levels and industrial character. The survey concludes that small and medium sized

manufacturing enterprises SMEs constitute the backbone of Etobicoke's economy.

- **Technological Development of Preferred Suppliers**

  Original equipment manufacturers and prime contractors have a sourcing relationship with a network of parts and component suppliers and subcontractors, mostly SMEs. This report, representing an application of the Holistic model of innovation, implies that there exist an association between the size and technological capabilities of many businesses.

- **Regional Innovation Strategies in the European Community**

  'Innovation', an ambitious program of the European Community, aims at helping the European regions to improve their innovation infrastructures. 'Innovation' covers a set of interrelated sub-programs, for instance Regional Innovation Strategy - RIS, and Regional Innovation and Technology Transfer Infrastructures and Strategies - RITTS. Since 1994, more than 68 regions, one in four across Europe, have initiated RIS and RITTS projects.

- **Mapping the Regional Innovation Systems**

  The comprehensive (national) systems of innovation covers all the institutions that lead, provide and support the socio-technical capabilities of a nation. The mapping of the comprehensive innovation systems is based on depicting the main information relationships between the economic, technological and learning institutions, at the three tiers of a government: Federal (central), provincial (state) and regional (local).

- **Innovation (Knowledge) Planning for Businesses**

  Financial plans, which hold the core of business planning, often are based on the assumption of current technology and regarding learning as a cost. Innovation (knowledge) planning, as a new management tool, consists of integrating a business plan with technology development plan and learning planing.

- **Knowledge-Based Cost Analysis**

  In conventional (standard) and activity-based costing, costs are being classified into three main variables: **Material**, **Labor** and **Overhead**. In this context the evaluation of knowledge phenomena (intangible assets) and measurement of innovation activities (e.g. R&D) are tough challenges. In 'Knowledge-Based Cost Analysis' costs are organized into four inter-related variables: "**Knowledge," "Human Resources," "Equipment,"** and **"Material, Energy and Services."** This configuration provides a structure to articulate knowledge (intellectual capital) as well as innovation in the cost/ benefit analysis.

- **Keynesian Economics and the Linear Model of Innovation**

Keynesian economics, the dominant economic doctrine in the wake of the Second World War, advocates government spending as a means of stimulating the economy and creating employment opportunities to prevent another Depression. This report, providing a new outlook to the relationships with the Keynesian doctrine and R&D classification, argues that the Linear model of innovation acted as the tacit innovation base for Keynesian economics.

- **Schumpeterian Economics and the Trilogy of Invention, Innovation and Diffusion**

  Joseph Schumpeter has widely been praised as the economists who integrated innovation in the economic studies, as well credited for elaborating the trilogy of invention, innovation and diffusion. This report intends to shed a new light on what Schumpeter actually wrote about innovation. The report argues that Schumpeter's main attention was the business cycles rather than innovation. Schumpeter employed innovation to explain the nature of the business cycles.

- **Mathematical Analysis of Macro-Economics and the Dynamic Model of Production**

  Orthodox mathematical analysis of macro-economics, being based on $Q = f(K,L)$, is consistent the assumption that knowledge is not a variable in the process of production. The Dynamic model of production provides a new platform for the mathematical analysis of macroeconomics based on the following formula: $Q = f(K, L, I, M, E, t)$.

- **Matrix Taxonomy of Industrial Classification Systems**

  Conventional standard industrial classifications, such as SITC, ISIC and SIC, are based on the classification of the industrial 'outputs'. The Holistic model of innovation is based on the knowledge 'input'. The combination of the output and input classifications provides the matrix taxonomy of industrial classification systems.