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Implications of Knowledge Economy for Citizens: An Empirical Exploration

D. Casey[1,2] and C. Brugha[1]

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We describe the application of Priority Pointing, a generically applicable research procedure, to the question how Ireland can become an innovative knowledge economy. Questioning received orthodoxy, we show that Irish culture should put more value on scientific skills, promote a scientifically literate culture, and reform institutional and structural support systems to develop an innovative knowledge-based economy. In autopoietic terms, we illustrate how structure of the social systems and the history of those systems determine the space and capability for future development and innovation. The Systems Science theory used is Nomology, which claims that three different processes of adjusting, convincing, and committing comprehensively describe how the mind structures decisions. Committing and convincing are subjective and correspond to the processes that build the autopoietic aspects of a society or organization. Consequently, the proposed adjustments that emerge from the research should not challenge what we are as citizens, within our autopoietic societal boundary.

KEY WORDS: autopoiesis; knowledge economy; nomology; priority pointing; systems methodology.

1. INTRODUCTION

We describe the results of a survey of expert opinions about what changes are needed for Ireland to become an innovative knowledge-based economy. A trap that researchers can fall into, when eliciting expert opinion, is to research previous solutions to develop hypotheses and ask respondents to select from them. This limits the search to the confines of the researchers' understanding. A way to avoid this and, at the same time, to gather the richest possible information from respondents is to ask them open-ended questions. This raises enormous systems difficulties. How does one synthesize and interpret the replies to such questions?

[1]Department of MIS, Quinn School of Business, University College Dublin, Dublin, Ireland.
[2]To whom correspondence should be addressed at Department of MIS, Quinn School of Business, University College Dublin, Dublin, Ireland; e-mail: dermot@10thmonth.net.

A way to explore complex strategic problems, which addresses these concerns, is through the Priority Pointing Procedure (Brugha, 2000). Priority pointing is rooted in Nomology, the science of the laws of the mind (Brugha, 1998a,b,c), which shows that adjusting, convincing, and committing decision processes comprehensively describe the three dimensions of how the mind structures decisions. Priority pointing exploits underlying decision structures to move cognitive processes from a subconscious to a conscious visualization. This helps the diagnosis of problems, helping individuals, organizations, and social groups to understand and thus manage the problems of strategic change.

Brugha (2001) has shown that development decision-making has three layers. The highest level involves phases of committing. Within these are stages of convincing. Committing and convincing are subjective and correspond to the processes that build the autopoietic aspects of a society or organization. These stages are implemented using an adjustment process. Another interpretation is that, whenever an autopoietic entity either is changed from the inside or challenged from outside, there is a need to ensure that it has a balanced relationship with the outside world. We report here adjustments that were proposed in order to take onboard IT-driven changes in our environment as a consequence of the impact of the Knowledge Age. They do not imply changes to what we are as citizens, i.e., within the autopoietic boundary.

The study showed that the first priority is recognition that the Irish culture does not value the scientific skills and activities required in an innovative knowledge-based economy. The second and third priorities generated by the study suggest a resolution to the Irish problem, through the promotion of a scientifically literate culture together with reforming of institutional and structural support systems. The results presented here show that making the adjustments necessary to bring in a knowledge-based society will not be easy.

2. UNDERSTANDING THE KNOWLEDGE-BASED SOCIETY

Turning Ireland into an innovative knowledge-based economy is seen as central to future economic growth. The State through the Information Society Commission (ISC, 2002) has envisaged a move to a "knowledge-based society" as the prerequisite for future economic development, "holding the status quo is not an option. We move forwards and embrace the conditions necessary to underpin higher value economic activity, better jobs, and new social prosperity. Or we prepare to fall into relative decline." (ISC, 2002, p. 7). The consensus is that investment in knowledge assets will drive a high-value knowledge-based society.

This consensus bandwagon is driven by the growth of Information Technology and the strength of the United States in the 1990s, and fuelled by policy documents on the importance of a knowledge economy (OECD, 1997). Some states, including the United Kingdom (DTI, 1998), New Zealand (MTI,

1999), and Australia (Australia, 2001) have produced reports on the importance of the knowledge economy. Ireland extended this to include the more general "*knowledge society*" (ISC, 2002). The avowed aim of the European Union is to "become the most competitive and dynamic knowledge-based economy in the world" over the next decade (EU, 2000).

The knowledge-based economy, under various guises, is seen as the cure for all societies' ills. Decades of experience in IT tells us "there are no silver bullets" (Brooks, 1987). This "promised land" can be a mirage as much as a miracle, given the contradictory and unexpected outcomes of IT Projects (Introna, 1997). Life is more complex than any panglossian approach would suggest. Each era of change brings with it losers as well as winners both at micro (individual) and macro (country) level. Why is an innovative knowledge-based economy seen as a panacea? An antonym of panacea is "magic cure" and one wonders if the focus of the knowledge economy is the modern equivalent of the alchemist's quest for the philosopher's stone. Alchemy holds a lesson for us. Newton was one of the last of the alchemists and one of the first scientists (White, 1997). By exploring the phenomenon of the knowledge-based economy, we may be able to begin the winnowing process, and find the true value in the idea.

3. THE COMPLEXITY OF CHANGE AND SOCIAL SYSTEMS

Change is essentially a wicked problem, with issues of interconnectedness, complicatedness, uncertainty, ambiguity, conflict, and societal constraints (Mason and Mitroff, 1981; Rittel and Webber, 1973). The fundamental nature of wicked problems means that the question being addressed is often only properly delineated when an answer is found. Despite the complexities of change, an obsession with predicting the future is a universal human characteristic (Brown, 1991; Pinker, 2002). People have always wished to determine the future, if not control it. In the past, shamans read entrails, soothsayers consulted the Oracle at Delphi, and astrologers calculated horoscopes. Modern attempts at long-range economic and weather forecasts have fared little better than their predecessors. If predicting the future is difficult, influencing the future is more arduous, akin to the witchdoctor who commands rain from the heavens.

A decade of phenomenal growth has seen Ireland achieve close to full employment and with incomes at European levels. The cultural orthodoxy sees fortuitous planning by development organizations, enlightened taxation policy, and educational excellence as the successful rain dance that brought economic progress (Macsharry and White, 2000). The witchdoctor's orthodoxy sees the location of high technology companies such as Intel, Microsoft, and Dell as exemplifying the success of the past rituals, and views Ireland as well-placed to become Europe's leading knowledge economy. The cultural orthodoxy envisions the possibility of foreseeing and influencing the future. The real world however is wicked. It is

nonlinear, a system of "punctuated equilibriums" where order persists for periods of time and is followed by rapid change (Gell-Mann, 1995; Kauffman, 1993). The insidious consequence of this is that the past provides a poor guide to the future.

Given the current economic conditions it is as important to ask why Ireland's economy stagnated for the previous seven decades as it is to ask why it grew in the 1990s (Lee, 1989; Ó'Gráda, 2002). History provides many examples of both the positive and negative impact of culture on economic development. The development of science flowered in enlightened Islamic cultures, while Europe lingered in the dark ages. Yet, at some point, the dynamic elements of Islam ossified and cultural stagnation followed. China, whose innovativeness by 1421 dwarfed every nation on the earth, stagnated for the following five centuries, a condition precipitated by cultural factors (Menzies, 2002; Mokyr, 2002; Pirsig, 1992). The industrial enlightenment preceded the industrial revolution in Europe (Mokyr, 2002). By examining the issues faced by Ireland we can get a clearer understanding of the steps toward a knowledge society.

4. AUTOPOIESIS, COMPLEXITY, LANGUAGE, AND INNOVATION

Autopoiesis is a complex systems-based theory that can be used to examine the issues of culture and innovation. Autopoiesis provides a biological analogy for understanding the development of human language and understanding (Maturana and Varela, 1980, 1992). Autopoiesis' claim is that basic principles of biology can be traced from simple cells up through animal societies to man. For instance people use chemicals such as pheromones to communicate in a way similar to other species (Watson, 2000). At a higher level of development, mammals and especially humans use language as an autopoietic function. The key difference is that "*human language confers the capacities for self-identity, self-consciousness, and reflection*" (Denning, 2003), to a degree not seen in other species, including higher primates (Deacon, 1997). Pirsig (1992, 1995) traces similar patterns of increasing complexity from inorganic life to the levels of society in a comparable albeit not identical mechanism to Maturana and Varela.

Autopoiesis has been used to examine a number of aspects of information systems. It has been used to examine the concepts of information and meaning in an IS context (Mingers, 1995), information management and power (Introna, 1997), and IS–organization relationships (Kay and Cecez-Kecmanovic, 2002). Sveiby (2001) recognized the link between autopoiesis and Polanyi's (1958) concept of "personal" knowledge and uses the idea of autopoiesis as a basis for epistemology in his "knowledge-based theory of the firm." Winograd and Flores used autopoiesis to consider the question of design "*how a society engenders inventions whose existence in turn alters that society*" (1986, p. 4).

Using autopoiesis, we can describe social activities in human terms as a "highly sophisticated process of cooperative interaction between people in the

medium of symbols in order to undertake joint action" (Stacey, 2000). This impinges directly on our understanding of innovation. Innovation is defined as "the action of innovating; the introduction of a new thing; the alteration of something established; a new practice or method" (OED, 1992, p. 1373). Innovation is essentially a creative endeavor, generating something, be it simple or profound, which did not exist previously. Koestler defines creative acts as "the combination of previously unrelated structures in such a way that you get more out of the emergent whole than you have put in" (Koestler, 1964). This is the idea of synergy as the basis for human progression described by Corning (2003).

This symbiotic combination of ideas as the basis for human innovation parallels the genomic combination that underpins the evolutionary process of speciation, the innovation of new forms in nature (Dennett, 1995; Margulis and Fester, 1991; Margulis and Sagan, 2002). Autopoietic interaction underpins the evolution of species (Margulis and Fester, 1991; Margulis and Sagan, 2002). In autopoietic terms, the structure of the systems and the history of those systems determine the space and capability for future development and innovation. As Mingers (2001, p. 119) noted "external stimuli provoke or trigger a response, but the nature of the response is determined by the structure of the organism at that instant, not by the stimuli. Moreover, it is the structure that determines what can or cannot be a stimulus for the organism." The structure of systems constrains future development options.

In social terms, interaction and language, the swapping of ideas in a synergistic manner, form the basis for innovation. Brugha (1999) has discussed the connection between autopoiesis and development in Nomology at a previous UKSS conference. Taking the example of the individual, he notes "if a country's politics is insecure an individual will be nervous about setting up a business; if one does not have a job one might be worried about taking on the responsibilities of a family." He describes how "the breakdown of stability at lower levels and the collapse of one's situation is akin to entropy or the escape of energy. The building up of such layers of energy systems could be described as negative entropy. When the ownership belongs to a group the sense of building on levels and the need that the lower levels be secure becomes an issue for the group. The sense of integrity that a group needs to develop or be self-creating has been named autopoiesis (Maturana and Varela, 1992; Maturana, 1988)." Thus, social structures underpin the capability for self-production and creation.

5. NATIONAL CULTURAL SYSTEMS AND INNOVATION

On the basis of the ideas by Maturana and Varela (1992), supported by Pirsig (1992, 1995), Deacon (1997), Stacey (2000) together with Damasio (1996) and Brown and Duguid (2002), we regard knowledge as created through the interaction of people, with each other, with the environment, and reflexively with themselves.

Innovation is the combination of knowledge, its spread and dissemination, the synergistic development of knowledge.

Lundvall *et al.* (2002) link the role of innovation to interactions involving nonprice relationships, questions of trust, and the difficulties with transmitting tacit knowledge. This illustrates the importance of cultural factors in economic progress. Acemoglu and Robinson's work on the role of politics in economic performance reinforces this view (Acemoglu and Robinson, 2002). Lundvall *et al.* (2002) point to industries where tacit knowledge is a central element of production. The effectiveness of investment in Information Technology (a human defined artifact), and the development of innovation in Information Systems is linked to tacit knowledge and understanding of social relations (Brown and Duguid, 2002; Markus, 1983; Markus and Benjamin, 1997; Remenyi *et al*., 1999).

At a national level, the idea of a national system of innovation (Johnson and Lundvall, 2001) encompasses both the cultural context of innovation and the institutional structures that affect innovation from an autopoietic perspective. Governments, policies, and institutions shape economic incentives and the rules of the market, and have a first-order effect on economic development (Acemoglu and Robinson, 2002; Mokyr, 2002).

The importance of the system of national innovation is that its culturally embedded structure guides the development of competencies and the dynamics of production within a state. These cultural systems are autopoietic. Human social "systems have operational closure, in the structural coupling of their components" while at the same time existing "as unities for their components in the realm of language" (Maturana and Varela, 1992 p. 198).

Mokyr (1998) has noted that resistance to change is a property of all cultural systems. Describing economic systems from a Darwinian perspective, Mokyr (1998) illustrates how the underlying structure of a cultural system (its genotype) constrains while not wholly determining its manifested identity (its phenotype) and its capacity for innovation. Resistance to change is a natural property of systems in an attempt to resist change that is too rapid which leads to instability and the hypercritical region where change becomes uncontrolled and unrestrained (Kauffman, 1993; Mokyr, 1998). This idea encompasses both Foucault "regimes of truth" which act to constrain our actions (Foucault, 1982) and Kuhn's analysis of how paradigms constrain normal science (Kuhn, 1970).

In autopoietic terms, cultural systems produce themselves and resist changes to their structure. Different cultures and different national systems resist changes to different degrees. The idea of national systems of innovation recognizes that innovation is engendered in language and dialogue as dynamic forms of interaction generate new knowledge. Knowledge is autopoietic, generated at the boundary as data from outside perturbs the system. Dynamism is central to understanding knowledge and innovation. To generate knowledge requires a dynamic element (Pirsig, 1992; Sveiby, 1997). Access to knowledge is socially mediated culture

constraining patterns of thought and of value (Hofstede, 1984; Nisbett, 2003; Pirsig, 1992, 1995). The more open a culture is to ideas, the more dynamic and questioning it is, and the better ecosystem it creates for generating innovation and knowledge (Archibugi and Lundvall, 2001; Lundvall and Johnson, 1994; Mokyr, 2002).

The more static a cultural system is trying to preserve everything and resisting the dynamic element the poorer the ecosystem. The culture, structure, and values of a society create a national system of innovation that ideally links theory and practice, using learning based on human communication to generate new innovative forms. Mokyr's description focuses on how the openness of the industrial enlightenment, the culture of the time-created systems of national innovation that led to the industrial revolution (Mokyr, 2002). As Mokyr specifically notes some States including "Ireland were resistant to innovation" (Mokyr, 2002, p. 77).

6. INTERPRETING IRELAND'S PROBLEM

Understanding how culture affects innovation in the Irish context is a complex task. One method for exploring difficult problems is through the Priority Pointing Procedure (Brugha, 2000), rooted in Nomology. Nomology is based on abstracting existing "regularities in human behaviours that are present in almost all fields of decision making" (Brugha, 2000). It works on the basis that people attempt to resolve complex problems by breaking them down into less complex ones using simple questions (Brugha, 1998a). The answers to these questions are structured in terms of dichotomies, either/or answers (Brugha, 1998a).

Priority Pointing treats the issue under investigation as a system focusing on three dichotomies to identify problems within a system. The first dichotomy examines what needs to be done to resolve the problem within a system. If we are uncertain about the action to take, then we will focus on planning. If, on balance, we feel relatively clear about the direction that should be taken we will focus on putting a solution into effect. The second dichotomy examines where the action needs to take place. The resolution to the problem is either through actions on place, for instance in some structural element of the State, or through focusing on the people involved in the system. The final dichotomy asks which way a problem should be resolved. Should we rely more on using position, an impersonal approach, or should we be focusing more on the person, using a personal solution to the problem? This dichotomy is the perennial dilemma of a top down versus a bottom up approach to problem solving.

The development of two dichotomies for each of three questions produces eight principal activities described by Brugha (1998a, 2000). This is illustrated in Fig. 1 below.

A healthy balanced system will find equilibrium between doing too much and too little of each activity (Brugha, 1998b). The development of any system

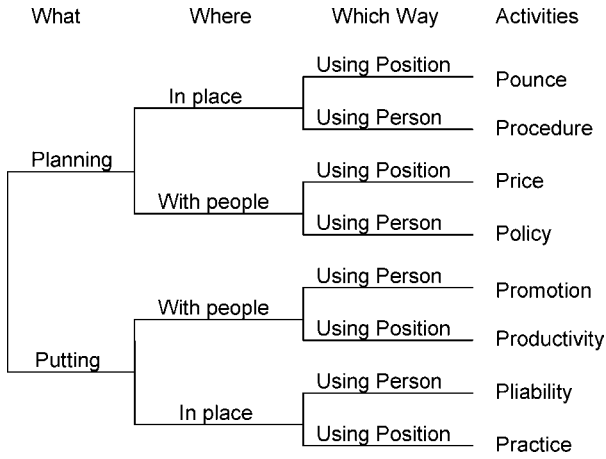

Fig. 1. Dichotomies and activities.

naturally flows through each of the eight activities beginning with uncertainty, moving to more certainty over time. Within these dichotomies, a vigorous system will alternate between people versus "place" (structure-orientated) approaches, and personal versus positional (non personally-interacting) approaches to resolving a problem, establishing equilibrium along the way.

The first two dichotomies lead to the four general activities termed Push, Pull, Perception, and Proposition. The third dichotomy leads to the eight Principal activities—Pounce, Procedure, Price, Policy, Promotion, Productivity, Pliability, and Practice. These activities are represented in the Priority Pointing Wheel (Fig. 2) below.

The imagery of the wheel is important as Nomology takes a systems approach to decision making considering the whole, not just the parts. Within Priority Pointing the focus can move between the four quadrants and eight sectors, which operate in a cycle when solving a problem in management. Each activity is important and there is a natural flow through the quadrants to resolve a problem, figuring out conceptual *proposition* of the problem, agreeing on the common *perception* of the solution, *pulling* people into alignment to ensure that the plans can be put into effect, finally *pushing* the system into alignment to ensure the changes to the system are practiced. The application of the procedure is based on asking six open questions (Brugha, 2000). The questions are designed to elicit responses along existing dimensions that are believed to reside in the minds of the respondents. The six questions are broken down into two general questions and four specific questions that address the four general activities (quadrants) of the Wheel. These questions need to be "expressed in colloquial language familiar to the respondent, relate specifically to that sector, and be completely open and unbiased" (Brugha, 2000).

Fig. 2. The wheel.

The questions are divided into two categories punch and prevention. Punch is defined as "the need to have sufficient support for some activity," and Prevention as "the need to ensure that no activity is used excessively" (Brugha, 1998b). Punch and prevention are used to indicate the flow of power within a system. A balanced system will find equilibrium between doing too much and too little of any activity. In a complex environment, this balance is a dynamic not a static equilibrium and is responsive to change, calling for the constant adjustment of the system. This reflects our understanding of complex nonlinear systems and is indicative of change in the modern business environment.

The two general questions are divided into a general punch and a general prevention question. The questions in the four quadrants can be either punch or prevention questions creating the possibility of a pool of eight questions to draw from. In analyzing the four quadrants we are examining two specific dichotomies, "planning" vs. "putting" and "people" vs. "place." These dichotomies represent the vertical and horizontal halves of the wheel respectively. The questions need to be carefully chosen to ensure that there are both punch and prevention questions in both people and place halves of the wheel. Similarly, there should be a punch and a prevention question in both of the planning and putting halves of the wheel. Using this approach the questionnaire comprising the six questions listed in Table I was developed.

7. ANALYSIS AND FINDINGS

Primary data was gathered using a survey mechanism based on the six open questions to analyze the principle dichotomies described above. One thirty-five

Table I. Survey Questions

Sector	Question
General punch	What is needed for Ireland to become an innovative knowledge-based economy?
General prevention	What is preventing Ireland from becoming an innovative knowledge-based economy?
Prevention question in proposition sector	What is stopping us from resolving these problems?
Punch question in perception sector	What should be done to increase our understanding how to become an innovative knowledge-based economy?
Prevention question in pull sector	What is holding us back from working better as a society to become an innovative knowledge-based economy?
Punch question in push sector	Are there any structural or policy changes we can make which will help us become an innovative knowledge economy

questionnaires were posted to senior individuals within Irish based Information and Communications Technology (ICT) companies, University researchers, and senior members of semi-state organizations. A total of 39 responses were received.

The replies to the primary survey point to a number of significant issues. Fundamentally the national system of innovation is flawed and inimical to innovation. There is a problem of "vested interests and cultural apathy"[3] and an acknowledgment that "culture takes time to change," particularly the issue of cultural attitudes to science and entrepreneurship. The Irish education system is not geared to science reflecting "peoples attitudes to science in general." Institutions and structures do not just shape attitudes, values, and beliefs in a vacuum; they embed and reflect existing values, beliefs, and attitudes making change difficult. Irelands approach to universities as places of learning, not places of commerce resulting in a failure in the development and transfer of Intellectual Property. This combination of problems results in "inertia at all levels." Ireland does not value science and is not willing to pay for it, illustrated by the historic low levels of investment in R&D.

Deep structural and cultural issues are holding Ireland back, not superficial ones. There is a clear incongruity between where Ireland wishes to go and its current value system. There is an unwillingness to pay the price required to become an innovative knowledge-based economy. Ultimately it requires a "question of belief in what the building blocks of the future are; people must be convinced of the value of the knowledge-based economy," without an appreciation of this there can be no real progress toward a culture of lifelong learning ("education at all levels") and entrepreneurship ("risk culture").

[3]Quotes in this section are taken from responses to the six questions.

The primary data provides us with a cogent summary of the current situation of the Irish State on the route to becoming an innovative knowledge based economy. The problem is one of awareness and of the negative perception of the value of science in society (*price* in the wheel in Fig. 2). This is a pernicious problem, with self-reinforcing negative feedback circuits. It affects the education system because it does not adequately value science. The route to resolving the problem is through *promotion* of science, and *pliability*, essentially reforming the structures to improve the education system to create a scientifically literate culture.

The analysis from the primary data is supported by secondary sources. The Eurobarometer (EU, 2001) survey confirms the diagnosis of a perceptual problem toward science in Ireland. Ireland has the lowest level of esteem for science as a career in 15 EU States.[4] There is poor understanding of science, little research and development, and poor linkages between academia and industry (EI, 2000; ICSTI, 2003; Macfarlen and Granowitz, 2002; OECD, 2003). And, because we do not value science, promoting these changes is difficult, and making the necessary changes to the existing structures is complex.

The proper framework for an innovative knowledge-based economy is absent. Instead of structures and policies that might enable a dynamic vibrant informed citizenry, there are bureaucratic, static structures, which are inflexible and resistant to change. We see a problem identified at the organizational level of too much structure (Brown and Eisenhardt, 1998), repeated at the level of the State. The Irish system of innovation has failed to "optimize the benefits of stability, while retaining the capacity to change, by combining and recombining both path dependence and path creation processes" (Lewin and Volberda, 1999). Problems persist that should be easy to solve. The more intractable problems of changing attitudes, reforming obstinate cultures, and transforming obdurate values have yet to be tackled. There is a lot to be done and it must be done in a coherent systematic way, treating the whole rather than each part of the system individually.

8. CONCLUSION

This paper used the Priority Pointing Procedure to indicate a direction for next steps toward helping Ireland to become an innovative knowledge economy. Priority Pointing reveals *punch* issues, which describe what should be done, and *prevention* issues, which hold the society back. The main problem is that the low value (*price*) Irish society puts on appropriate skills and knowledge is preventing the development of a Knowledge Economy or Society. What should be done to remedy this can be shown in terms of the three adjustment dichotomies. Firstly, what should be done does not require a lot of planning; it is more about putting plans into effect (left-side of wheel). Secondly, where it should be done involves

[4]Data C. 2001 prior to expansion of EU to 25 States.

both people and "place," i.e., systems and structures (bottom and top of wheel). Thirdly, this should be done in an interpersonal way, and not through the state and society using their positions to force these changes. On the people side this means *promoting* a knowledge society, and on the place side making structures sufficiently *pliable* that they will integrate and synergize with this new era.

Priority Pointing does not offer a detailed prescription. In fact, it points to where the solution *is not*, e.g. not more planning, than to where the solution *is*. It does not suggest the form of activity *within* the *promotion* and *pliability* sectors. It does provide a rich language with which to discuss the issues further, a language provided by the respondents. This overcomes the Wittgenstein problem: "the limits of my language are the limits of my thoughts," by creating a language based on a shared context which points toward the actions to be taken. It is a very practical and useful procedure. The same study could be done in other countries or regions, and the results compared, both the emerging priorities and their language. The same procedure can be applied to any strategic question. The main difficulty is with the interpretation of the answers. For help see http://mis.ucd.ie/RESEARCH/mcdm/ppp/.

As with any healthy system the Irish national system of innovation needs to be capable of dynamic changes, of autopoietic second order learning. Not being able to predict the future means we need to hedge our bets, by sustaining the requisite fit with our current environment while planning for (and creating) changes in this environment. The key to future economic success is diversity, trying many things, accepting that not all of them will succeed, maintaining a healthy doubt over our own plans and predictions. Like the witchdoctor we are not able to control the rain. However, a healthy dynamic system of national innovation could provide us with an umbrella.

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