ISSN: 2001-015X

Journal of Intelligence Studies in Business

Journal of Intelligence Studies in Business

Vol. 7, No. 1 2017

Included in this printed copy:

Vol 7, No 1, 2017

Editor-in-chief:
Klaus Solberg Søilen

The **Journal of Intelligence Studies in Business** (JISIB) is a double-blind peer reviewed, open access journal published by Halmstad University, Sweden. Its mission is to help facilitate and publish original research, conference proceedings and book reviews.

FOCUS AND SCOPE

The journal includes articles within areas such as Competitive Intelligence, Business Intelligence, Market Intelligence, Scientific and Technical Intelligence and Geo-economics. This means that the journal has a managerial as well as an applied technical side (Information Systems), as these are now well integrated in real life Business Intelligence solutions. By focusing on business applications, this journal does not compete directly with the journals that deal with library sciences or state and military intelligence studies. Topics within the selected study areas should show clear practical implications.

OPEN ACCESS

This journal provides immediate open access to its content on the principle that making research freely available to the public supports a greater global exchange of knowledge. There are no costs to authors for publication in the journal. This extends to processing charges (APCs) and submission charges.

COPYRIGHT NOTICE

Authors publishing in this journal agree to the following terms:

Authors retain copyright and grant the journal right of first publication with the work simultaneously licensed under a Creative Commons Attribution License that allows others to share the work with an acknowledgement of the work's authorship and initial publication in this journal. Authors are able to enter into separate, additional contractual arrangements for the non-exclusive distribution of the journal's published version of the work (e.g., post it to an institutional repository or publish it in a book), with an acknowledgement of its initial publication in this journal. Authors are permitted and encouraged to post their work online (e.g., in institutional repositories or on their website) prior to and during the submission process, as it can lead to productive exchanges, as well as earlier and greater citation of published work (See The Effect of Open Access.)

PUBLICATION ETHICS

The journal's ethic statement is based on COPE's Best Practice Guidelines for Journal Editors. It outlines the code of conduct for all authors, reviewers and editors involved in the production and publication of material in the journal. An unabridged version of the journal's ethics statement is available at https://ojs.hh.se/.

Publication decisions: The editor is responsible for deciding which of the articles submitted to the journal should be published. The editor may be guided by the policies of the journal's editorial board and constrained by such legal requirements as shall then be in force regarding libel, copyright infringement and plagiarism. The editor may confer with other editors or reviewers in making this decision. *Fair play*: An editor will evaluate manuscripts for their intellectual content without regard to race, gender, sexual orientation, religious belief, ethnic origin, citizenship, or political philosophy of the authors. *Confidentiality:* The editor and any editorial staff must not disclose any information about a submitted manuscript to anyone other than the corresponding author, reviewers, potential reviewers, other editorial advisers, and the publisher, as appropriate. *Disclosure and conflicts of interest*: Unpublished materials disclosed in a submitted manuscript must not be used in an editor's own research without the express written consent of the author.

Duties of Reviewers
Promptness: Any selected referee who feels unqualified to review the research reported in a manuscript, is aware of a personal conflict of interest, or knows that its prompt review will be impossible should notify the editor and excuse himself from the review process. *Confidentiality*: Any manuscripts received for review must be treated as confidential documents. *Standards of Objectivity*: Reviews should be conducted objectively. Referees should express their views clearly with supporting arguments. *Acknowledgement of Sources*: Reviewers should identify relevant published work that has not been cited by the authors. *Disclosure and Conflict of Interest*: Privileged information or ideas obtained through peer review must be kept confidential and not used for personal advantage.

Duties of Authors
Reporting standards: Authors of reports of original research should present an accurate account of the work performed as well as an objective discussion of its significance. Fraudulent or knowingly inaccurate statements constitute unethical behavior and are unacceptable. *Data Access and Retention*: Authors are asked to provide the raw data in connection with a paper for editorial review, and should be prepared to provide public access to such data (consistent with the ALPSP-STM Statement on Data and Databases). *Originality and Plagiarism*: The authors should ensure that they have written entirely original works, and if the authors have used the work and/or words of others that this has been appropriately cited or quoted. *Multiple, Redundant or Concurrent Publication*: An author should not publish manuscripts describing essentially the same research in more than one journal or primary publication. Submitting the same manuscript to more than one journal concurrently constitutes unethical publishing behaviour and is unacceptable. *Acknowledgement of Sources*: Proper acknowledgment of the work of others must always be given. *Authorship of the Paper*: Authorship should be limited to those who have made a significant contribution to the conception, design, execution, or interpretation of the reported study. The corresponding author should ensure that all appropriate co-authors and no inappropriate co-authors are included on the paper, and that all co-authors have seen and approved the final version of the paper and have agreed to its submission for publication. *Disclosure and Conflicts of Interest*: All authors should disclose in their manuscript any financial or other substantive conflict of interest that might be construed to influence the results or interpretation of their manuscript. All sources of financial support for the project should be disclosed. *Fundamental errors in published works*: When an author discovers a significant error or inaccuracy in his/her own published work, it is the author's obligation to promptly notify the journal editor or publisher and cooperate with the editor to retract or correct the paper.

ARCHIVING

This journal utilizes the LOCKSS system to create a distributed archiving system among participating libraries and permits those libraries to create permanent archives of the journal for purposes of preservation and restoration.

PUBLISHER

Halmstad University, Sweden
First published in 2011. ISSN: 2001-015X.
Owned by Adhou Communications AB

Journal of Intelligence Studies in Business

Journal of Intelligence Studies in Business
Vol. 7, No 1 (2017) p. 4
Open Access: Freely available at: https://ojs.hh.se/

Stevan Dedijer
1911-2004

Business intelligence, big data and theory

Again, the articles for this issue are mostly about the application of new technology and about business intelligence, reflecting a strong development in corporations. The only exception is the first article, which is purely theoretical.

The contribution by Søilen, entitled "When the social sciences are based in evolutionary theory: the example of geoeconomics and intelligence studies," is a theoretical article. It argues for why it was wrong to make the study of physics the model for the new social sciences after the Second World War. Moreover, it describes how this was done for the study of economics and how new studies like geoeconomics and intelligence studies have an advantage in this sense, and that a fresh look at theory is easier in these cases.

Hughes, in his article "A new model for identifying emerging technologies," argues for the relevance of the intelligence expert despite the increase in new complexities required for understanding an industry, but he also emphasizes the importance for the analyst to learn more about big data. Our technological systems are still ineffective at knowing the relevant data sources and how to connect the data in meaningful ways to derive value for the firm, but their importance is increasing. The author proposes a new forecasting model that incorporates a combination of technology sequencing analysis and big data tools within the organization while also leveraging experts from across the open innovation spectrum.

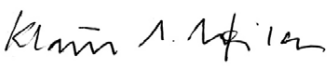
Salguero et al., in the article "Proposal of an assessment scale in competitive intelligence applied to touristic sector," present a mathematical CI model to be applied in the tourism sector, specifically for hotels. The model is also tested and fine-tuned, proving to have value for the CI function. The authors also present an extensive literature review.

The extensive article by García and Pinzón, "Key success factors to business intelligence solutions implementation," builds on previous literature published in this journal, such as Cidrin and Adamala (2011) and takes as a starting point the high number of BI projects that fail. The authors identify 13 factors that affect business intelligence solution success.

The final article, by Papachristodoulou et al., "Business intelligence and SMEs: Bridging the gap," talks at great length about the problem of implementing BI in small and medium enterprises (SMEs). It shows how new products have changed to adapt to a new sector of customers.

On behalf of the Editorial Board,

Sincerely Yours,



Prof. Dr. Klaus Solberg Søilen
Halmstad University, Sweden
Editor-in-chief

Journal of Intelligence Studies in Business
Vol. 7, No. 1 (2017) pp. 5-37
Open Access: Freely available at: https://ojs.hh.se/

Why the social sciences should be based in evolutionary theory: the example of geoeconomics and intelligence studies

Klaus Solberg Søilen[a]

[a]*Department of Engineering, Natural Sciences and Economics, Faculty of Marketing, Halmstad University, Halmstad, Sweden*

**Corresponding author: klasol@hh.se*

Received 15 January 2017; accepted 2 February 2017

ABSTRACT This article gathers arguments for why the social sciences should be based in evolutionary theory by showing the shortcomings of the current paradigm based on the study of physics. Two examples are used, the study of intelligence studies and geoeconomics. After a presentation of the geoeconomics literature and an explanation of what the organic view of the social sciences is, we follow the study of economics as it developed after the Second World War to see where it went wrong and why.

KEYWORDS Economics, evolutionary theory, geoeconomics, geopolitics, intelligence studies, social sciences

1. INTRODUCTION

The development of theory is essential to any science. A little more than a century ago it looked as if the study of economics was going to be based on evolutionary theory. Then focus shifted with the *methodenstreit* and then after the Second World War it was decided that the new brave social sciences would be based on the study of physics.

The victors of the Second World War were aware that the struggle for theory was more important than the military struggle. With a military you may win the war, but to win the peace you have to convince people of your moral high ground. Oakeley, in her book "History & Progress" (1923), expressed it this way:

> The principles which England and her allies are opposing is not merely one that claims moral worth (…) It is (…) a theory of history (from chapter "German though: The real conflict", pp. 136-7). The great struggle seems then ultimately to be more accurately expressed as the struggle whether ideas have a sway in life.

The allies were fighting German materialism, evolutionary thinking, the idea of history as physical power, as expressed by Treitschke (1898), and at the end simply the notion of power (Macht) in the literature altogether. This was done to avoid "Prussian world-dominion".

Instead we got American world dominion, but without the theories that said so or explained how. We got in its place a set of unrealistic and idealistic theories such as individual free choice, equilibrium theories and free open markets. But reality finally caught up with the theory. The gap between them became too big at the end of the Cold War, bringing the physics paradigm in the social sciences to a definite impasse. Germany had never shown any enthusiasm for the new social sciences. Now the new Chinese superpower made it clear it was not going to adopt Western values. In Russia the news was welcomed as a relief. Instead the social sciences now have to

distinguish between on one hand explaining human and social behavior as it is and on the other hand thinking about how the world could be. This development may also lead to a revival of romanticism.

1.1 The example of intelligence studies and geoeconomics

Not all disciplines had adopted the new paradigm. Some, such as intelligence studies, have lived their lives largely outside of the ivory towers of academia. Others, such as the study of geopolitics, never left the old paradigm. Those disciplines that embraced the *Realpolitik* assumption found themselves to be popular again (they had been relevant all along, but now others rediscovered their relevance). The new version of geopolitics, called geoeconomics, automatically looked to the study of biology rather than physics. The aim of geoeconomics is to present intelligence (e.g., economic, political, or social) in the form of maps, wisdom and maxims that help explain current events and make predictions (For examples see Søilen, 2012, pp. 140-295). It is a discipline adapted to the world of globalization and multinational enterprises which shifted the power balance from the nation state to private organizations. The methodology of geoeconomics is similar but not exactly the same as the study of geopolitics (Søilen, 2012; Søilen, 2010; Søilen, 2016; Wigell and Vihma, 2016). Geopolitics was defined as an evolutionary science right from the start with Kjellén (1914) and had only to continue.

The new study of intelligence studies, with its focus on information and its tradition in the practical work of intelligence organizations may also be based in evolutionary theory, even though most contributions in competitive intelligence, market intelligence and business intelligence do not take this approach. Like so many other management disciplines they focused on solving practical problems and as a consequence have been seen as less valuable as academic disciplines. Critics fail to see that these disciplines left theory because the existing scientific paradigm seemed unrealistic and to change it seemed an impossible task.

While intelligence studies is often concerned with the micro level, geoeconomics is primarily occupied with the macro level. This then is how the two studies fit together, theoretically, methodologically and in the content they study. But unlike the study of geopolitics, intelligence studies is at the very beginning of its theory development, mainly because it has lived its life largely outside of academia and gained its legitimacy as a distributor of valuable practices to professionals. For geopolitics and geoeconomics it is a question of sticking to their roots, adjusted for a number of biases identified during the past half a century, which can be summarized as the seduction of maps (i), the seduction of history (ii) and the seduction of current events (iii) (See Søilen, pp. 21-35).

The study of geoeconomics is what we today should call a multidisciplinary field building on the study of history, geography (maps) and political science (the study of power based on *realpolitik* assumptions) to explain current events and try to predict future action by organizations. Intelligence studies is also practiced as a multidisciplinary field, in fact all relevant social sciences today are forced to become multidisciplinary, meaning simply to revert the failures of specialization by the current scientific paradigm in order to become more relevant again. The overspecialization and over-compartmentalization that was the physics paradigm has led to entire disciplines like economics and political science becoming ever more irrelevant.

The next section of the paper is in large part a reprint from the book "Geoeconomics" (Søilen, 2012)[1] which explains the relevance of geoeconomics, its methodology and how it fits with evolutionary theory and the evolutionary approach to the social sciences, but it also presents current research in geoeconomics.

2. GEOECONOMIC THEORY

2.1 The geoeconomic literature

There cannot be any politics without political realism, and economic issues lie at the core of politics. The person, company, or nation which possesses economic wealth has resources, and resources are power; where power is defined as the ability to control the actions of others, thus increasing one's own opportunities for creation of further and future wealth. We find this same notion in Klare's understanding of geopolitics as the study of "the contention between great powers and aspiring great powers for control over territory, resources, and important

[1] Thanks to Karin Jakobsen at Ventus Publishing for permission to reprint parts of the book for part 2 of this article.

geographical positions, such as ports and harbors, canals, river systems (fresh water supply), oases, and other sources of wealth and influence" (Klare 2003: 51; see also Klare 2001), but today it's no longer the nation states who are driving these processes, but corporate interests which answer to different logic: thus the importance and relevance of Geoeconomics (Søilen, 2012, p 104).

Cowen and Smith (2009) have previously shown how there is a recast from geopolitics to geoeconomics as the globalization ideologies from the turn of the 21st century have faltered. Instead events have been understood with a geopolitical and geoeconomic logic. At the same time there has been an auto-destruction during the last decade of the relevance of critical geopolitics as presented by Dalby (1991) and Tuathail (1996). More constructivist criticism against geoeconomics comes from other geographers like Sparke (2007). Much of the interest for Geoeconomics is coming from authors and topics outside the Western world, for example from Russia (Cf. Alexander, 2011; Anokhin and Lachininskii, 2015; Lachininskii, 2012; Rozov, 2012), the Russian-German relationship (Szabo, 2014) and former Soviet states (Scekic et al., 2016), but first of all China (Cf. Ciuriak, 2004; Holslag, 2016; Hsiung, 2009, Huotari & Heep, 2016, Kärkkäinen, 2016; Khurana, 2014; Søilen, 2012 B) and comparisons inside of China (Schlevogt, 2001), as if the political struggle is also a struggle for ideas, and more precisely for a new scientific paradigm. There are also those who see the geoeconomic logic as a new balance of power between East and West (Couloumbis, 2003), and those who argue that the US policy was geoeconomic all along (Mercille, 2008), or still is (Morrissey, 2015). As shown by Barton (1999) the system of Flags of Convenience can be seen as one of the oldest examples of geoeconomic flexibility, or a logic of geoeconomics. The first writings on geoeconomics had a focus on natural resources (Kärkkäinen, 2016), realizing that the third world could have greater strategic importance than Europe (Hudson et al., 1991), and the West (oil, water). Resources would in many cases have a larger meaning and include the financial system (Sidaway, 2005), and infrastructure like oil and gas pipelines (Vihma & Turksen, 2015). Also the notion of geography as space of economic importance has reemerged, not only concerning the new passages by the North Pole (Moisio & Paasi, 2013).

What is largely missing in the current literature is the attempt to build and explain geoeconomic theories. In this article we suggest how this is done through a paradigm shift, by shifting attention from the study of physics to biology and evolutionary theory. The shift itself is not new, but has been suggested at numerous intervals for more than a century. As a consequence the focus in the next section is just as much to explain historic events in the history of the social sciences, and more precisely for the study of economics and business.

2.2 The organic view of the social sciences

The organic view of the social sciences says in essence that we human beings are not so much in control of our behaviour as we think we are. We are predominantly emotional and not particularly rational creatures. We learn not by theory, but by trial and error, that is through failures. Consequently, we should seek to understand human behaviour more by personal experience and by studying values, which are the basis of character-formation, rather than by losing ourselves in the uncharted waste of abstract theories and assumption of rationality. The latter may be intellectually interesting, but do us little practical good. All living organisms are nowadays studied in the light of evolutionary theory, except for Man. We have to ask why. Why should the social sciences be any different from zoology in this respect, unless we hold that Man stands outside biology? If we do hold that, as some Christians do by advocating creationism, then at least we are being consistent; but that is not the position of the social sciences today. Yet these sciences continue to define themselves as not part of biology. The intention here was good: this line was taken partly in order to emphasize that Man has moral obligations. But a problem arises when the morality and values assumed are ones which belong to and favour one particular civilization or viewpoint. Then we are facing not morality but moralism, the attempt of one person or culture to impose its values on others. We see this clearest today in the struggle between Western and Eastern values. In the light of claims about value-neutrality of the social sciences, it is problematic that most social-science journals support Western values. The validity of Western values must be questioned, if the social sciences are to have any credibility in the

21st century. Or alternatively, the study of human behaviour must revert to the humanities, where moral positions are less problematic.

It is no more than a century ago that we eliminated the moral component from the study of economics. At the beginning of the twentieth century, but particularly after the Second World War, the discipline of economics decided to assimilate itself to physics and its logic of "dead material" (non-organic). The original motive for this was that physics was and is a successful science, and the social sciences needed greater rigour. It was also seen as a way to solve the normative problem, by literally taking the moral component out of the equation. Furthermore, it was an inevitable consequence of splitting the discipline of political economy into two instrumental parts, political science versus economics and, later, management. Over the past two decades, there has been criticism of this approach, and of the lack of results produced by ever greater specialization. Over specialization seems to have shifted much of our research away from reality and towards obscurity, abstraction, and dogma. The phenomenon of interdisciplinary studies can be seen as a reaction against this development; so we saw a significant growth of interest in interdisciplinary scholarship around the turn of the 21st century. But this only solved parts of the problem.

Another characteristic of twentieth-century social-science research and methodology was a tendency towards linear thinking. Everything in economics seemed to be explainable in terms of the intersection of straight lines on x and y axes. Our linear way of thinking – as opposed to the cyclical ideas of Ferdinand Tönnies (1887) and the pendulum ideas of Hegel (1820), his thesis, antithesis, and synthesis – can be traced back to the Old Testament and the introduction of Christianity to Europe. The notion was reinforced in the period we call the Enlightment. The linear paradigm peaked with the contempt for the historical method on the part of the social sciences following the Second World War. That is the direction that is here being questioned. We must question not only the lack of useful results, but equally the claim of objectivity. So what are the alternatives?

The discipline of geoeconomics is founded on an organic understanding of social behaviour. This is also a method borrowed from the natural sciences too, but from the discipline of biology. By "organic" we mean that Man and human organizations function rather like living organisms. They too are brought into life, grow, and fade away, some sooner than others. Evolutionary theory is a powerful explanatory tool for any science, including the social sciences. That does not mean that all social behaviour can be understood by studying evolutionary theory, but this is the model with greatest explanatory strength and most potential to explain and predict human behaviour.

This line of thinking is not novel within economics. Evolutionary thinking got off to a good start in the discipline of economics in the USA with Thorstein Veblen in the closing decades of the nineteenth century. But economists chose to abandon evolutionary theory at the turn of the twentieth century, in part because it did not correspond to our political convictions about how Man should think about himself and society. The new slogan of the time was liberalism, individualism, and free choice – ideas that had been seriously challenged by evolutionary thinking, which had a more deterministic perspective on human life. The newly liberated discipline saw that as infringing on our ability to think of ourselves as free individuals with almost unlimited choices. Furthermore, a new world power needed to make a break with the existing scientific tradition, especially to the extent that it was associated with German thinking. The change of scientific paradigm corresponded in time to the rise of the American Empire and continuation of English-speaking world dominance under new leadership. Thus, although the original thought underlying the new empiricist paradigm was largely European (Austrian, French, British), its development was mostly American.

The organic view of social behaviour in fact goes back far further than the nineteenth century. A Venetian ambassador to France once said "States are like men in that their vigour and prosperity does not last forever; they mature, they grow old, they succumb" (quoted in Ross and McLaughlin 1981: 305). The Venetian diplomatic corps wrote some of the finest geopolitical analyses of all time, and their city's dominance lasted for more than three centuries. The methodological focus was not on algebra, 3×3 matrices, and Cartesian co-ordinates, such as we see so often in the social sciences today, but much broader. It covered observations on national character, ways of life, natural resources, and military strength and tactics. This methodological tradition later

spread to Rome and to the Catholic Church. We find it, for instance, in the writings of Olaus Magnus, Archbishop of Uppsala, who in 1555 published an extensive book on the history of the Nordic people (Magnus 1982).

The methodology was representative for the time; readers wanted books to give clear answers to real problems. A modern-style empirical article would probably have provoked outright laughter – "How long did you live there? Where did you travel? Do you speak the language? You mean to say you know because you questioned 250 people at a supermarket?" Even if you put half a dozen of these research articles together it can still be difficult to say anything specific about a given social problem. Often it will be more useful to read a good magazine, like the *Economist* or some *Quarterly Review*. Consequently companies often complain that they get too little value from modern social-science research. If business-school academics largely ignore this critique that is largely because they are safe to do so: it does not threaten them. They are responsible not to the world of real-life business but to a promotion system which is based on the type of research that businesspeople are complaining about. So companies often look for the social data they need among other sources, by piecing together gleanings from geography (maps), history, and current events (Søilen, 2012, pp. 107-109).

2.3 Evolutionary theory versus environmental adaptation

In order to apply evolutionary theory to the social sciences we need to distinguish between a number of different issues. One problem is that people mean different things by the word "evolution". The term is often used to refer to the fact that all living organisms are linked by descent from a common ancestor. Alternatively, it is sometimes used to refer to ideas about how the first living organisms appeared; that might instead be called "abiogenesis". We also use "evolution" when we really mean natural selection, which is just one of the many mechanisms of evolution.

François Perroux (1983: 23) defines evolution as "changes that are interlinked, as opposed to a 'random' succession of events and structures occurring in irreversible and historical time". These changes are what we may call genotypic changes.

In a strict sense then, non-heritable changes are not part of what we call evolution. Instead we may call them environmental adaptations. To many social scientists it seems that environmental adaptation is more relevant than evolution to their own subjects. Evolutionary theory is relevant chiefly to the natural scientist, who studies behaviour over generations. Not even the long-term business cycles of Schumpeter and the Kiel School bear much relation to evolution. What seems to be most relevant for evolutionary economists is therefore Man's phenotype, where phenotype is defined as the morphological, physiological, biochemical, behavioural, and other properties exhibited by a living organism. An organism's phenotype is determined by its genes and its environment.

At the cultural level mutation is not uninteresting to economists either: Chinese and Pakistanis are at least two mutations apart, Europeans and Africans perhaps as many as six or more. There are particularly many mutational differences within the African continent as this is where Homo sapiens first evolved. We need to consider what role, if any, these particular genetic differences have for economic behaviour. As a comparison, modern neuroscience is showing a genetic basis for behavioural differences between the sexes: for instance, females communicate more sensitively than males.

Then there is the variable of change. We acquire new customers, develop and buy new computers, and communicate with one another using new tools and behaviour. We must distinguish between those changes which are "evolutionary" and those which are not. Evolution in biology refers to (i) "the biological process in which inherited traits become more or less common in a population over successive generations", recognizing that (ii) "Over time, this process can lead to speciation, the development of new species from existing ones" (Wikipedia article on "evolution"). Under (i), we need to discover whether, say, a travelling salesman's son becomes better at selling, whether younger people today are able to use computers more efficiently than older people, and to what extent the content of our communication and way of communicating are changing with each new generation. Under (ii), we need to discover how rapidly these inherited changes occur. What biologists disagree about is not whether these changes occur, but whether they are continual or happen in occasional bursts (so-called *punctuated equilibrium*, advocated for instance by Stephen Jay Gould). The extreme case of change, in which an animal's lineage diverges into

separate species, seems to have little relevance for the study of economics, for the foreseeable future at least (ii above). What cannot be ignored by economists is the modification of "inherited traits" (i). What we need to discover is whether these changes have any implications for our economic models, and how significant they are. In other words, we need to ask what are inherited traits and what are explanatory factors to be accounted for in economic theory? It should be possible to begin coming up with answers to these questions soon thanks to the advance of genetic research. Without ever forgetting the contribution attributable to Man's free will, we should be able to explain how a given individual will behave, based on his or her genome together with what we know about how he or she has acted in the past (habit). When we achieve this we are starting a real scientific study of Man, not before.

For evolution to continue, there must be mechanisms to create or increase genetic variation, and mechanisms to decrease it. The mechanisms of evolution are mutation, natural selection, genetic drift, recombination, and gene flow. These can be grouped into two classes: those that decrease genetic variation and those that increase it. We can treat the physical properties of the world as constants. Human behaviour is changing. It is Man's appreciation of how the physical properties can be exploited which evolves. Then there are the other limitations as to Man's action related to his resources; the material, capital and what man is capable of doing.

What are then the fundamental building-blocks of geoeconomics? From a materialist perspective these could be material, capital, people, and actions. By acting on material mankind initiates an evolution which is proper to his species. Since mankind has chosen not to share material in common, but to control it through the institution of private property, capital is another building-block. Capital and private property are products of political law. Other man-made limitations include social rules and ethics, whether these are causes or effects.

The first question is why Man acts as he does? The answer will tell us what kind of actions to expect, which will help us foresee the direction of our evolution. When facing a decision, man participates in the process as a whole being; his interests are not only economic, but aesthetic, sexual, and humanitarian. These other interests cannot be assumed away if we are to understand the underlying causes or motives for human action and to suggest realistic answers. Or, as Veblen (1899: 10) puts it: "Changes in the material facts breed further change only through the human factor. It is in the human material that the continuity of development is to be looked for; and it is here, therefore, that the motor forces of the process of economic development must be studied if they are to be studied in action at all". This is a materialist approach, without necessarily being a Marxist one.

We appreciate the complexity of the task when we consider that we must list all the possible motives for action Man can have, and decide which motives are strongest for each set of possible actions. We would need to do this for all human beings and all their economic actions every day. And it will be difficult to decide which actions are economic and which are not, since an economic action may be caused by a non-economic action. Unless we can achieve this, which at this point seems well-nigh impossible, we will not achieve complete certainty about our evolution.

The question then becomes, how accurate an estimate can we make of a person's, a company's, or a nation's evolution, based on what we can observe? And will it be accurate enough to be worth our undertaking? We can always describe economic actions in terms of basic principles of evolutionary science and make them serve as examples without pretending that they have predictive capabilities, in much the same way as case-studies are written today: as descriptive data that resemble real life. One thing is clear: the better the knowledge we have about a subject's actions, the greater the likelihood of getting accurate predictions. It will not do to sit at a desk and draw general conclusions from small data-sets. This is a major difference from the mechanistic approach, whose advocates believe that useful conclusions can be drawn from mathematical reasoning once a number of limited variables are found and defined. The major problem here is that they are way too few to be of much value.

The natural sciences nowadays are concerned with "dynamic" relations and series. Unlike chemistry, which was able to move away from its taxonomic stage and develop into a modern science, economics ignored new developments in the study of biology and chemistry and clung instead to the idea of natural rights, with its roots in the writings of the eighteenth-century French physiocrats,

men such as Quesnay, Baudeau, Le Trosne, and Mirabeau, but also Condorcet, Gournay, and Turgot (cf. Veblen 1899: 2). These men laid the groundwork for the British development of economics, which evolved into the Lausanne school with its refinement of the mechanistic programme as applied to economics, and that in turn led to the blossoming of the new approach in the USA with the neoclassical school, first of all the Chicago school of economics, setting so the standard and the definition of what the Nobel Prize in economics should reward.

It may be that the marginalist school will fade away as the American empire declines, or because the number of remaining marginalists drops below some critical mass, rather than as a consequence of the persuasiveness of evolutionary arguments. Others would argue that the marginalist school will wither when other schools can make better predictions about economic behaviour. And these possibilities are not exclusive.

This is a constructivist perspective on social-science paradigms. Identifying the limitations of the marginalist approach, criticizing its assumptions, in a word "deconstructing" it, is only a first step, and will not be enough to make geoeconomics a real alternative. Besides, many marginalists would agree with their critics to an extent: "our approach is an over generalization of reality, but it is the only way we know to develop an economic science". If evolutionary economists want to offer an alternative, they must develop an alternative method which yields answers to real-life problems. Instead Geoeconomics can succeed where Evolutionary Economics or the evolutionary approach to Economics has failed by developing a coherent methodology.

The deconstructionist critic argues that marginalist economics typically assumes perfect competition, meaning that all parties have equal ability to compete. This assumption is refuted by what is called the *Matthew principle*, from the words of the evangelist: "for whosoever hath, to him shall be given", implying that it is easier for the rich to accumulate than the poor (Boulding 1981: 75). This is relevant to evolutionary economics since economic development is almost bound to increase inequality, particularly in its early stages (*op. cit.*: 77). The great evolutionary development of the last two hundred years has undoubtedly increased world inequality (*loc. cit.*), even though more people are enjoying a higher standard of living. These facts in themselves will put further pressure on the marginalist school.

"The activity is itself the substantial fact of the process, and the desires under whose guidance the action takes place are circumstances of temperament which determine the specific direction in which the activity will unfold itself in the given case. … The economic life history of the individual is a cumulative process of adaptation of means to ends that cumulatively change as the process goes on, both the agent and his environment being at any point the outcome of the last process. His methods of life today are enforced upon him by his habits of life carried over from yesterday and by the circumstances left as the mechanical residue of life of yesterday". (Boulding 1981: 75–7)

In mainstream economic theory these forces are assumed away. Another important assumption in marginalist economics is the maximization of gain. In reality, do we try to maximize gain, or to minimize the fear of loss? Do we compete against all alike, or less against certain groups, family, and neighbours? Marginalist economics also assumes free choice. This is questioned by a number of physicists and neurobiologists (Cf. Nicolas Gisin in Brunner, Gisin, and Scarani, 2005). Research by Angela Sirigu showed that experimental subjects formed a conscious intention to perform an action only slightly after they had in fact started to perform it. If that is true, it puts the whole of rational choice literature into question. Possibly the most convincing argument for an evolutionary approach in the social sciences was propounded by the Russian scientist Petr Kropotkin. Kropotkin (1902: vii–x) observed two aspects of human life which may help to explain behaviour. One was the extreme severity of the struggle for existence, and the great loss of life when food is scarce (the law of Mutual Struggle). The other was the fact that bitter struggle for the means of existence fails to occur among animals of the same species (the law of Mutual Aid). When food was plentiful he observed the phenomena of mutual aid and mutual support. Thus individuals who enter the market economy from a situation of mutual struggle are often more motivated to work and succeed. The concept of struggle for existence as a factor in evolution was introduced by Darwin and Wallace. The idea of the law of Mutual Aid was suggested by Kropotkin's professor at the university in St Petersburg, Karl Kessler, who was also dean of the

university. Kropotkin essentially took up Kessler's side as and proved both of them empirically. When Man has more than enough money to live he sets out to help his fellow man. This observation speaks against the assumption of constant competition, but fits well with observations of billionaires' behaviour, for instance in the USA recently, at least on the face of things. Bill Gates and Warren Beatty, like Rockefeller and Carnegie before them, have decided to give away large parts of their fortunes to charity. The problem can also be seen from a more selfish perspective: it is easy to spend a million dollars on consuming, but difficult to spend a billion dollars. There are only so many things to buy. Our needs may stay constant, but we want different things. Giving may still be an expression of pure self-interest, as when it results in greater power and an enhanced reputation.

The problem from the perspective of economic theory is that we have constructed our economic models with the individual as the reference point, acting to maximize his own self-interest at the present moment. Our models have been set up to portray economic life as a matter of seeking to maximize satisfaction of our wants, assuming that the individual knows what is best not only for himself, but indirectly also for others. All these assumptions must be questioned.

The discipline of economics has been imposing individualist assumptions, not only at the cost of thinking about society, but also at the cost of thinking for the long term. Attempts by economists like Nicholas Georgescu-Roegen to discount for future generations were rejected since it was thought – justifiably – that this would make our economic models very complicated. But perhaps even more important was that it would call into question the way we live. Georgescu-Roegen was a mathematician, so he did not object to the complexity, but it was argued that the models would be difficult to explain to a non-mathematical audience and to practising businesspeople, and difficult to apply. His ideas about discounting for future generations were seen as a political statement which broke with existing utilitarian practices. They were seen as a threat to our modern liberal democracy built on free trade. Thus, from being the favourite student and follower of Schumpeter, he soon became an outsider, and went to teach at minor universities. But in reality, of course, the accepted margin a list or neoclassical models are just as political as the models advocated by Georgescu-Roegen. But worse, and as I will show in more detail, they are leading Man's development in the wrong direction, encouraging the consumption of future generations' resources.

Some will see this as implying a rather sombre outlook on human existence, but there is another element to consider, as mentioned before: our ability to shape our own evolution. We have the ability to change our nature by altering our ideas and actions (habits). In the short run we can adopt new habits, in the long run we can expect changes through genetic modifications and mutations. That is, we are not necessarily the pre-programmed competitive machines we are sometimes made out to be, but a complex competitive organism where only one aspect is mechanical. Thus, to be considered truly human in today's world one requires a good portion of empathy and an interest in others' wellbeing. These values are already becoming part of our nature. Science has shown that we have become more human just by living closer together in cities. These findings refute the idea, held by some, that we were more social and more caring when we lived in small isolated groups. The fact that we can include empathy in our equations, however, does not mean that we must abandon evolutionary theory or our biological explanatory models. Empathy is part of nature, and can be explained as such.

Social ideas have influenced us for millennia, but they first had significant impact on our lives during the period we call the Enlightenment, in the eighteenth century, through the writings of philosophers such as Voltaire, Montesquieu, Rousseau, Hume, Kant, and Schiller. To ignore the values bequeathed to us by these men and others would mean to close our eyes to human evolution. We should not allow ourselves to be reduced to mere animals, not even when we get bored with the entire project of civilization (as sometimes seems to happen) and decide to inflict massive destruction on our own kind. Afterwards we wake up full of remorse.

This, then, must be the full perspective of any introduction to the theory of competitive advantage, if we are to address the interests and concern of all mankind. The biological perspective is important not only because it gives us scientific data (since we indisputably are a part of evolution), but also because it helps us to realize our limitations. When evolutionary theory was abandoned at the turn of the last century (economics) and again at the

end of the Second World War (political science), we swapped realism for elegant models and politically-correct opinions about the world, which have merely ended by making our studies less useful and putting our species in greater danger. Instead we need more realistic models that can incorporate the idea of change (Søilen, 2012, pp 107-114).

2.4 Theoretical foundations and academic influences for the evolutionary approach

The study of economics has two objectives; first, to develop theory to attempt to explain and predict human economic behaviour (economic theory), secondly to provide economic actors or agents with tools enabling them to conduct business and public operations more efficiently (applied fields). Of these, the second is the less problematic. The discipline of economics is continually providing economic agents with practical working tools to enhance organizational performance and efficiency. Much of this is done under the heading of management, and in close collaboration with practising businesspeople. It is the former objective which is a cause for concern. The larger methodological question is what basis we can found the discipline of economics on, to give its models predictive power. Are there any such models?

The choice of physics as a model for the development of economic theory, a methodological direction which has been particularly dominant since the Second World War, has increasingly been criticized by economists, and not only by evolutionary theorists, but by members of a variety of schools. Many of these critics see biology as an alternative methodological direction that merits investigation. Modelling economics on biology is not a novel idea; it is an attempt to revisit a number of questions which were left behind at the turn of the twentieth century. Thus the fundamental question is whether the concept of evolutionary economics was abandoned prematurely, or for good reasons.

The French philosopher and mathematician René Descartes inspired two lines of scientific thought. One was abstract, mathematical, and mechanistic; it led to significant advances in knowledge thanks to men like Leibniz and Newto[2]. The other approach explored the development of our living world with everything in it, from insects to animals. This second approach was taken forward by men like Buffon (1749), Lamarck (1809), Cuvier (1812), Wallace (1876), Darwin (1872), and Wegener (1915). In these terms we can say that evolutionary economists are trying to show where the former line of thought falls short when applied to the understanding of economic behaviour, and where the second line may be of help.

Adam Smith (1776) is often used as a reference by the neoclassical or marginalist school of economic thought. We shall argue that Smith, Thomas Malthus, and Alfred Marshall (1890) were in fact all inclined towards the evolutionary approach. If that is so, it means that the neoclassicals are not so much "classical" as "neo". The "marginalist school", which is a better term for the neoclassicals, might also be called the "mechanical approach", as compared with the evolutionary approach. The marginalist school, or marginalism, studies marginal concepts in economics: problems related to marginal cost, marginal productivity, marginal utility, the law of diminishing rates of substitution, and the law of diminishing marginal utility. Marginal calculations were a natural direction to follow once the physics paradigm had been selected.

The evolutionary model is implicit in Marshall's *Principles of Economics*, even though he did not incorporate the idea into his more formal theories. That was part of the problem for evolutionary economists at the turn of the century: they had not succeeded in producing applicable theories and models, but mostly left their analyses on the descriptive level. So when it came to building a scientific platform on which the positivist study of economics could stand it was the French economist Léon Walras who was chosen. Walras and his successors had mathematicized the Newtonian system[3]. They could offer the discipline of economics a rigorous methodology which promised to deliver elegant answers, all in the spirit of the natural sciences. The underlying assumption was that if this method had worked wonders for the natural sciences then it should do the same for the social sciences. In other words, their answers promised to be more precise than what

[2] Newton is said to have been inspired by Descartes after having read his "geometry".

[3] Their primary tool was elementary and linear algebra.

economists had delivered before; and that promise was delivered. The fact that the new models and their predictions often failed to correspond to actual economic behaviour was mostly due to their assumptions. They were nevertheless far better than nothing (a point which continues to be a main argument for the marginalists), and hence the evolutionary perspective was gradually lost from the discipline of economics (Boulding 1981: 17). However, it soon became clear that the problem was no longer one of precision, but of relevance. In other words, the answers were detailed and elegant and might have been correct, but they did not correspond to the economic realities.

Later, with Paul Samuelson – whose models essentially involved stable parameters and a dynamics based on stable differences or differential equations – economics became even more Newtonian, less Darwinian (Boulding 1981: 84). If it were not that current economic theories have still not demonstrated themselves to be the relevant predictive tools that economists had hoped for, our scientific journey would probably have ended here. But it continues.

The best philosophical foundation for economic research seemed to many to be a renewal of utilitarianism. The rehabilitation of economic theory was due to the Austrian Carl Menger – known to students today for his theory of supply and demand. Menger's essential aim was to discover the laws determining prices and to initiate discussions of supply and demand, human needs and marginal utility (Schumpeter 1992: 84). The biggest flaw in his assumptions is that Man is not entirely hedonistic, his nature is not wholly fixed and predetermined:

He is not simply a bundle of desires that are to be saturated by being placed in the path of the forces of the environment, but rather a coherent structure of propensities and habits which seeks realisation and expression in an unfolding activity (Veblen 1898: 11).

Both Karl Marx and Menger were much influenced by Ricardo. Menger gave rise to what has today become mainstream economics, but that was not his original role. Menger was at one time the outsider, at a time when Marx and the German historical school led by Gustav von Schmoller represented the consensus within the discipline of economics[4]. Critique of the "mechanistic approach" is by no means new either. In his 1875 book *The Character and Logical Method of Political Economy*, the Irish classical economist John Elliott Cairnes disputed Jevons's idea that economic truths are discoverable through mathematical reasoning (*op. cit.*: vi). What maths can do is illustrate and simplify conclusions that have been reached by other methods, or in his words:

> I have no desire to deny that it may be possible to employ geometrical diagrams or mathematical formulae for the purpose of exhibiting economic doctrines reached by other paths. (*op. cit.*: vii)

The reason why mathematics can have only limited application to economics is twofold. First, "its close affinity to the moral sciences brings it constantly into collision with moral feelings" (*op. cit.*: 3). The second is even more fundamental: maths is ultimately by nature just another language, even if of course much more precise than ordinary languages[5]. But precision by itself does not help. In the same way as we do not solve a problem by translating it into a foreign language, maths by itself cannot solve economic problems. It can only express what is already there in a simpler and clearer form. Progress using maths in the social sciences only comes through our ability to see and handle ideas more easily. The advantage is the same that came from the development of symbolic logic[6]. Both mathematics and symbolic logic are very helpful in summing up what we have already discovered, but we have to draw the inferences for ourselves.

Why has physics not provided a successful cornerstone for the social sciences? When we compare the results of the social sciences to those of the natural sciences, we find that social phenomena are more difficult to study, less tangible, less physically observable. Social systems are just too complex if we hope to pin down individual behaviour; they contain too many variables, with too many possible and often irrational outcomes, to be explained via physics and mathematics alone. More important, our mathematical approaches are not capable of treating the element of change –

[4] It was they who called Menger and his followers the "Austrian School", to distinguish them from prevailing thinking among German economists.

[5] This point is discussed clearly by Bertrand Russell (1903).

[6] Unfortunately, the success of symbolic logic has reduced interest informal logic, a subject with much greater applicability in everyday life.

what is often referred to in the scientific literature as the dynamic aspect. Newtonian and Cartesian numerical mathematics, which has dominated the study of economics for a century now, is unsuitable for the more structural and topological relationships found in evolutionary systems, except insofar as the topological relationships can be mapped and converted into numerical relations (Boulding 1981: 86).

Economic theory as developed in the twentieth century builds on a number of mechanistic assumptions. These assumptions were first criticized by Herbert Spencer in his 2 volumes book "the principles of sociology" (In Peel, 1972: 6), who held that they must be wrong because "it assumes the character of mankind to be constant". Or put differently, the problem is that "existing humanity" does not exist, but is constantly changing. Change is the law of all things, true equally for a single object as for the entire universe; all things are mutable: shells into chalk, sand into stone. "Strange would it be, if, in the midst of this universal mutation, man alone was constant, unchangeable" (op. cit.: 7). Everything is in a state of continual change or fluctuation, even the things we think of as most stable. Dynasties and private fortunes seldom last more than a few centuries; even a stone monument has a limited life. We seem to have a cognitive difficulty with change, probably because we constantly need to find order in our everyday lives. We have a strong need to live and find our balance in the present, hence we prefer to think in terms of constants rather than of fluctuation. This seems to be the way we are born. In much the same way, we do not feel the earth speeding round the sun, and that is good: if we did, we would not be able to concentrate on anything else. In other words, we seem inclined to think in the linear terms of a static, mechanistic world perspective. Likewise, we think we can have knowledge of the future, but we cannot. Instead we are continually surprised; and to top it all we are not surprised that we are constantly surprised. Within rational choice theory we might define these observations as a set of rationality errors. They mark a biological limit to our understanding of the real world, i.e. of Kant's *Ding an sich*.

From the above one might take it that we are confronted with an either/or choice between marginalist and evolutionary approaches. To the extent that these premisses are not contradictory, the method used should be whichever method has the strongest predictive power in each particular case of economic behaviour. It is not a question of either Newton and physics or Darwin and biology[7]. So far as we can tell to date, the evolutionary approach to economics is not necessarily, and not necessarily always, a replacement for neoclassical economics. For instance, it seems that it is more suited for studying economic behaviour over the long term, when the element of change becomes most significant. There are many problems, e.g. of production that are simple enough for marginalist calculations to be of value, but they seldom include problems of social complexity like international business.

To complicate the question further, in many cases marginalists and evolutionary economists will both espouse the same methods or theories. So for instance game theory is seen as a marginalist contribution by some, because it can be highly quantitative, but as an evolutionary approach by others, because it is dynamic and does not seek to maximize a given set of variables. Game theory can also be studied from either a mathematical or a non-mathematical perspective, as in the writings of von Neumann and Morgenstern (1944) on one side and Axelrod (1984) on the other (Søilen, 2012, p. 119).

2.5 On the European continent: from Buffon to Lamarck, Cuvier, and Darwin

Much attention is given to Darwin, but mechanisms of evolution had already been set out by the French naturalist Jean-Baptiste Lamarck in his classic 1809 work *Zoological Philosophy*. Lamarck began as a botanist before becoming a professor of invertebrate zoology, and he is known for having developed the first positivist theory of evolution for living organisms, but also for the influence he had on Darwin[8].

Others would want to mention Buffon as a pioneering figure. His contributions established the scientific foundation and the

[7] Paul Krugman (1996) calls neoclassical economics and evolutionary science "sister fields" (though he will not give up the maximization and equilibrium approach).

[8] Darwin learned about Lamarck through a fellow student while studying medicine at the University of Edinburgh.

scope for natural history, a subject which he himself thought always leads back to a reflection on oneself (Buffon [1749] 1984: 39)[9]. Buffon called this the first truth:

> ...that man must arrange himself in the class of animals, of which he resembles above all in what is material, but even his instincts may seem more certain than his reason, and his industries more admirable than his arts. (*op. cit.*: 45)

He reckoned that, when mankind becomes aware of the true possibilities contained in his intellect, "he could make his nature perfect, morally, as well as physically" (*op. cit.*: 247). This project, to improve mankind morally, has given rise to a whole series of normative, politically-correct studies in the social sciences, in connexion with topics such as gender, sustainable development, immigration, and human rights. Putting it differently, many university departments today, especially in our newer universities, are not so much asking what the truth is, as what it ought to be, based on what kind of human beings we want to create. This becomes a new form of positivism whereby politicians steer science in an intended direction instead of letting it be free. It may also be seen as an evolutionary approach, but we must then distinguish normative from positivist evolutionists.

Unlike other animals, man can decide the direction of his own social development. In other words, he can elevate himself. This is done by creating an ideal, not by accepting what is "natural". The problem, when we move away from the notion of natural truths, is to know which ideal is the right one to follow and who should decide which it should be. Some academics go so far as to claim that the "natural" as such does not exist. One can then argue that the sciences can never really escape from the domain of politics, since all scientific findings have political consequences, whether we are talking about Stalinism or the atom bomb. On the other hand one might argue that more politics will not make university life any more manageable, as became apparent on campuses all over the Western world in the 1960s and 1970s. It is true that we can never become fully objective in the sense that we can escape our own subjective minds, but we can develop scientific methods to reduce our biases. To argue otherwise is in a sense to be a methodological fundamentalist.

One might ask what a book about zoological philosophy has to do with the study of human behaviour. The fact is that when Lamarck wrote about living organisms in general he actually had mankind in mind, as we see in a passage such as:

In order to give a living body the ability to move without impulsion from a communicated force, to be aware of objects outside of himself, to form ideas, to compare or combine these ideas, and to produce opinions which to him are ideas of another order, in one word, to think; not only is this the biggest of all miracles which the forces of nature have attained, but, in addition, it is the proof of the employment of a considerable time, as nature has achieved nothing but gradually. (Lamarck [1809] 1994: 122)

We might see Lamarck's contribution to evolutionary economics as implicit in his writings, even though it was Herbert Spencer who first developed the idea explicitly: namely, that societies are like organisms, in that they (i) augment in mass, (ii) gain in complexity, (iii) their parts gradually acquire a mutual dependence, and (iv) society is independent of each of its component units, i.e. is not affected by individual deaths. These similarities are often referred to as the four parallelisms (Peel 1972: 57). There are other parallels to human life as well. In Chapter VII of his book Lamarck discusses the influence of different circumstances on the actions and habits of animals, and the influence of those actions and habits on their living bodies, as causes of modifications to their structure and anatomy (Peel 1972: 206). Habits become a second nature. Lamarck reminds us that for a long time we have observed the influence that different states of our organism have on our character, our inclinations, our actions, and even our ideas. But he also notes that no-one has yet recognized the influence of our actions and our habits on our structure. Our whole organism changes when our behaviour changes. These changes are so slight that we hardly notice them. They are hard to notice because they only become apparent after a very long time. To demonstrate this, look at an old photo of your grandparents. Not only the clothes are different: their facial expressions

[9] Buffon wrote his magnum opus over the years 1749 to 1788. A summary edition appeared the following year, in 1789.

are different too. The implication is that we have become our own evolutionary machines, even though the changes that we can observe are very small. What is driving this machine forward so fast is a system of technological development and economic growth. The changes in our organisms are initiated by needs. "If these new needs become constant or long lasting, the animals take on new habits, which are as constant as the needs which brought them to life" (Peel 1972: 208).

Lamarck notes that the great diversity of animal life must be understood against the background of the great range of diverse needs that appear when new species encounter one another in an ever-changing environment. Basic human needs for food, clothes, and shelter are much the same now as they were in the Stone Age, but their expression is changing because of the fact that we as human beings create new needs through a social mechanism called in everyday life "fashion" and the constant struggle for ever-higher living standards (again a form of social competition) in the shape of better and more diverse food, more clothes, and larger and more expensive houses than others have, than our neighbour has. In marketing we call this last form wants, to separate them from needs, which are more constant). We do this because we are always seeking greater comfort or because we want to impress our fellowman, out of some version of a struggle to survive but also out of habit and perhaps because we do not always know how else to express our will. This creation of new forms and degrees of need is a human characteristic, because we have the time and the resources to indulge in it.

Our needs are seemingly endless and depend only on our imagination. But the strength of some needs decreases as others are fulfilled. Man is always looking to maximize his satisfaction (the marginalist perspective). We know too that types of need change: from basic human needs to luxury and what are understood as projects for self-realization, as we ask what the meaning of life is (evolutionary perspective). The discipline of marketing, we recall, is largely about how to register and communicate these needs and wants.

As human being we act when there is a need to change something, to improve something. Or putting it differently, a person who is satisfied with everything will seldom find a motive for pursuing truly great endeavours. "In human beings and in the most perfect of animals, life cannot be conserved without irritation in the parts which must react..." (Peel 1972: 344). This phenomenon can be observed in business life too, as when the son or daughter of some great industrialist is too happy with life as it is to take on the hard work needed to develop his or her father's business. Often such individuals feel they have nothing to prove; all needs are satisfied, there is no irritation. This is noticeable when we consider the contrast between entrepreneurs and executives. The former are often less risk-averse, more adventurous and curious, while the latter are typically more concerned with stability and a steady flow of income. From a biological perspective these characteristics may be seen and understood as different types of psychological irritation, results of environment and upbringing as well as inheritance. Teaching entrepreneurship from an evolutionary perspective then becomes largely a matter of making the student aware of these irritations and maintaining them.

Darwin was also indebted intellectually to the French naturalist and zoologist Georges Cuvier. In a famous letter to Ogle in 1882, as a thank for a gift, Darwin described Linnaeus and Cuvier as his "two gods". Cuvier set out to tell the history of our planet by showing all of the changing processes it has been through, continually giving life to new species. One example is the different types of shell found in separate marine strata (Peel 1972: 150). Cuvier noted that among all the thousands of fossils he had investigated, there was never a single human bone, which led him to conclude that mankind is a relatively young species. Cuvier's endpoint is Darwin's starting point: if all those other species had a predecessor, then the same must be true for mankind. We must have evolved from other species.

Darwin begins his *Origin of Species* by drawing a difference between *natural* and *domestic* variation (Darwin [1852] 1994: 5). Even though Nature continues to bring about changes in mankind, these variations are considerably smaller than those of the domestic or self-imposed kind. This starting point has a parallel in modern evolutionary economics, with the contrast between those who focus on universal Darwinism, represented by Hodgson and Knudsen, and those who focus more on domestic variation, represented by Nelson, Winter, Cordes, and Witt (Witt 2006: 473–6). Thus it is problematic to speak about a single school of evolutionary economics. Instead what we have are different

varieties of theory with different starting points. Rather than one school, there are various schools which all share an evolutionary approach. If we accept the arguments for the evolutionary approach, it follows that all social sciences that claim to be scientific must adhere to this method. Also the study of history, which is part of the humanities, can be understood as following the methods of evolutionary theory.

Man's "self-imposed" variation has increased significantly over the past hundred years. This domestic variation is governed by complex laws:

> Variability is not actually caused by man; he only unintentionally exposes organic beings to new conditions of life, and then nature acts on the organisation and causes it to vary. (Darwin *op. cit.*: 410)

Rather, we select among the variations given to us by Nature, accumulating them in any manner desired. The same principles that act in circumstances of domestication also act in Nature (*op. cit*: 412). The individuals selected are those which find a competitive advantage in the environment within which they live and function. Finding such an advantage depends on the individual's ability to adapt. Since numerous individuals are involved and only some can succeed, competition is often fierce. These are very much the same forces that are involved in economic life.

In Nature males try to win females by being vigorous, by struggling, by acquiring special weapons, means of defence, or charm. In economic life mankind tries to gain an advantage in very similar ways. What this means is that the theory of natural selection is valid also for the discipline of economics; but, more, that it is being enhanced by the free-market economy, which in turn is the product of our philosophical ideals, such as freedom of the individual. In economic life Man struggles to satisfy human needs in very much the same way as animals struggle to survive: first by adapting, then by competing and trying to find a competitive advantage, a niche from which he can fend off competitors and sit undisturbed.

The most common form of domestic variation is indefinite variability. These are changes that last for a limited time only, like coughs or colds resulting from a chill (*op. cit.*: 6–7). Habits, inheritance, and the use or disuse of particular body parts are other reasons for variation. It is hard to distinguish clearly between individual differences and minor varieties, or between more plainly marked varieties and subspecies, or between subspecies and species (*op. cit.*: 212). These are all different degrees of variation. Nature preserves these differences with the same keenness, hoping they will result in a competitive advantage. These ideas are relevant to and would find a natural place in the discipline of economics, if economists would accept them. "Differentiation" is one of the generic strategies in Porter's model of competitive behaviour. Porter's contributions, although ignored by mainstream economists, in fact amount (probably unintentionally) to one of the more successful blueprints for a new discipline of evolutionary economics.

What we have seen so far is that a first academic grouping developing the ideas which would eventually underlie evolutionary economics was well established in France with men like Buffon, Cuvier, and Lamarck, long before Darwin. Darwin belonged to a second grouping, but we will postpone discussion of this (and take it up in conjunction with the fourth grouping), because its influence on economics occurred mainly in North America. Before looking at that we shall consider a grouping that historically came third, and was located in German-speaking Europe.

2.6 Germany and Austria: Austrian versus historical schools

Economics as defined by marginalists is the study of a particular range of social facts to do with how we produce, distribute, exchange, and consume scarce resources. As anyone who has considered the matter will have noticed, it has also a lot to do with money, or wealth. When economics and political science was a single subject, about a century ago, the study of political economy was defined as the science of wealth (Cairnes 1875: 8). The laws of this phenomenon of wealth were "simply the facts of wealth, such facts as production, exchange, price; or again, the various forms which wealth assumes in the process of distribution, such as wages, profits, rent, interest, and so forth" (*op. cit.*: 18–19). This definition, however, was inappropriate for the new group of economists who wanted to turn economics into a true science after the model of the natural sciences. The new definition needed to be value-neutral, and could not include factors such as power or the natural status that results from having different starting points in life. The assumption had to be that all human beings in principle have the same possibilities. The new,

more specialized science of economics, which was to replace political economy, was to be "positive" rather than "hypothetical" like its predecessor; and the tools which were to achieve that was the discipline of mathematics and empirical research. This soon created an academic and scientific culture based on small, narrowly-defined empirical projects, such as we today find in most highly-regarded economics and management journals.

This would not be a problem, if it were not for the fact that, well over a century later, we have not made the advances we hoped for in terms of theory building. We are however wiser by many experiences. For one thing, we have refuted Marxism, and we have also tested the limits of the mathematical method. In the words of the Japanese economist Michio Morishima, in his Introduction to the posthumous book by Schumpeter and Takata[10]:

> Since the second world war economics has become mathematicised to what could be deemed an excessive degree (…) economics has become isolated; the isolation has in its turn promoted mathematical inbreeding. (Schumpeter and Takata 1998: vii)

The reasons why mathematics has prevailed ever since as the dominant paradigm must be sought elsewhere. Some critics argue that the study of economics has become a political tool, a means of defending free trade through the use and abuse of statistics. And the heavy use of mathematics in economics helps keep its critics at bay, rather as Latin preserved the Catholic Church from its critics in the days of Erasmus of Rotterdam. Today a whole class of bureaucrats and experts are putting forward figures and calculations that only a minority can understand and few can question.

Specialization within the discipline of economics, furthermore, has not always benefited the subject. After all, human beings do not only perform economic actions. A person also performs religious, political, and social actions, and, more importantly, these various actions have direct influence on each other. Thus, a practising Muslim may avoid earning interest. This more complex range of human actions as the starting point for the German sociologist Niklas Luhmann. Luhmann (1985) saw human behaviour as a set of distinct and interacting social systems. Accordingly his framework is well suited for an evolutionary approach to the social sciences, although to date his theories have chiefly inspired numerous interdisciplinary and multidisciplinary studies.

When economics parted company with the disciplines of history, politics, and social investigation in general, its models and academic forms became simpler and more refined, but the discipline did not become better at predicting future events:

The role of politics and sociological elements in explaining economic phenomena has gradually diminished, until finally pure economics (neo-classical school) has come to be regarded as the most important tool for elucidating economic problems. (Schumpeter and Takata 1998: ix)

This is the same neo-classical school which Schumpeter once helped to found in Europe based on the ideas of Eugen von Böhm-Bawerk[11]. In fact, initially Schumpeter's work was seen as too mathematical and too theoretical for most English and American economists. It was not until after Schumpeter had gained a secure academic position in the USA that he began changing his views, and drifted away from the use of maths towards the evolutionary approach, just as Boulding did after him. Unfortunately for us, this came rather late in his life. Schumpeter was never able to complete his ideas on evolutionary economics. The closest he got to describing his method was in the outline at the end of his *History of Economic Analysis*, a book he never finished. Today Schumpeter's contributions to economics are mostly associated with the study of entrepreneurship, an area which was to be taken forward by a fellow Austrian emigré, Peter Drucker. Unlike Schumpeter, Drucker never made any real attempts to set his theories within a broader methodological perspective so he was mostly ignored by fellow academics. His fame stems almost entirely from the fact that CEOs and managers found his books relevant. The same can only be said for a few economists who have won the Nobel prize.

---

[10] This book was a response to Böhm-Bawerk's 1914 book Macht oder ökonomisches Gesetz ("Power or Economic Law"). Takata and Schumpeter met for discussions in 1931. Whereas Takata wanted to incorporate power into the study of economics, Schumpeter wanted to leave that aspect to the discipline of sociology

[11] Böhm-Bawerk in turn drew his inspiration largely from Carl Menger.

Schumpeter looked to a range of different disciplines for inspiration. This is confirmed not only by his wide general reading, but by his affiliation and sympathy with the Kiel school of economics and by his academic training in the Austrian school. In his theory of economic development, Schumpeter attempts to offer a theory of economic change in purely economic terms. In the Japanese edition of the book he says that his aim is the same as that of Marx's economic teaching; he places his concept of economic evolution in a Hegelian setting: "He concentrated his analytical powers on the task of showing how the economic process, changing itself by virtue of its own inherent logic, is incessantly changing the social framework – the whole of society in fact" (Schumpeter 1952: ix). What distinguished Marx from his contemporaries and predecessors in economics was a vision of economic evolution as a distinct process generated by the economic system itself (*loc. cit.*) and a deterministic certainty about future economic events and their consequences[12].

Although trained in the Austrian school, Schumpeter's convictions lay elsewhere, influenced not so much by Eugen von Böhm-Bawerk as by adherents of the historical school – Marxists like Hilferding and Kautsky, but above all evolutionary economists of the Kiel school such as Lowe and Lederer, with their focus on "structural" theories of growth and business cycles. Together with the Kiel-school economists, many of whom ended up at the New School in New York, Schumpeter represents the third academic grouping in evolutionary economics. However, when they moved to the USA it was the physics paradigm and their mathematical contributions to the marginalist school that were wanted, not their evolutionary ideas. The young continent also approved of the laissez-faire doctrines of the Austrian school, the very same doctrines which has just turned the Western world close to bankrupt. The evolutionary ideas were abandoned with much of the rest of the intellectual baggage European emigrés carried with them from a Nazi-infested Europe. American evolutionary thought was soon a thing of the past, associated with men like Veblen and later with isolated mavericks like Boulding and Georgescu-Roegen, who were treated as unsuitable to teach at the great universities. Those who conformed to the new methodological plan for the discipline of economics could advance in their careers; those who did not were at best ignored. The new paradigm was established.

2.7 The USA: from Veblen to Boulding via Spencer

Many economists had been inspired by Herbert Spencer's introduction of the evolutionary approach into the social sciences. An American economist of Norwegian extraction, Thorstein Veblen, is often seen as the first real evolutionaryeconomist on that continent, but also as the last of the classical evolutionists (Peel 1972: xlvii). In his famous 1898 article "Why is economics not an evolutionary science", Veblen wrote that economics was "helplessly behind the times". Biology as a science was on its march forward. The social sciences needed to follow. It is likely that Veblen had read and was influenced by the British economist Alfred Marshall, fifteen years his senior, who in 1890 pointed out that economists had much to learn from the recent history of biology when developing their science. "Darwin's profound discussion of the question [in *The Origin of Species*] throws a strong light on the difficulties before us", wrote Marshall (1890: bk 1, ii). He felt strongly that it was biology, rather than Newtonian mechanics, which should be the model for the study of economics.

> It is commonly thought that evolutionary economics is an attempt by economists to adapt economics to the principles of the natural sciences. In fact one might well argue that it was the other way round: Darwin is said to have got the idea of natural selection by reading Malthus. (Boulding 1981: 84)

When we look more closely at the history of economics we find that most useful progress has been achieved within the applied fields, such as the study of marketing or management, which are more concerned with real-life situations and applications than with theory building. Yet it is the theoretical advances which have been rewarded, for instance with the Nobel Prize. An important question is how far the discipline of economics

[12] The Foreword to Schumpeter's book by his widow Elisabeth Boody explains the essence of his philosophy even better.

really needs theory-building in order to justify its existence. Many business schools, especially graduate schools and master's programmes, are perfectly satisfied with teaching students how to do things (know-how), developing their skills and giving them "tools". This matches Heidegger's notion of the future of the social sciences and the humanities as *Steuermannskunde* or *Kybernetik* (etymologically, "the art of the helmsman"), focusing on the ability to solve practical problems. These ideas have been shaping business schools for decades now.

There is a another point here too, as mentioned before. There seems to be no real correlation between economic theory-building and economic success among industrial nations. Thus countries like Germany, South Korea, Japan and China are highly competitive nations economically, but have contributed little to the development of modern economic theory, particularly as compared to English-speaking countries. The latter have lost much of their industry over the last few decades while those theories were being created. Their economies have shifted from a society of craftsmen and industrial production to one of knowledge production and services, a shift which has been very much supported by their own economic theories. Both the USA and Britain, which are producing most of these theories, are now suffering from general economic decline.

We talk of "economic theory", but mean very different things. How often does phenomenon *A* (cause) have to lead to phenomenon *B* (effect) for the relationship to be called a theory? Some talk of theory if they have done a small empirical experiment which gives answers that go in one direction. Others avoid the term altogether. There is less confusion about the term "economic law": few economists today would claim to have discovered any economic laws[13]. R. F. Harrod, one of the founders of the Oxford Economics Research Group, may have come closest when he put forward a law of evolutionary economic behaviour summarized as "Nothing for nothing" (Perroux 1960: 8), but such common-sense theories are of little value. The evolutionary perspective on human behaviour leaves little place for a formulation of natural law in terms of definite normality. Nor does it leave room for that other question of normality, namely what should be the end of the developmental process under discussion (Veblen 1899: 12). The best way for the evolutionary approach to demonstrate its value is to produce theories with greater predictive success than those produced by alternative schools of thought, or else to reject the idea of theories in the social sciences altogether.

> One of the real challenges to evolutionary economics is how to define and measure change. Early evolutionists discovered that the differences in traits and species increased with geographical distance, and they sought to classify change into (i) change of stations, and (ii) change of habit. A habitat is a special environmental area inhabited by a particular species or organism. Similar animals may be found at many stations, but only within one habitat (Wallace 1876: 4).

There are a number of reasons why comparable research projects are troublesome in economics. First there is the globalization argument: economic agents travel extensively and live all over the world. They cannot be defined as belonging to one geographical location. Secondly, any research that points to differences in economic performance between human groups is likely to meet serious criticism. One of the advantages of marginalist theory is that it is politically correct, since it complies with human-rights ideals and assumes that all men have the same economic abilities and possibilities initially, regardless of upbringing, cultural background, or genetics. This in turn is what makes differing economic outcomes fair, from the marginalist's point of view. We know this is not so: for instance, children born in wealthy families have a better than average chance of economic success themselves, not least because they can expect to inherit their parents' fortune. In that sense it could be argued that neoclassical economics is a convenient tool for the rich to defend their property.

Veblen's definition of evolutionary economics does not ignore cultural differences, nor does it ignore the notion of power:

> [evolutionary economics is] the theory of a process of cultural growth as determined by the economic interest, a theory of a cumulative sequence of economic

[13] An economic law may be defined as a case where a phenomenon A invariably leads to a phenomenon B.

> institutions stated in terms of the process itself. (Veblen 1899: 13)
>
> ... where man's knowledge of facts may be formulated in terms of personality, habit, propensity/natural tendency and will power. (*op. cit.*: 5)

This is the culturalist position, so heavily criticized by the academic establishment today for its political incorrectness. Men living under different climatic conditions will tend to behave differently. They have simply developed different habits. For instance, in many places on earth the climate is simply too hot to engage in much economic activity. We see this in large parts of sub-Saharan Africa, the Arab world, and South-East Asia. We also behave differently depending on our geographical location. Thus, island people tend to keep to themselves, or make occasional outbursts into the world, but are also inclined to engage in large-scale export efforts to stay competitive. Among competitive Island economics there is always the realization that if they keep to themselves they will decline, even if that is just as true for landlocked countries. We see this not only with Japan, but also with Britain, Sweden (half-island), Taiwan, South Korea (half-island), and Singapore. Our cultures have imprinted their particular traits on us, which again helps to explain our behaviour, including our economic behaviour. This does not mean that individuals cannot break out of these patterns, or that cultures do not change. They do. The culturalist position does not have to be a dogmatic one. Culturalists are also attacked for embracing the scenario summarized as survival of the fittest, implying that some individuals survive at the expense of others. However, it has been suggested that a better phrase would be survival of the fitting, since success is not restricted to a single individual or species, and survival seems to be more a question of finding a niche than of forcing others out (Boulding 1981: 18). In the wild, animals who are not adapted, who have not found some sort of advantage, disappear. Darwin called that the survival of the fittest, a phrase he borrowed from the English philosopher Herbert Spencer (rather than *vice versa*). Again, objections to the doctrine have a lot to do with ways in which it has been exaggerated. It does not necessarily mean aggressive behaviour. We do not want to live in a society where only the fittest survive; that would be inhumane. Instead we have constructed a political and social system in which those who are "unfit for survival" receive some form of help. However, if those who asked for help formed the majority of citizens, the nation would lose its competitive advantage. So the theory does apply and the effects of this phenomenon can be observed in large part of the Western world today. The consequences are economic and social distress. What corresponds to extinction in business life is bankruptcy. Bankruptcy does not mean that the bankrupt actually disappears, it merely simulates disappearance by excluding agents who perform poorly from conducting further business for a period of years. Furthermore, the precise consequences of bankruptcy vary, depending on the social-welfare system in place in a particular country. Thus the metaphor of survival of the fittest does not have the same consequences in modern society as it has in Nature, and the cruelty involved is often exaggerated but on the whole the theory holds.

Spencer, who was greatly influenced by Adam Smith and Lamarck, is one of the more neglected among classical sociologists. The reasons for this neglect are many: in part political, in part due to his outspoken, consequent denial of historic analysis as a method to gain scientific knowledge, and, no doubt, in part due to his notoriously blunt statements. His ideas were frequently utopian. Hence Spencer remained interesting for a long time as a literary figure but (like Marx and Comte) quickly became unacceptable as a scientist. His Lamarckian biology was dismissed in Europe, partly because it was bad timing to present a value-free social science in a Western world marked by high unemployment and great social misery. He was misunderstood, as when he is associated with social Darwinism and *laissez-faire* politics. In reality he argued for increased State intervention. Spencer survived in the USA by virtue of ideas such as rejection of absolute standards of truth and elevation of practice over theory. In the 1920s and 1930s these ideas were taken up by Dewey. Two features were never abandoned in the US: (i) economics-based models of social structure, and (ii) methodological individualism (Peel 1972: xl). He also inspired a whole new school of American anthropologists, including L. H. White, J. H. Steward, Marshall Sahlins, and Elman Service, who saw the task of anthropology as being to trace the path by which cultures "evolve" (*loc. cit.*). This

approach was inspired by the long-established German discipline of *Völkerkunde*. A similar approach is familiar in linguistics – as when we can trace the Indo-European languages back to Sanskrit – and we see something similar when scholars trace the development of mythologies (Cox 1870). The movements of populations suggested by such investigations are being confirmed today by genetic research. If sociology is not to be value-free, it must have a moral basis. This moral stance was widely accepted in sociology following Spencer, but has since been largely forgotten. As Spencer saw it, the chief role of evolutionary sociology was to reconcile Man to the inexorable processes of Nature. He wanted to describe a theory of social change. Economists who have worked to unite economics and sociology along these lines have included Schumpeter, Vilfredo Pareto, and Ferdinand Tönnies, a German sociologist who taught economics at Kiel University (Schumpeter and Takata 1998: xxxiii). Tönnies is perhaps best known for having reintroduced Thomas Hobbes into the social sciences. This strengthened the evolutionary approach to economics. The notion of power is vital in understanding human behaviour because we live in social, hierarchical systems. Had Tönnies not died in 1936 he would probably have had to flee Germany, as his children and so many of his colleagues did because of the rise of Nazism. The Nazis made a short process of anyone criticizing their movement. Tönnies was considered a social democrat, but this was also the fate of many conservative German intellectuals like the Manns and Carl Schmitt.Daniel Defoe's Robinson Crusoe represents life at the opposite extreme to the world of economics as portrayed by Hobbes. Economic marginalists reason very much as if Man were created as an isolated individual in Nature, like Robinson Crusoe on his island, and Crusoe is therefore a favourite trope among marginalist economists. Their critics argue that we do not live like Crusoe, so that any such comparison is a gross oversimplification bound to give false answers. Evolutionary economists argue that (whether we like it or not) the world is more Hobbesian than we care to admit, and that the task of a science is to describe reality.

For significant new discoveries in the study of Man and human behaviour, we are reliant on future work by psychologists, biologists, and neuropsychologists to show us how we reason and why. This is an argument in favour of more interdisciplinary research in economics. A sensitive specialist pursuing his investigations in any field, Boulding reminds us (1950: viii), finds himself on the frontiers of other disciplines. That was also very much a watchword in Boulding's own research. How can you study economics in mediaeval times without considering religion, and how can you study economics during the Industrial Revolution without considering the class distinctions of that period, Boulding asked (Perroux 1960). In the same way, how can you study the economics of today without considering the phenomenon of globalization – probably the greatest accelerator of change ever known on this planet, leaving aside natural catastrophes.

Every age, every nation, every climate exhibits a modified form of humanity (Peel 1972: 7). This universal law of physical modification is also the law of mental modification (*op. cit.*: 9). According to Spencer all imperfection is unfitness. Progress, therefore, is not an accident, but a necessity (*op. cit.*: 13). Rather than civilization being artificial, it is a part of Nature. Spencer thought that this imperfection would end and Man would attain some sort of completeness. Thus according to Spencer the law of evolution may be expressed as a change from a less coherent homogeneity to a more coherent heterogeneity. There is and can only be one evolution, as all the different existences are component parts of the same cosmos. Why should mankind be different, why should he follow different laws from all other living organisms? That is the question that every social scientist must ask himself. Furthermore, towards what form is Man evolving? For Peel the ultimate man is seen as one whose private requirements coincide with the public ones (*op. cit.*: 26). Considered over a large time interval, we find that Man's character is growing more civilized, less violent, shaping into what we might call "social man". The further we come away from violence, the more successfull we seem to evolve. This development in our character can be seen for instance in styles of leadership over recent centuries – a shift from the boss to the leader, who gives fewer orders and instead aims to be a role model through his actions; from the military commander type associated with the early days of industrialization to the team player of today. This is also reflected in the terms "social intelligence" and "emotional intelligence", which have become a focus today. We also

speak of "people skills", but seem to mean the same thing. True, others say that Man is becoming ever more selfish, a result of his striving for ever more independence. But that may represent more a backlash than an actual long-term trend. The evolution of our character can rather be plotted as a rising curve, so far as present data indicate at least.

Taking human actions as a starting point for the human sciences, instead of theories or ideas, has given us some of the most useful techniques or methods available in the social sciences today, including game theory and rational choice theory. But these contributions are not necessarily marginalist or even neoclassical. We shall rather argue that game theory relates more closely to informal and formal logic than to mathematics. In fact it is really a non-marginalist approach, with no fixed number of variables to be optimized. And yet arguably game theory, invented by the German economist Oscar Morgenstern and the Hungarian-born mathematician John von Neumann, is one of the better analytical tools available to describe and analyse social dynamic realities. It is also interdisciplinary, meaning that it is equally applicable in any of the social sciences, and in the humanities.

So long as scarcity is a major problem, the economic forces that constrain us will be very real. On the island of Utopia there is no need for the discipline of economics, because everything that people need is available in plenty, and people do not ask for more than they need. In Thomas More's book the character Peter Giles believes that:

Till property is taken away there can be no equitable or just distribution of things, nor can the world be happily governed: for as long as that is maintained, the greatest and the far best part of mankind will still be oppressed with a load of cares and anxieties.

More draws this conclusion from his experience of early sixteenth-century England, ruled by Henry VIII, where "all things will fall to the share of the worst men" and where "all things are divided among the few". From a national perspective this situation improved dramatically with industrialization, which allowed a large proportion of the poor to rise into the middle class, like in today's China. From an international perspective the problem is more complicated, since what we have been doing is largely exporting low-wage jobs to other, less developed countries: as the saying goes, out of sight out of mind. The possibility of continual improvement in standards of living is limited, since it is those who already have money who have the best chance of making more. That is a consequence of the efficiency of financial markets, which has brought us to a point where the free-market system is once again being criticized as unfair because it is to the advantage of those who are already ahead. The result of these mechanisms in the Western world has been a poorer middle class.

More's Utopia is a land where leisure is to be used for reading books, playing chess, and engaging in gardening. But the problem of who will do the work if everyone lives a life of ease is solved by slavery; as More says, "All the uneasy and sordid services about the halls are performed by their slaves...". In modern times the work these slaves contribute with can be compared to our taxes. To take a current example, a universal or citizen's salary to replace unemployment benefits is mere relabeling and will not change the problem as to where the wealth will come from in a world free of slaves.

Man is always a child of his time, and the social scientist can seldom ignore the values of his time. Being a successful social scientist is to a large extent a question of writing in conformity with the values of one's time. Those who do not do that are choosing to live the hard way. One economist who places in that category was Nicholas Georgescu-Roegen, Schumpeter's favourite student. Few if any have done more to advance the evolutionary approach in the study of Man.

2.8 Georgescu-Roegen : the right man at the wrong time

Bioeconomic analysis sees new technology as a set of Man's most sophisticated *exosomatic organs*. A stick picked up in the woods as a club meant a stronger arm, one of the earliest examples of an exosomatic organ. According to Georgescu-Roegen (1980: viii), Man's exosomatic evolution has brought with it three "predicaments", or unpleasant situations from which escape seems difficult. The first is conflict between various human communities or cultures. Thus *Homo indicus* is different from *Homo americanus*, in that the former travels more by foot and the latter by car. The predicament may also reflect differences in taste. The second predicament is the conflict between the two social classes of governors and governed. The third predicament is ranges of technically-sophisticated equipment, such as PCs, the Internet, and mobile phones today.

This equipment is continually changing, and creating problems about haves and have-nots. We see this today in the area of e-commerce, where certain countries including Japan, South Korea, the USA, and Sweden are ahead of the field and the companies are becoming bigger and fewer.

Georgescu-Roegen's bioeconomics builds on one major principle: mankind must not discount the future. By this he means that the price of a resource should be determined by all potential buyers, including those who are not yet born. "And since future generations cannot be present now, we should bid in their place" (*op. cit.*: xii). This problem is highly relevant today, since past generations have raised their standard of living by imposing debt burdens on future generations. Thus, we may say that our current degradation of the environmental and the living conditions on the planet is in part a result of our economic theories.

Georgescu-Roegen begins from the assumption that mankind is going to be around for a long time: "the dinosaurs lasted hundred and twenty millions years"[14]. If this assumption is correct, or so long as we do not know how long mankind will exist, we should manage our natural resources with care. Marginalist economic theory typically models economic problems as if each generation were the last. When economies are put under heavy strain, the chances of war will increase. Georgescu-Roegen (*op. cit.*: xi) reminds us that "all major wars have had no main objectives other than the possession or the control of natural resources". We have seen recent proofs of this whether it is in the form of America's war on Iraq (geopolitical logic) or with Chinese investments in Africa (geoeconomic logic). The difficulty with the discounting problem is that we have no way of knowing what resources future generations will need and how long they should be discounted for and, we could add, at what rate. To help resolve this question the aim of Georgescu-Roegen is:

a world organization whose role be to decide the acceptable rhythm of depletion of mineral resources and their distribution among all nations according to a rough criterion of hierarchical needs. (*op. cit.*: xii)

This is the idea of the World State, a project which will become relevant in the 22nd century at the earliest. It is in turn largely a question of human political and social evolution.

Georgescu-Roegen follows Schumpeter's idea that the evolutionary approach is not an economic "theory" in the marginalist sense of the word, but must be more of an "analysis". His first book (Georgescu-Roegen 1966), in which he outlines his thoughts on evolutionary economics, is entitled *Analytical Economics*:

> … theoretical science is logically ordered knowledge. A mere catalogue of facts, as we say now a day, is no more science than the materials in a lumber yard are a house. (p. 15)

And:

> ... if the cornerstone of science is the dogma that all phenomena are governed by mechanical laws, science has to admit that life reversal is feasible. (p. 83)

Instead Georgescu-Roegen suggests that economic analysis should follow the formula set by Cuvier: *nommer, classer, décrire* (name, classify, describe) – what is called a taxonomic process, or filing system. This same search for a universal principle of classification once led to the birth of formal logic. Theoretical science is a logically ordered description. Marginalist economic theory is an attempt to show that mathematics can be the logic for the study of economic phenomena. But, whereas the purpose of economics is to understand economic facts, the purpose of pure science is not prediction, but knowledge for its own sake (Georgescu-Roegen 1971: 37). This is the excuse science gives for not always producing realistic findings. Georgescu-Roegen rejects all accurate predictions in the social sciences: "No analytical device can allow you to describe the course of your future actions" (*op. cit.*: 335). He instead agrees with the Hegelian approach we find in Schumpeter: "If economics is to be a science not only of 'observable' quantities, but also of man, it must rely extensively on dialectical reasoning" (*op. cit.*: 337). Dialectical reasoning cannot be exact, but can be largely correct. It implies that we attempt to express ourselves in numbers, weights, or some other measure. "Hence careful reasoning and analysis should be the backbone of economics", as Marshall suggested" (*ibid.*). Dialectical reasoning opened the way of literary economics, where both sides of each argument

[14] G-R wrote this some years ago, 165-185 million years is probably a closer number today

are weighed up. That is also very much the tradition of critical theory applied in geoeconomics.

In his next major book Georgescu-Roegen discussed the law of entropy, based on ideas of the German physicist Rudolf Clausius, who held that change undergone by matter and energy must be qualitative change (197: 1). Georgescu-Roegen argued that an economy is a biological process governed by the law of entropy, not by the laws of mechanics. The book is a critique o*f Homo economicus*, in which Georgescu-Roegen takes up the objection that economics as a science strips Man's behaviour of every cultural propensity, which is to say that Man is treated as acting mechanically (*ibid*.). Georgescu-Roegen's thermodynamic approach to economics is based on Carnot's work on entropy from 1865 and Boltzmann's from the 1870s:

A cultural propensity may be a factor in economic growth, as when cultural activities in countries such as France, Spain, or Italy encourage the growth of tourism. It might have been similar observations that led Spengler to the thesis that economic growth depends upon the degree of compatibility between the economic components of the respective culture (*op. cit*.: 362).

> Evolution appears so mysterious to us only because man is denied the power of observing other planets being born, evolving, and dying away. And it is because of this denial that no social scientist can possibly predict through what kinds of social organizations mankind will pass in its future. (*op. cit*.: 15)

> Had economics recognized the entropic nature of the economic process, it might have been able to warn its co-workers – the technological sciences – that "bigger and better" washing machines, automobiles, and super jets must lead to "bigger and better" pollution. (*op. cit*.: 19)

Economic theorists like Robert Solow, Joseph Stiglitz, and Paul Samuelson have praised Georgescu-Roegen's mathematical contribution, but none of them have shown any interest in his ideas on evolutionary economics and bioeconomics. None could have failed to notice that Georgescu-Roegen was Schumpeter's favourite student at the Harvard Graduate Seminar. So it was impossible to ignore him; but his thoughts deviated too much from existing theory.

Herman Daly (1999) has asked how long neoclassical economists can go on ignoring Georgescu-Roegen's contributions. For instance, what will future generations say about the fact that we are systematically denuding the planet of oil and gas, resources which may be needed for more important tasks in the future when alternatives are not available? Faced with the threat of global warming, environmental deterioration, and now the financial crisis, Georgescu-Roegen's economics are long overdue for a review.

Solow and the marginalists assume that natural resources can always be substituted. His well-known work in growth theory is based on an aggregate production function in which resources do not appear at all: it takes production to be a function solely of capital and labour (Daly 1999: 15). This is like expressing improved cuisine as a function of a cook and a kitchen, forgetting the ingredients. The Solow–Stiglitz variant of the Cobb–Douglas function including resources is expressed as:

$$Q = K^{a1} R^{a2} L^{a3}$$

– where Q is output, K is stock of capital, R is the flow of natural resources used in production, L is the labour supply, $a1+a2+a3=1$, and $a>0$. In reality, increase in capital implies depletion of resources; and if $K \rightarrow \infty$, then R will rapidly be exhausted by the production of capital (Daly 1999: 17). Georgescu-Roegen calls this a "conjuring trick". Land and resources have been eliminated, on the argument that capital is a near-perfect substitute. If so, then resources could equally be substituted for capital (reverse substitution). To do that would run counter to the whole direction of neoclassical theory, which is to deny any important role to Nature (*op. cit*.: 18).

None of Georgescu-Roegen's ideas on the biophysical foundations of economics were ever canonized by inclusion in Samuelson's famous textbook. There has been no interest in Georgescu-Roegen's ideas at MIT, the American Economic Association paid little attention to his death, and hardly a trace of his influence is left in the economics department of Vanderbilt University, where he taught for twenty years (*op. cit*.: 13). One reason may be that few economists understood his ideas with their emphasis on advanced mathematics,

physics, and biology[15]. He may also have been too interdisciplinary for his own time. A further reason may be that he is said not to have been easy to work with. A deeper explanation would be that if one accepted Georgescu-Roegen's ideas, the consequence would be a complete paradigm shift in economics. The political and economic implications of accepting his theories would amount to nothing less than a revolution in the way we organize our lives, and it is perhaps one we are not yet ready to undertake.

Georgescu-Roegen's own explanation of why his ideas were never accepted was in terms of a Romanian proverb: "In the house of the condemned one must not mention the executioner". After arguing his case for decades without ever getting much response, Georgescu-Roegen gave up on standard economics and resigned from the American Economic Association (*op. cit.*: 15). In his own words "I was a darling of the mathematical economists as long as I kept contributing pieces on mathematical economics" (Georgescu-Roegen 1992: 156).

Schumpeter too had come to the United States as a two-edged sword, like Georgescu-Roegen later. Influenced by Léon Walras and W.S. Jevons, economics departments in the USA, especially after the Second World War, decided to base development of their discipline on the mechanical perspective. To many critics this system quickly came to look more like a church than a community of independent thinkers. However, despite enthusiastic espousal of the mechanical approach in the USA, one American economist was never willing to abandon Georgescu-Roegen's ideas: namely, Kenneth Boulding, a strong independent thinker among American economists.

2.9 Parallels between Boulding and Luhmann: cybernetics and scial systems

In his 1968 book *Beyond Economics*, Boulding identifies some of the methodological limitations of economic theory:

(i) the *ceteris paribus* assumption, associated with Marshall, involves isolating a problem by assuming that all other variables are held constant. The problem with this assumption, Boulding argued, is that it leads to results that are true only in a very limited domain, and there is a danger of over generalization.

(ii) the method of simultaneous equations, associated with Walras and the Lausanne School, based on the proposition that any system of variables, each of which can be written as a function of all the others, yields *n* of these equations that are consistent with one another (Boulding 1968: 10). This method often gives results that are mathematically correct but economically meaningless, such as negative prices.

(iii) the study of macroeconomics, as associated with Keynes[16], consists essentially in using wage aggregates of economic variables as the basic parameter of simplified models, the exact properties of which can be fairly easily determined. The Problem lie in the generalizations within these models, such as the "level of employment", and the "price level". Furthermore, society has not become classless[17]. Economic theory assumes that all individuals have the same starting point, the same possibilities. Only then can it be fair. This ignores such factors as (family) contacts, culture, and nationality, relevant to the competition to win business contracts, and parental income, relevant to receiving a university education. It also ignores the phenomenon of contracts won through bribery, which means that much business conducted outside the Western world must be excluded from the theory. Perhaps the problem is that economics in fact remains a moral science, as in the old Cambridge Tripos, "in spite of all attempts to dehumanize the science of Man", Boulding concludes (1968: 12).

[15] This is an odd trait among many fellow economists, they argue for mathematics, by which they imply the right amount of mathematics, enough to separate them from academics studying the humanities. But, when someone with a physics background comes along, it becomes evident that they know too little mathematics, and then the physicists end up in the wrong.

[16] Macroeconomics began to emerge in the models of Irving Fisher and Knut Wicksell, but culminated in the work of John Maynard Keynes.

[17] The essence of the term "class" as used today has to do with income differences. The Marxist proletarian–bourgeois–capitalist distinction has become less relevant today, in the West at least. Instead we have other, newer class divisions, as in "new class theory".

Boulding takes as his starting point the ideas of a theory of change outlined by Schumpeter. As any pioneering scientist would necessarily do, he begins by asking what types of change occur in economics; and he concludes that there are two types: long-term and short-term. The biggest form of social change would be called a revolution. Revolution can be understood as a social reaction to a situation where there has been no hope of change for too long.

Boulding's social-dynamics perspective is inspired by Georgescu-Roegen's ideas. If economics is to be a science, it must use dialectical reasoning. But whereas Georgescu-Roegen thinks this relationship must be "extensive", Boulding holds it to be "relatively insignificant" (Boulding 1981: 20).

Boulding argues that there are two types of process at work in human history: one dialectical, involving conflict and the victory of one group over another; and one non-dialectical – incidental, cumulative, evolutionary, and continuous (Boulding 1970: v). Of these two he sees the dialectical process as merely waves and turbulence on the great historical tides of evolution and development. One of the problems with the dialectical process is that it focuses on conflict likely to lead to even greater conflict (*op. cit.*: 52). The process of biological evolution seems on the whole to be non-dialectical (*op. cit.*: 55). Boulding believes in the historical method, but whereas Boulding thinks that the future can in part be understood by studying history, Georgescu-Roegen disavows any predictions about the future (Georgescu-Roegen 1971: 335)[18]. Boulding himself acknowledges that the ability to predict is less robust than the ability to understand.

Boulding defines four processes through which we suppose that we might be able to gain knowledge of the future. These are: (i) random processes, such as throwing dice. For this method, recorded information is irrelevant. (ii) Deterministic mechanical processes, as used for instance when estimating future population figures; (iii) theological processes, in which movement through time is guided by some image or information-structure of the agents in the system at the outset; and (iv) the evolutionary process. Boulding (1970: 19) chooses to see human history largely as an extension of the evolutionary process from the biological into the social domain (an idea which goes back at least to Spencer). These methods are relevant for the discipline of intelligence studies within such areas as early warning, signal analysis, scenario analysis and just general prediction.

According to Boulding (1981: 11) the evolutionary perspective presupposes that at any one point in time and space there will be an ecosystem, and with a given set of parameters this will move to an equilibrium where the rate of growth of all populations within it will be zero. This seems to conflict with his later critique of the equilibrium approach[19]. However it is possible that Boulding, like Schumpeter before him, changed his mind. Boulding also criticized neoclassical economics for not having incorporated time and space as factors in their theories, even though obviously "all productive processes involve space and a fine vine will turn into vinegar" (Boulding 1970: 19).

"Bioevolution is characterized by constant ecological interaction, which is selection, under conditions of constant change of parameters, which is mutation" (Boulding 1981: 12). Put differently, mutation takes place in the egg, selection in the chicken (*op. cit.*: 65). The parametric changes can be physical, such as a change of climate, but the basic source of change is genetic mutation, that is change in the DNA sequence. Evolution is not a deterministic system, like celestial mechanics, because it is not an equilibrium system. It involves inherently unpredictable changes of parameters because of the long-run importance of improbable events (*op. cit.*: 69). As economic life is a subset of human activity, we should expect it to follow the general principles of evolution (*op. cit.*: 16). The principle of ecological interaction is the ultimate foundation of the evolutionary perspective (*op. cit.*: 11).

Like Georgescu-Roegen, Boulding equates human history with the evolution of artefacts. Human artefacts are of three kinds: (i) "things", material objects; (ii) organizations; and (iii) learning processes (*op. cit.*: 15). This is very much the Materialist perspective to economics. Material artefacts have developed from the flint arrowhead to the space shuttle; organizations have developed from the clan to the corporation; and people's minds have

[18] No analytical device can enable you to describe the course of your future actions.

[19] But in Tang et al. (1976) Boulding says that "equilibrium is a fiction of the human imagination and is really unknown in the real world" (p. 3).

developed alongside these. Exchange is the mechanism through which this process is carried on. Exchange, which contains an element of reciprocity, makes the parties involved better off, hence more fit for competition. Labour hours and price are two examples, or forms, of exchange. Price may be seen as the expression of the balance or equilibrium of the social system of needs. Thus the evolutionary approach to economics may be more relevant in times of great transformation, like the one mankind is facing today through the globalization process.

According to Boulding (1985: 7) it was his year at the International Christian University in Japan in 1963–4 that led him to a renewed interest in evolutionary theory, which produced *A Primer on Social Dynamics* in 1970 and *Ecodynamics* in 1978. In 1970 he also wrote a book on *Economics as a Science*, in which economics was treated as an ecological science. We see how both Schumpeter and Boulding were open and akin to Asian ideas and analysis for understanding social economic behaviour through a direct cooperation with Japanese economists.

Even before that, in *Beyond Economics* (1968), Boulding defined a general theory of growth, which said that all growth phenomena have something in common. The phenomena can be classified into: (i) simple growth, the growth or decline of a single variable or quantity by accretion or depletion; (ii) population growth, that is births and deaths; and finally (iii) structural growth, as when a butterfly emerges from a chrysalis (Boulding 1968: 64). Growth phenomena in the real world usually involve all three types (*op. cit.*: 65). In the same book Boulding defines "social systems" as whatever is not chaos (*op. cit.*: 98). The best way to reduce the complexity of human history to manageable, systematic form is to break up the social system into subsystems (*op. cit.*: 101). The same logic is applicable to the human sciences.

The idea of the social world as made up of systems is an idea he held on to. In his 1985 book *The World as a Total System* we find the same idea of the social sciences as systems: "The social system is so interconnected that any division of it is a little arbitrary, but, as we shall see, we can conveniently divide it into the economic system, the political system, the communication system, and the integrative system" (Boulding 1985: 29). The same idea is also central to the philosophy of the German sociologist Niklas Luhmann, who published his classic *Soziale Systeme* the same year. Social evolution is also a central idea for Luhmann[20]: "What evolves is simply meaningful possibilities, each possibility that is selected yielding new eligible possibilities". Only to the extent that money guides our choices does economics have strong predictive power in the social sciences, Luhmann concludes.

Boulding (1985: 31) divides the world into three kinds of system: physical, biological, and social. Social systems are an evolutionary development out of biological systems. They involve biological organisms that have the powers of communication, consciousness, and the ability to produce artefacts (*op. cit.*: 71).

One of the great differences between the socio sphere and the biosphere is the much greater importance of decisions in social systems for determining the future (*op. cit.*: 82). There are many ways of classifying social systems. Luhmann divides them into:

1. Subsystems of society:
   a) Religion
   b) Law
   etc.
2. Social systems proper:
   a) Interactive
   b) Organizational systems
3. Other systems.

Boulding, on the other hand, classifies social systems according to the nature of the relationships (1985: 83), into:

1. The threat system
2. The exchange system
3. The integrative system

The world economic system is seen as interacting closely with the political system and with organizations like the church, families, clubs, and so forth (*op. cit.*: 89).

Another biological idea which interests Boulding is Man's limited ability to understand his own environment. What we know is a function of what we can imagine. That is to say that our brain, not the external environment, controls and sets limits to what we are capable

[20] Boulding wrote about social systems in 1970. Luhmann wrote about evolution as early as 1972, and about social systems as early as 1970. Boulding makes no reference to Luhmann.

of understanding[21]. This view, that we increase our knowledge of the world by studying the brain, not only by studying external reality, may be called a neurological approach to the social sciences. "We construct images in our minds of the world or even the universe as a succession of constantly changing states through time" (Boulding 1981: 9). Boulding shows great interest in this cognitive approach to the social sciences (cf. Boulding 1985: 9; 1956). Today neuroeconomists like Antonio Rangel have made great advancements in this direction (Rangel et al., 2008).

The belief that an image is true often derives from authority, or from evidence. In some cases we resolve the ambiguity of evidence by experiment. That only applies, however, to systems which are stable, repeatable, and divisible, such as chemical systems, where, for instance, all hydrogen atoms are essentially similar. We cannot do experiments on unique events or on the past (Boulding 1981: 10).

Boulding explains (1950: viii) that "the first focus of my dissatisfaction with economics is in the theory of the firm, or the economic organism, and its immediate relationships and interactions". This leads him to a "relationship" perspective on economics. We find the same parallel between the relational perspective of marketing by Gummesson and the Nordic School and Kotler's mechanistic and marginalist perspective on marketing (see e.g. Gummesson 2002). As such this Nordic school is very much founded in the European continental intellectual tradition.

Boulding's second focus of dissatisfaction (1950: ix) was with Keynesian macroeconomics, with "the failure to distinguish between the exchange of payment and the process of production". This led him to the process perspective on economics. Both concepts belong to what we could call evolutionary economics.

We can follow the change in Boulding's perspective on economics through his books, from the more mathematical contributions he wrote while he was in Michigan, to the anything-but-mathematical writings of his Colorado years. What started as mere echoing of the *status quo* in economic thought developed into a strong, highly-differentiated contribution to the discipline of economics, turning him into a strong independent thinker, but also an outsider. Unlike many other evolutionary economists discussed here, Boulding never limited himself to any one perspective but continued to move in many different intellectual directions at once. This may have been his biggest weakness as an economist, in that he was unable to complete and present a coherent system of economic thinking.

To sum up, the academic community of evolutionary economists in America can be divided into two: on one side economists of the Midwest, inspired by the English-language economics literature, such as Veblen and Boulding, and on the other side the European diaspora, including Kiel School economists and men like Schumpeter and Georgescu-Roegen. Of the five groupings defined here, the third, fourth, and fifth can be described as evolutionary economists, while the first and second were groupings which made direct contributions to a discipline of evolutionary economics.

The purpose of this historical trajectory has been to show how the study of Geoeconomics and intelligence studies can be based on the same ideas which are often referred to as an evolutionary approach. As such the studies have a methodological foundation as a part of the study of economics too. This does not mean of course that the evolutionary approach needs to lead to the study of geoeconomics only. Geoeconomics can also be said to belong to critical theory and the normative sciences.

3. CONCLUSION

In this article we have shown why and how the scientific basis and methodology of the study of economics and management can be evolutionary theory and the evolutionary approach.

As an example, intelligence studies is a discipline and an approach to the study of business that sees information as a basic building block for the study of organizations and human behaviour. It is not unique in this sense but shares this starting point with other information sciences after the shift called the Information Age with a focus on information and knowledge, as opposed to the age of the Industrial Revolution with its focus on more narrowly defined tasks and outcomes measured as a function of man hours, capital and material. However, unlike all the other

[21] The first philosopher to set this idea out in detail was Kant, in his Critique of Pure Reason of 1781

information sciences its methodology may be defined as biology instead of physics right from the start.

The study of geoeconomics is a discipline that studies the macro environment of organizations through what we today should call a multidisciplinary approach consisting of history, geography and political science (the realpolitik assumption). The starting point is not Marshall's Descartesian systems à la supply and demand curves, but the world map, resources and cultures. Both intelligence studies and geoeconomics have more to gain as disciplines and sciences by using the evolutionary approach not only to explain their findings but to build coherent theory. So have all disciplines who study man.

As a new study all researchers have not agreed upon clear definitions of geoeconomics yet (Mattlin and Wigell, 2016) and there is a need for analytical methods as suggested by Wigell (2016). It suffices to look at the reference list to see that geoeconomics is new ground. The average article on the topic came out in 2011. The median publication date is 2012. The oldest publication is from 1991 and could be defined as an outlier. The number of researchers with profiles on Google Scholar who say they focus on geoeconomics are less than a dozen, but then many scholars in this field will typically steer clear of the publication haze that indexes promotes. Of course the numbers for geopolitics are much higher.

At the beginning of the 21st century it was clear that neoclassic theory as developed after the Second World War had mostly been a flawed project, now even admitted at their own conferences and declared by conservative media like The Economist. The neoclassic or marginalist paradigm is not able to predict economic behavior and its explanations of current events are too simplistic and narrow to be of much use outside of its journals, even though the committee for the Nobel Prize in economics ("in memory of Alfred Nobel"), which is still the final guarantor of the neoclassic paradigm, do their utmost to convince the public of the opposite. Instead other schools have done better in the meantime, like institutional economics. Keynesianism and Marxism have also seen a revival in past decades and are clearly more relevant directions within the study of economics.

The evolutionary approach was left for the wrong reasons, not because the science itself was flawed, but because of the way it was used, applied, first of all by German national socialists and fascists to dominate other people and countries. This is much like leaving the science of nuclear physics because of what happened in Hiroshima and Nagasaki. It's understandable, but irrational. Besides, the new American superpower needed a new paradigm, its own (the theories were invented on the European continent, but the new science developed on the American continent). Those who deviated from this new paradigm were marginalized in the post-war academic world.

A good example is Peter Drucker who was successful outside of academia among CEOs and corporations. He was more relevant than all the neoclassic scholars put together. Other scholars, who had completely different opinions about economics but could do the necessary math needed in neoclassic economics (econometrics, advanced statistics and calculus), like Georgescu-Roegen, were embraced, at least for a while, but isolated as soon as he openly objected to the paradigm. Other scholars who started out supporting the neoclassic paradigm, like Schumpeter, saw its scientific flaws and deviated from it in later life. Schumpeter went back to evolutionary theory at the end of his "Economic Analysis", published by his wife after his death.

Critical theorists can argue that the neoclassic paradigm has basically served to preserve the power of a certain American and Anglo-Saxon dominated elite. Thus the decline of the neoclassic paradigm coincides with the decline of the American superpower. The fact that it's not scientific arguments that alter scientific paradigms, but geopolitical shifts is itself a confirmation of the relevance of evolutionary theory for the study of man.

4. REFERENCES

Alexander V., K. (2011). Globalization Effects within New Geoeconomic Paradigm. *Evropejskij Issledovatel', Vol 14, Iss 11, Pp 1506-1510 (2011)*, (11), 1506.

Alexander V., K. (2011). Globalization Effects within New Geoeconomic Paradigm. *Evropejskij Issledovatel', Vol 14, Iss 11, Pp 1506-1510 (2011)*, (11), 1506. (In Russian)

Anokhin, A., & Lachininskii, S. (2015). Evolution of the ideas and contents of geoeconomic studies. *Regional Research Of Russia*, *5*(1), 90-95.

Bárdos-Féltoronyi, Nicolas (2002). *Géoéconomie*. Amsterdam: De Boeck

Barton, J. (1999). 'Flags of Convenience': Geoeconomics and regulatory minimisation. *Tijdschrift Voor Economische En Sociale Geografie*, *90*(2), 142-155.

Boulding, K.E. (1950). *A Reconstruction of Economics*. New York: Wiley

Boulding, K.E. (1956). *The Image*. Ann Arbor, Mich.: University of Michigan Press

Boulding, K.E. (1968). *Beyond Economics*. Ann Arbor, Mich.: University of Michigan Press

Boulding, K.E. (1970). *A Primer on Social Dynamics*. New York: Free Press

Boulding, K.E. (1981). *Evolutionary Economics*. Beverly Hills, Calif.: Sage Publications

Boulding, K.E. (1985). *The World as a Total System*. Beverly Hills, Calif.: Sage Publications

Bücher, Karl (1901). *Die Entstehung der Volkswirtschaft*. Tübingen: Verlag der H. Laupp'schen Buchhandlung

Buffon, G.L.L. (1749). *Histoire naturelle*. Reprinted Paris: Gallimard, 1984

Cairnes, J.E. (1875). *The Character and Logical Method of Political Economy*. London: Macmillan

Carlomagno, Marcos Cantera (1997–8). Geopolitikens återkomst. In *Yearbook of the New Society of Letters at Lund*

Chaliand, Gérard and Jean-Pierre Rageau (1983). *Atlas stratégique – géopolitique des rapports de force dans le monde*. Paris: Fayard

Chauprade, Aymeric, ed. (2005). *Géopolitique des États-Unis*. Paris: Ellipses

Ciuriak, D. (2004). The Laws of Geoeconomic Gravity Fulfilled? China's Move toward Center Stage. *Asian Affairs: An American Review*, *31*(1), 3-28.

Clark, Robert M. (1975). Scientific and technical intelligence analysis. *Studies in Intelligence* 19.39–48

Clark, Robert M. (2004). *Intelligence Analysis*. Washington, DC: CQ Press

von Clausewitz, Carl (1832). *On War*. English translation, London: Trübner, 1873.

Colleto, Thomas, ed. (1988). *Syria: a country study*. Baton Rouge, La.: Claitor's Publishing Division

Couloumbis, T. A. (2003). Toward a Global Geopolitical and Geoeconomic Concert of Powers?. *Journal Of Southeast European & Black Sea Studies*, *3*(3), 17-27.

Conway, McKinley (1994). *Geoeconomics – the new science*. Norcross, Ga.: Conway Data Inc.

Coulomb, Fanny (2003). Pour une nouvelle conceptualisation de la guerre économique. In Daguzan and Lorot (2003)

Courrier International (2005). *L'Atlas des atlas,* March–May 2005. Paris: Arthaud

Cowen, D.)., & Smith, N.). (2009). After geopolitics? From the geopolitical social to geoeconomics. *Antipode*, *41*(1), 22-48. doi:10.1111/j.1467-8330.2008.00654.x

Cuvier, G. (1812). *Recherches sur les ossemens fossiles de quadrupèdes, où l'on rétablit les caractères de plusieurs espèces d'animaux que les révolutions du globe paroissent avoir détruites* (4 vols). Paris

Daguzan, Jean-François, and Pascal Lorot, eds (2003). *Guerre et économie*. Paris: Ellipses

Daly, H.E. (1999). How long can neoclassical economists ignore the contributions of Georgescu-Roegen? In K. Mayumi and J.M. Gowdy, eds, *Bioeconomics and Sustainability*. Cheltenham: Edward Elgar

Dalby S (1991) Critical geopolitics: Difference, discourse, and dissent. *Society and Space* 9:261–283

Darwin, Charles (1859). *The Origin of Species*. London: John Murray

De Castro, Renato Cruz (2000). Whither geoeconomics? Bureaucratic inertia in U.S. post-Cold War foreign policy toward East Asia. *Asian Affairs* 26.201–21

Dorling, D., M. Newman, and A. Barford (2008). *The Atlas of the Real World*. London: Thames & Hudson

Dougine [Dugin], A. (1997). *Principe de géopolitique*. Paris: L'Age d'Homme.

Doyle, Rodger (2004). Energy geopolitics. *Scientific American*, Oct 2004

Drucker, Peter (1985). *Innovation and Entrepreneurship: practice and principles*. New York: Harper & Row

Drucker, Peter (1998). The future that has already happened. *The Futurist*, November 1998, pp. 16–18

Du Castel, Viviane (2001). *La Géoéconomie et les organisations internationales*. Paris: L'Harmattan

Engdahl, William F. (2007). *Seeds of Destruction*. Montreal: Global Research

Fouskas, Vassilis K. (2003). *Zones of Conflict*. London: Pluto Press

Frobenius, Leo (1933). *Kulturgeschichte Afrikas*. Zürich: Phaidon

Gardiner, Sam (2003). Truth from these podia: summary of a study of strategic influence, perception management, strategic information warfare and strategic psychological operations in Gulf II. www.usnews.com/usnews/politics/whispers/documents/truth.pdf <accessed 2012.2.19>

de Gaulle, Charles (1944). *Le Fil de l'épée*. Paris: Berger–Levrault

Georgescu-Roegen, N. (1966). *Analytical Economics*. Cambridge, Mass.: Harvard University Press

Georgescu-Roegen, N. (1971). *The Entropy Law and the Economic Process*. Cambridge, Mass.: Harvard University Press

Georgescu-Roegen, N. (1980). Foreword to R.K. Pachauri, ed., *International Energy Studies*. New Delhi: Wiley Eastern

Glassner, M. I. (1996). *Political Geography*. New York: Wiley

Gummesson, E. (2002). *Total Relationship Marketing*, 2nd edn. Oxford: Butterworth-Heinemann

Hanusch, Horst and Andreas Pyka, eds (2007). *Elgar Companion to Neo-Schumpeterian Economics*. Cheltenham: Edward Elgar

Harriman, Ed (2005). So, Mr. Bremer, where did all the money go? *The Guardian* (London), 7 Jul 2005

Haushofer, Karl (1924). *Geopolitik des Pazifischen Ocean*. Berlin-Grunewald: Kurt Vowinckel

Hegel, Georg Wilhelm Friedrich (1820). *Grundlinien der Philosophie des Rechts*. Leipzig: Felix Meiner

Heisbourg, François (2001). *Hyperterrorisme: la nouvelle guerre*. Paris: Odile Jacob

Henning, R. (1931). *Geopolitik: die Lehre vom Staat als Lebenswesen*. Leipzig und Berlin: B.G. Teubner. (First published 1928.)

Henry, S. G. B. (1969). *Elementary Mathematical Economics*. London: Routledge & Kegan Paul

Herring, Jan P. (1999). Key intelligence topics: a process to identify and define intelligence needs. *Competitive Intelligence Review* 10.4–14

Hodgson, G.M. (2007). Evolutionary and institutional economics as the new mainstream? *Evolutionary and Institutional Economics Review* 4.7–25

Hodgson, G.M., W.J.Samuels, and M.R. Tool, eds (1994). *The Elgar Companion to Institutional and Evolutionary Economics*. Edward Elgar: Aldershot

Holslag, J. (2016). Geoeconomics in a globalized world: the case of China's export policy. *Asia Europe Journal*, *14*(2), 173-184.

Huotari, M., & Heep, S. (2016). Learning geoeconomics: China's experimental financial and monetary initiatives. *Asia Europe Journal*, *14*(2), 153-171.

Houweling, Henk and Parvizi Amineh (2003). Introduction: the crisis in IR-theory: towards a critical geopolitics approach. *Perspectives on Global Development and Technology* 2.315–35

Hsiung, J. (2009). The age of geoeconomics, China's global role, and prospects of cross-strait integration. *Journal Of Chinese Political Science*, *14*(2), 113-133. doi:10.1007/s11366-009-9045-y

Hudson, V., Ford, R., Pack, D., & Giordano, E. (1991). Why the Third World Matters, Why Europe Probably Won't: The Geoeconomics of Circumscribed Engagement. *Journal Of Strategic Studies*, *14*(3), 255-298.

Jenster, Per and Klaus Solberg Søilen (2009). *Market Intelligence*. Copenhagen: Copenhagen Business School Press

Johnson, L.K. and J.J. Wirtz, eds (2008). *Intelligence and National Security*. New York: Oxford University Press

Kaminsky, Catherine (2004). *La Géopolitique et ses enjeux*. Paris: Les Essentiels Milan

Kaplan, R. (2009). The revenge of geography. *Foreign Policy*, May/June.

Kärkkäinen, A. (2016). Does China have a geoeconomic strategy towards Zimbabwe? The case of the Zimbabwean natural resource sector. *Asia Europe Journal*, *14*(2), 185-202. doi:10.1007/s10308-015-0445-7

Kent, Sherman (1949). *Strategic Intelligence for American World Policy*. Princeton, N.J.: Princeton University Press

Khurana, G. S. (2014). China's Maritime-strategic Presence in IOR: Geopolitical, Geoeconomic and Security Import. *Maritime Affairs: Journal Of The National Maritime Foundation Of India*, *10*(2), 1-15. doi:10.1080/09733159.2014.969549

Kissinger, Henry (1994). *Diplomacy*. London: Simon & Schuster

Kjellén, Rudolf (1914). *Politiska Essayer*. Stockholm: Hugo Geber

Klare, Michael T. (2001). *Resource Wars: the new landscape of global conflict*. New York: Metropolitan Books

Klare, Michael T. (2003). The new geopolitics. *Monthly Review*, July–August 2003

Knorr, Klaus (1964). Foreign intelligence and the social sciences. Research paper 17, Center of International Studies, Princeton University

Kropotkin, Petr A. (1902). *Mutual Aid: a factor of evolution*. Reprinted Boston, Mass.: Porter Sargent, n.d.

Kurzweil, Ray (2005). *The Singularity is Near*. New York: Viking

Labroussse, Alain (2004). *Géopolitique des drogues*. Paris: PUF

Lachininskii, S. (2012). Current trends in geoeconomic studies in Russia. *Regional Research Of Russia*, *2*(1), 80-86.

Lamarck, J.-B. (1809). *Philosophie zoologique*. Reprinted Paris: Flammarion, 1994

Lamprecht, Karl (1900). *Die kulturhistorische Methode*. Berlin

Lemke, Hans, ed. (2001). *Die Reisen des Venezianers Marco Polo im 13. Jahrhundert*. Cologne: Parkland

Lorot, Pascal (1999). *Introduction à la géoéconomie*. Paris: Economica

Lu Xun (1919). Knowledge is a crime. The Chinese University Press

Luhmann, N. (1985). *Soziale Systeme: Grundriss einer allgemeinen Theorie*. Frankfurt am Main: Suhrkamp

Luttwak, Edward (1993). *The Endangered American Dream: how to stop the United States from becoming a Third-World country and how to win the geo-economic struggle for industrial supremacy*. New York: Simon & Schuster

Mattlin, M., & Wigell, M. (2016). Geoeconomics in the context of restive regional powers. *Asia Europe Journal*, *14*(2), 125-134.

McChesney, Robert W. (2004). *The Problem of the Media: U.S. communication politics in the twenty-first century*. New York: Monthly Review Press

McDermott, John J., ed. (1973). *The Philosophy of John Dewey*. Chicago and London: the University of Chicago Press.

Machiavelli, Niccolò (1532). *The Prince*.

Magnus, Olaus (1982). *Olaus Magnus Historia om de Nordiska Folken*. Hedemora, Sweden: Gidlund

Mann, James (2004). *Rise of the Vulcans*. New York: Viking

Marshall, A. (1890) *Principles of Economics: an introductory volume*. London: Macmillan

Maull, Otto (1936). *Das Wesen der Geopolitik*. Berlin and Leipzig: Taubner

Mercille, J. (2008). The radical geopolitics of US foreign policy: Geopolitical and geoeconomic logics of power. *Political Geography*, *27*570-586. doi:10.1016/j.polgeo.2008.06.00

Minc, Alain (1987). *La Machine égalitaire*. Paris: Grasset

Minc, Alain (1993). *Le Nouveau moyen âge*. Paris: Gallimard

Möller, Jörgen Östrom (2008). *European Integration: sharing of experience*. Singapore: Institute of Southeast Asian Studies

Moisio, S., & Paasi, A. (2013). From Geopolitical to Geoeconomic? The Changing Political Rationalities of State Space. *Geopolitics*, *18*(2), 267-283. doi:10.1080/14650045.2012.723287

Morrissey, J. (2015). Geoeconomics in the Long War. *Antipode*, doi:10.1111/anti.12183

Motturi, Aleksander (2007). *Etnotism*. Göteborg: Clandestinobiblioteket

Mudry, Thierry (2005). *Guerre de religions dans les Balkans*. Paris: Ellipses

Muir, R. (1997). *Political Geography: a new introduction*. Basingstoke: Macmillan

Mujanović, Erol (2005). La Bosnie-Herzégovine et la présence française. Infoguerre.com (accessed 2005.12.04)

Murphy, Alexander B. and Corey M. Johnson (2004). German geopolitics in transition. *Eurasian Geography and Economics* 45.1–17

National Counterintelligence Executive (2001). *Annual Report to Congress on Foreign Economic Collection and Industrial Espionage*.

Nelson, R.R. and S.G. Winter (1982). *An Evolutionary Theory of Economic Change*. Cambridge, Mass.: Harvard University Press

von Neumann, J. and O. Morgenstern (1944). *Theory of Games and Economic Behavior*. Princeton, N.J.: Princeton University Press

Ó Thuathail, G. (1996). Critical Geopolitics: the politics of writing global space. Minneapolis: University of Minnesota Press

Oakeley, H. D. (1923). History & Progress: And Other Essays and Addresses. Allen & Unwin

Ohmae, Kenichi (1995). *End of the Nation State: the rise of regional economies*. London: HarperCollins

Ortega y Gasset, José (1930). *The Revolt of the Masses*. English translation: New York, W.W. Norton, 1932

Ortega y Gasset, José (1946). *Concord and Liberty*. New York: W.W. Norton

Ostwald, Wilhelm (1909). *Energetische Grundlagen der Kulturwissenschaft*. Leipzig: Klinkhart

Pepper, John E. (1999). Competitive intelligence at Procter & Gamble. *Competitive Intelligence Review* 10.4–9

Perkins, John (2004). *Confessions of an Economic Hit Man*. San Francisco: Berrett-Koehler

Perroux, F. (1960). *Économie et société*. Paris: PUF

Perroux, F. (1983). *A New Concept of Development*. Paris: Unesco

Pichot-Duclos, Jean and Christian Harbulot (1995). Le faux débat sur la guerre économique. *Revue Défense Nationale* no. 5, May 1995.

Pierre, Erik (2005). *Irak – 25 Hemligheter*. Malmö: Sekel Bokförlag

Pinochet Ugarte, A. (1968). *Geopolítica: diferentes etapas para el estudio geopolíticos de los estados*. Santiago de Chile: Andrés Bello

Platt, Washington (1961). *National Character in Action: intelligence factors in foreign relations*. New Brunswick, N.J.: Rutgers University Press

Pollard, J., & Sidaway, J.. (2002). Nostalgia for the future:1 the geoeconomics and geopolitics of the Euro. *Transactions Of The Institute Of British Geographers*, *27*(4), 518-521.

Porter, Michael (1980). *Competitive Strategy : techniques for analyzing industries and competitors*. New York, NY: Free Press

Porter, Michael (1990). *The Competitive Advantage of Nations*. New York: Free Press

Preto, Paolo (1999). *Servici segreti di Venezia*. Milano: Il Saggiatore

Rangel, A., Camerer, C., & Montague, P. R. (2008). A framework for studying the neurobiology of value-based decision making. *Nature Reviews Neuroscience*, *9*(7), 545-556.

Ratzel, Friedrich (1885). *Völkerkunde*. Leipzig and Vienna: Bibliographisches Institut

Rauschning, Hermann (1939). *Hitler Speaks*. London: Thornton Butterworth

Renner, George T. (1953). *World Economic Geography: an introduction to geonomics*. New York: Thomas Y. Crowell

Revel, Jean-François (1992). *Le Regain démocratique*. Paris: Fayard

Rey, Alain (1992). *Dictionnaire historique de la langue française*. Paris: Dicrobert.

Ricks, David A. (2006). *Blunders in International Business*. Malden, Mass.: Blackwell

Riding, Alan (1984). *Distant Neighbors: a portrait of the Mexicans*. New York: Vintage

Risen, James (2001). In hindsight, CIA sees flaws that hindered efforts on terror. *New York Times*, 7 Oct 2001

Romer, J.C. (1999). *Géopolitique de la Russie*. Paris: Economica

Roscher, Wilhelm (1854). *System der Volkswirthschaft* (5 vols). Stuttgart: Cotta'scher Verlag

Ross, J.M. and M.M. McLaughlin, eds (1981). The Portable Renaissance Reader. New York: Penguin Books

Rozov, N. S. (2012). Geopolitics, Geoeconomics, and Geoculture. *Russian Social Science Review*, *53*(6), 4-26.

Russell, Bertrand (1903). *The Principles of Mathematics*. London: Routledge

Scekic, R., Draskovic, M., & Delibasic, M. (2016). Neoliberalism in geoeconomics: The case of Southeast Europe. *Journal Of International Studies*, *9*(1), 66-75.

Schlevogt, Kai-Alexander (2001). Institutional and organizational factors affecting effectiveness: geoeconomic comparison between Shanghai and Beijing. *Asia Pacific Journal of Management* 18.519–51

Schmitt, Carl (1950). *Der Nomos der Erde im Völkerrecht des Jus Publicum Europaeum*. Köln: Greven

Schumpeter, J.A, Takata, Y. (1998). *Power or Pure Economics*. London: Macmillian Press Ltd.

Schumpeter, J.A. (1952). *Ten Great Economists*. London: Allen & Unwin

Schumpeter, J.A. (1954). *History of Economic Analysis*. New York: Oxford University Press

Schumpeter, J.A. and Y. Takata (1998). *Power or Pure Economics*. London: Macmillan

Short, J. R. (1993). *An Introduction to Political Geography*. London: Routledge

Sidaway, J. D. (2005). Asia–Europe–United States: the geoeconomics of uncertainty. *Area*, *37*(4), 373-377.

Sigurdsson, Jon and Yael Tågerud, eds (1992). *The Intelligent Corporation: the privatization of intelligence*. London: Taylor Graham

Skjervheim, Hans (1996). *Deltakar og Tilskodar*. Oslo: Aschehoug

Smith, Adam (1776). *The Wealth of Nations*.

Smith, Dan (2003). *Atlas des guerres et des conflits dans le monde: peuples, puissances militaires, espoirs de paix*. Paris: Édition Autrement

Smith, Laurence (2011). *The New North: the world in 2050*. London: Profile

Smith, Woodruff D. (1991). *Politics and the Sciences of Culture in Germany, 1840–1920*. New York: Oxford University Press

Spencer, H. (1966). *The works of Herbert Spencer*. Osnabrück: Otto Zellner

Söilen, K. S. (2016). What role does technology play for intelligence studies at the start of the 21st century?. *Journal of Intelligence Studies in Business*, *6*(3).

Søilen, K. S. (2012). *Geoeconomics*. Bookboon.

Solberg Søilen, K. (2012 B). Chengdu-Chongqing as a major battlefield of global industrial competition in the first half of the 21st century–A Geoeconomic analysis. In *VSST'2012 Conference–Veille Stratégique Scientifique et Technologique, Ajaccio, Corsica, May 24-25, 2012*.

Søilen, K. S. (2010). The shift from Geopolitics to geoeconomics and the failure of our modern Social Sciences. In *TELOS Conference-From Lifeworld to Biopolitics: Empire in the Age of Obama*. The Telos Institute.

Søilen, Klaus S. (2004). Wirtschaftsspionage in Verhandlungen aus Informationsökonomischer Perspektive – Eine Interdisziplinäre Analyse. Dissertation, Wirtschaftswissenshaftlichen Fakultät Universität Leipzig

Solomon, Richard H. (1992). America and Asian security in an era of geoeconomics. *Dispatch* 3.410

Sparke, M. (2007). Geopolitical fears, geoeconomic hopes, and the responsibilities of geography. *Annals Of The Association Of American Geographers*, *97*(2), 338-349.

Spykman, Nicholas John (1942). *America's Strategy in World Politics: the United States and the balance of power*. New York: Harcourt, Brace

Starlitz, Ekkehart (1935). *Die Welt-Ostbewegung in der deutschen Geschichte*. Breslau: Ferdinand Hirt

Stiglitz, Joseph (2002). *Globalization and its Discontents*. New York: W.W. Norton

Stiglitz, Joseph (2006). *Making Globalization Work*. London: Penguin

Stockwell, John (1978). *In Search of Enemies: a CIA story*. London: André Deutsch

Strauss, Leo (1996). *Gesammelte Schriften*. Stuttgart and Weimar: Metzler

Sykes, Charles J. (1988). *ProfScam: professors and the demise of higher education*. New York: St Martin's Press

Szabo, S. F. (2014). *Germany, Russia, and the rise of geo-economics*. Bloomsbury Publishing.

Tang, A.M., F.M.Westfield, and J.A. Worley, eds (1976) *Evolution, Welfare, and Time in Economics*. New York: Lexington Books

Taylor, J. P. (1993). *Political Geography: world-economy, nation-state and locality*. London: Longman

Thual, François (2002). *Géopolitique du chiisme*. Paris: Arléa

Thual, François (2004). *Géopolitique des Caucases*. Paris: Ellipses

Tönnies, Ferdinand (1887). *Gemeinschaft und Gesellschaft*. Leipzig: Fues's Verlag

Veblen, T. (1898) Why is economics not an evolutionary science? *Quarterly Journal of Economics* 12.373–97

Veblen, T. (1899) The preconceptions of economic science. *Quarterly Journal of Economics* 13.121–50

Victor, Jean-Christophe, Virginie Raisson, and Frank Tétart. (2006). *Le Dessous des cartes*. Paris: Editions Tallandier/ARTE Editions

Vihma, A., & Turksen, U. (2015). The Geoeconomics of the South Stream Pipeline Project. *Journal of International Affairs*, *69*(1), 34-53.

von Treitschke, H. (1898). *Politik* (Vol. 2). S. Hirzel. Wallace, A.R. (1876). *The Geographical Distribution* of Animals. London: Macmillan

Wegener, A. (1915). *Die Entstehung der Kontinente und Ozeane*. Brunswick: Friedrich Vieweg

Wigell, M. (2016). Conceptualizing regional powers' geoeconomic strategies: neo-imperialism, neo-mercantilism, hegemony, and liberal institutionalism. *Asia Europe Journal*, *14*(2), 135-151.

Wigell, M., & Vihma, A. (2016). Geopolitics versus geoeconomics: The case of Russia's geostrategy and its effects on the EU. *International Affairs*, *92*(3), 605-627.

Witt, U. (2003). *The Evolving Economy: essays on the evolutionary approach to economics*. Cheltenham: Edward Elgar

Witt, U. (2006). Evolutionary concepts in economics and biology. *Journal of Evolutionary Economics* 16.473–6

Wundt, Wilhelm (1911). *Probleme der Völkerpsychologie*. Leipzig

Wundt, Wilhelm (1915). *Die Nationen und ihre Philosophie*. Leipzig

Journal of Intelligence Studies in Business
Vol. 7, No. 1 (2017) pp. 38-47
Open Access: Freely available at: https://ojs.hh.se/

Proposal of an assessment scale in competitive intelligence applied to the tourism sector

Gisela Casado Salguero[a*], Pedro Carlos Resende Jr.[b*] and Ignacio Aldeanueva Fernández[a*]

[a]*Department of Business Economy and Administration, Faculty of Economics and Business Studies, University of Malaga, Malaga, Spain*
[b]*Department of Administration, Faculty of Economics, Administration, Accounting and Information Science, University of Brasilia, Brasilia, Brazil*

**Corresponding authors: gcasado@uma.es, pcrj73@gmail.com* and *ialdeanuevaf@uma.es*

Received 27 January 2017; accepted 20 February 2017

ABSTRACT Companies operate in uncertain environments, where decision-making is a complex task. Thus, one of the key elements to take into account in the aforementioned decision-making is the environment in which the business operates. This is where competitive intelligence (CI) makes sense, understood as the process of establishing the environmental information needs, information acquisition and its analysis, transforming it into intelligence and putting it at the service of decision-makers in the company. This paper focuses on the proposal of a CI model that can be applied in the tourism sector, specifically in hotels, due to the relevance of this sector in many economies worldwide. In order to build the model a deep review of the CI literature was made and subsequently the content validation method was applied, for the purpose of identifying the most important items in the two first stages of the CI cycle: planning and collection.

KEYWORDS Competitive intelligence cycle, decision-making, hotel management, tourism

1. INTRODUCTION

Nowadays, companies develop their activity in more and more uncertain and complex everyday environments (Zhang et al., 2010). The nature of that environment makes it a difficult task for the companies to maintain a competitive advantage (Shih et al., 2010), as well as carry out decision-making. According to Jiménez-Quintero & Aldeanueva-Fernández (2016), a country's political situation, together with their way of visualizing international business, has an important impact on decision-making. Consequently, management systems are now becoming more dynamic and less predictable, i.e., more sophisticated.

In order to make decisions that guarantee the maintenance of a competitive advantage and business survival, companies not only have to take into account their internal environment, but also what has happened, is happening or could happen in their external environment. It is the latter point that competitive intelligence (CI) processes are focused on.

CI can be defined as the art of collecting, processing and storing information to be made available to people at all levels of a firm to help shape its future and protect it against current competitive threats. It should be legal and respect codes of ethics. It involves a transfer of knowledge from the environment to the organisation within established rules (Rouach & Santi, 2001). As Søilen (2015) states, the growing importance of CI in academics brings it closer to become a relevant discipline in the social sciences.

The tourism sector is a key element for socioeconomic progress, because of the enterprise and job creation that comes with it. Its growth has been practically uninterrupted and it is expected to continue with this trend

until 2030, according to the World Tourism Organization (2015).

Tourism growth is, therefore, essential to achieve GDP increments. This has been proved by extensive research undertaken in several countries: Sweden, Norwegian, Denmark and more (Lee & Chang, 2008); United Kingdom, Croatia and Spain (Pérez-Rodríguez et al., 2015); Hungary, Romania, France and Spain (Zurub et al., 2015); Brazil, Chile, Colombia, Ecuador, Peru and other Latin-American countries (Eugenio-Martín et al., 2004); Taiwan and South Korea (Chen & Chiou-Wei, 2009); China, Pakistan, Russia and India (Tiwari, 2011).

Given the importance that tourism has acquired worldwide, and its prominent role in the GDP of many economies, we decided to conduct research that linked, on the one hand, one of the key agents in tourism: hotels; and on the other hand, CI, understood as a tool for decision-making, and hence, business survival.

In this context, the main objective of this paper is to elaborate on an assessment scale of the CI process applied to the tourism sector using a content validation method. This is because, apart from the aforementioned, a literature review about CI between 2011 and 2016 has been conducted, finding a lack of CI research in tourism.

2. LITERATURE REVIEW ON COMPETITIVE INTELLIGENCE

CI is based on the environmental school of strategic management (Casado-Salguero & Jiménez-Quintero, 2016) and plays a very important role in the development and deployment of corporate strategies (Dishman & Calof, 2008). The proof of this is in the significant number of proposals present in specialised literature that incorporate CI in several countries and fields. For instance, Šperková et al. (2015) in the banking sector of Czech Republic, Bisson (2014) in public agricultural organisations in France, and Fatti & du Toit (2013) in the pharmaceutical industry in South Africa, etc.

A traditional definition of CI is the one that Porter (1980) presented in his book "*Competitive Strategy: Techniques for Analysing Industries and Competitors*", where he explains that CI includes the early recognition of threats and opportunities through gathering and analysing information related to the environment of the company to support managers in the business decision-making process.

According to Calof (2008), CI helps the company maintain and create competitive advantages by using information from the environment about clients, competitors, and technologies. Fleisher & Bensoussan (2007) define this term as the process whereby a company legally gathers and interprets the environmental information, to make it available to decision-makers. In this case Søilen (2016) shows that the internet and mobile telephones allow access to a wider range of knowledge about companies' and people's activities. Therefore, it is necessary to enable secure encryption to preserve confidential electronic information. Casado-Salguero & Jiménez-Quintero (2016) explain that CI in the organisation is the set of practises aimed at gathering information from the business environment ethically and legally, in order to transform it into intelligent information useful for strategic decision-making and, therefore, leading to business success and survival.

Table 1 Concepts under which CI has been studied, based on Dishman & Calof (2008)

Concept	***Authors***
Environmental scanning	Aguilar, 1967; Fahey & King, 1977; Fahey & Narayanan, 1982; Hambrick, 1982; Sashittal & Jassawalla, 2001; Saxby et al., 2002
Business intelligence	Cleland & King, 1975; Benjamin, 1979; Pearce, 1976
Strategic intelligence	Aaker, 1983; Montgomery & Weinberg, 1979
Competitor analysis	Ghoshal & Westney, 1991; Rothschild, 1979
Competitive technical intelligence	Albagli et al., 1996; Brockhoff, 1991
Market intelligence	Chonko et al., 1991; Maltz & Kohli, 1996
Peripheral vision	Day & Schoemaker, 2006
Competitive analytics concept	Davenport, 2006

Table 2 Empirical research on CI by industries (2011-2016)

Sector of Activity	***Authors***
Exploitation of natural resources	Rothberg & Erickson (2013); Sewdass & du Toit (2014); Ramírez et al. (2013); Guimaraes (2011); Jin & Ju (2014); Johns & Van Doren (2010)
Public sector	Sewdass (2012)
Technology-based companies	Adidam et al. (2012); Dos Reis et al. (2013); Yap et al. (2013); Ramírez et al. (2013); Mariadoss et al. (2014); De Carvalho & Janissek (2014); Sewdass & du Toit (2014); Guimaraes (2011); Samtani & Capatina (2012); Capatina et al. (2013); Nemutanzhela & Iyamu (2011); Sun & Wang (2015); Jin & Ju (2014); Opait et al. (2016); Ahearne et al. (2013); Xu et al. (2011); Johns & Van Doren (2010)
Manufacturing	Adidam et al. (2012); Pellissier & Nenzhelele (2013); Yap et al. (2013); Dos Reis et al. (2013); Sewdass & du Toit (2014); Guimaraes (2011); Jin & Ju (2014); Shih et al. (2010)
Service sector	Faust & Gadotti (2011); Nemutanzhela & Iyamu (2011); Adidam et al. (2012); Zheng et al. (2012); Pellissier & Nenzhelele (2013); Dos Reis et al. (2013); Yap et al. (2013); Tuță et al. (2014); De Carvalho & Janissek (2014); Sewdass & du Toit (2014); Trong (2013); Guimaraes (2011); García-Alsina et al. (2013); Fernández & Tañski (2011); Rapp et al. (2015); Zambon & Anunciação (2014); Ahearne et al. (2013); Hughes et al. (2013) ; Guarrochena & Paul (2013); Erickson & Rothberg (2013) ; Gatsoris (2012) ; Pelissari et al. (2012); Safarnia et al. (2011); Fernández & Tañski (2011)
Hotel sector	Faust & Gadotti (2011); Rapp et al. (2015); Calero et al. (2010)

Despite its presence both in academic and professional areas, a single generally accepted definition of CI does not exist (Fleisher & Wright, 2009). In fact, as can be seen in Table 1, there are different CI perspectives approached by several authors in the literature.

Examining the literature, in last five years we can find empirical research about CI in different sectors, including tourism. However, studies about CI in hotels are scarce, which is a strong argument to conduct this paper.

To reach that conclusion a literature review in two databases was undertaken: *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* (CAPES) and *Web of Science* (WOS). These databases contain the highest impact journals in the indexed literature. The keyword in the search was "competitive intelligence", and in order to select the sample of papers the following criteria where established: a) papers had to include the keyword "competitive intelligence", either in the title or in the keywords; b) they had to follow empirical research; c) they had to belong to the field of business and economics; and d) they had to be published between 2011 and 2016. Thirty-six papers were obtained in all, which constitute the analysis base used in this paper.

The analysed papers were classified, as shown in Table 2, within the following industries: exploitation of natural resources, public sector, technology-based companies, manufacturing, service sector, and finally, hotel sector.

Research in CI during the last five years can be summed up as follows: research is mostly focused on service sector companies (33% of the selected papers), followed by technology-based companies (31%) and manufacturing (16.7%). Note the scarce research on the public sector (2.4%) and natural resources exploitation (11.9%), but it is especially important to highlight the poor participation of CI research in hotels, which comprises only 4.8% of selected papers.

3. PROPOSAL OF A COMPETITIVE INTELLIGENCE MODEL

Many multinational companies are aware of the fact that, thanks to CI, a competitive advantage can be achieved, so some of them, such as Procter and Gamble, General Motors and British Petroleum, have established formal CI units within the organisation or have

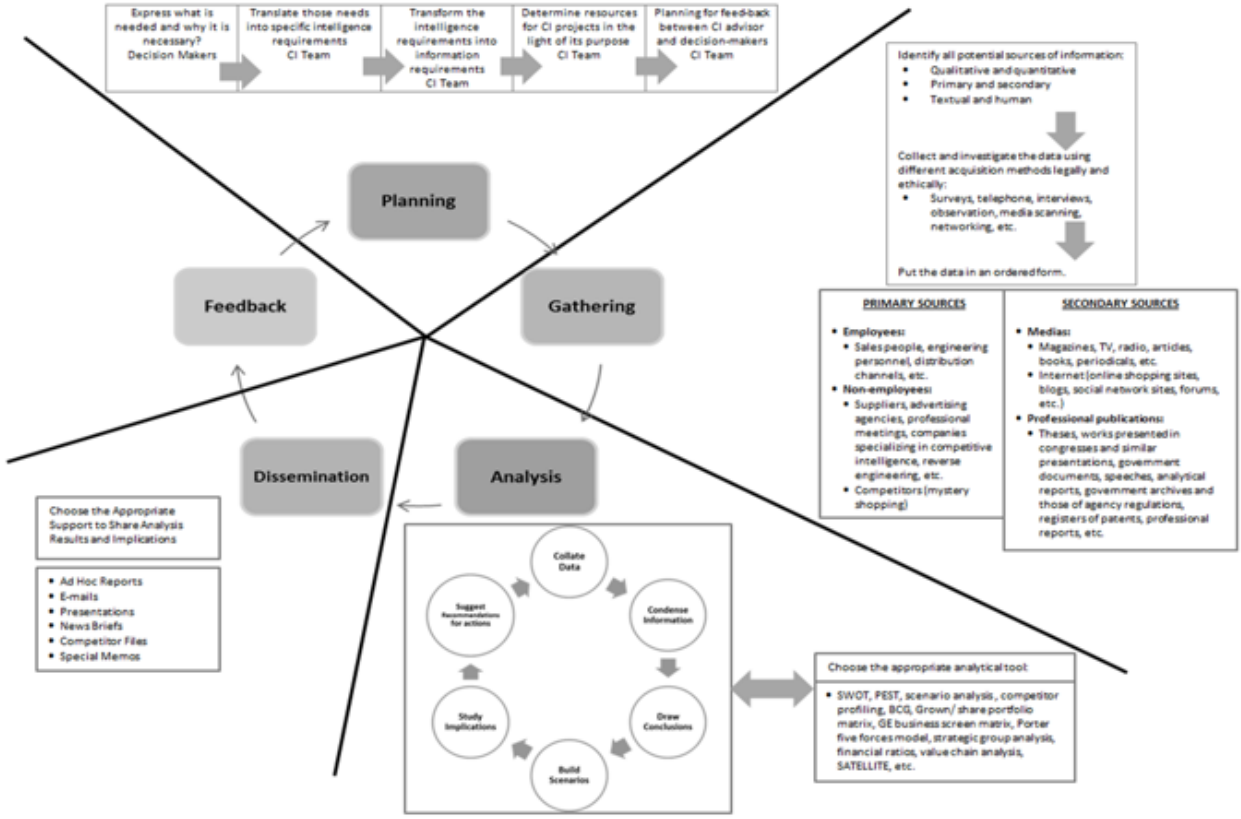


Figure 1 . Stages in the CI cycle, based on Strategic and Competitive Intelligence Professionals (2014) and Cloutier (2013).

adopted structured processes to gather and analyse information from the environment (Bose 2008; Groom & David, 2001; Pepper 1999; Vedder et al., 1999; cited by Hughes et al., 2013). Furthermore, companies with a higher standard in CI activities also show better financial performance (Adidam et al., 2012).

Due to the above, and the relevance of the tourism sector in many economies, we propose a CI model that can be applied by hotels. We focus on the first two stages of the CI cycle, based on a comprehensive literature review to establish the items belonging to each stage, items that have subsequently been validated by a committee of experts in the tourism sector. The result is a CI model applicable to hotels (and even to other sectors, with the appropriate modifications), which will allow to organisations to implement a CI process.

But in practice, how is a CI process applied? There are several authors that talk about the so-called "CI cycle", in other words, a set of successive phases that help us obtain the necessary intelligence for decision-making. In the various CI cycles that we can find in the literature, there are common elements among them. However, the name and number of the stages can be different (Cloutier, 2013).

Figure 1 shows one of the most widely accepted CI cycles among professionals and academics. We are referring to the one proposed by the Strategic and Competitive Intelligence Professionals (2014). This cycle consists of the following five stages: a) planning (recognition of the information needs); b) gathering (needed information and choosing a source to obtain it); c) analysis (turning information into intelligence); d) dissemination (making the obtained intelligence available for decision-makers); and e) feedback (setting a mechanism to validate the reliability of the obtained intelligence to determine the potential variances in any stages of the cycle).

4. METHODOLOGY

To build the assessment scale of the CI practices, a content validation by a panel of judges was applied, according to Hernández-Nieto (2002) and Pasquali (2010). To measure the content validation coefficient (CVC) of each item in the questionnaire, the following criteria were adopted: a) clarity of language; b) practical relevance; and c) theoretical relevance.

The aim of the validation through a panel of judges is to confirm, theoretically, the hypothesis that items properly represent the

construct, by asking people who don't constitute a representative sample of the population to build that instrument (Pasquali, 2010). Nine judges were selected to be part of the production of the questionnaire content validation coefficient (CVC). CVC calculation was made through the following steps:

a) Each item mean score (Mx) is calculated from the judges' score:

$$M_x = \frac{\sum_{i=1}^{9} X_{ij}}{j}$$

where i=1 represents the total judges' score and j the number of judges.

b) The initial CVC is obtained from:

$$CVC_i = \frac{M_x}{V_{max}}$$

c) Error is the same for each item, and it is calculated as follows:

$$P_{e_i} = \left(\frac{1}{j}\right)^j$$

d) Then, the final CVC is obtained for each item:

$$CVC_c = CVC_i - P_{e_i}$$

e) Finally, the total CVC of the questionnaire is calculated for each assessment criteriaon (clarity of language, practical relevance and theoretical relevance):

$$CVC_t = M_{CVC_i} - M_{P_{e_i}}$$

where M_{CVC_i} is the mean of content validation coefficient items and $M_{P_{e_i}}$, the mean of error of the items in the questionnaire. After the calculation, it is recommended that only items with $CVC_c > 0{,}8$areaccepted. are accepted.

5. ANALYSIS AND RESULTS

The instrument consists of two blocks of items that assess some of the main CI activities found in the literature: planning of the CI needs and information gathering.

For the planning block, 51 items were proposed, although 30 didn't reach the minimum coefficient required in the literature after the panel of judges' evaluation and those items had to be removed from the scale. Items with a content validation coefficient below 0.8 were excluded from the proposed scale. Therefore, the block was only composed of 21 items.

Table 3 Items referring to planning of CI activities.

Items referring to planning of CI activities	CVC_t
1. Competitor price is decisive to fix my price	0.90
2. There is a management practise to monitor competitor strategy	0.87
3. There is a management practise to monitor competitor price	0.87
11. Takes into account guest satisfaction with each department to manage it	0.83
12. Takes into account guest opinion on the state of the premises	0.92
13. Provider prices determine if we continue working with them in the future	0.84
15. We know other existing providers' prices	0.93
17. Issuing country's political stability in long-term concerning decisions is taken into account	0.83
18. The economical stability of the country in long-term concerning decisions is taken into account	0.81
20. Our country's threat of terrorism impacts long-term decisions	0.83
28. Level of crime and public security affect tourists arrival	0.86
29. Our country's infrastructure affects tourist arrival	0.86
30. Issuing countries' infrastructure affects tourist arrival	0.81
33. Unemployment rate affects domestic tourism	0.91
34. Issuing countries' unemployment rate affects tourist arrival	0.87
36. The standard of living in our country impacts domestic tourism	0.93
37. Issuing countries' standard of living impacts tourist arrival	0.90
43. Process automation affects way of working	0.84
45. Issuing countries' culture in its management is taken into account	0.87
46. Countries' culture in its management is taken into account	0.85
50. Energy costs affects management	0.87

This way, there is alignment between the assessed dimensions and a coefficient whose extent is 0.13, the accepted rate in the literature.

For the gathering block, 41 items were proposed, although 24 didn't reach the minimum coefficient required in the literature after the panel of judges' evaluation and those items had to be removed from the scale. Items with a content validation coefficient below 0.8 were excluded from the proposed scale. Therefore, the block was only composed of 17 items.

For items referring to information gathering, the extent of the CVCt was 0.18, as recommended in the literature. That was possible due to the fact that in about 35% of the items, the CVCt was between 0.9 and 1. At least one item, one out of the three assessed dimensions, had a maximum concordance qualification among the panel of judges.

Table 4 Items referring to gathering of the information.

Items referring to gathering of the information	CVC_t
1. There is a management practise to identify main competitors	0.97
2. There is a management practise to monitor competitor strategy	0.84
3. There is a management practise to monitor competitor price	0.96
4. There is a management practise to monitor new competitor services	0.84
5. There is a management practise to monitor competitor scores on search engines	0.88
7. There is a management practise to segment the market	0.93
8. There is a management practise to determine each segment's characteristics	0.87
9. There is a management practise to monitor guests' suggestions	0.93
11. There is a management practise to monitor the information obtained about guests in each department	0.99
12. There is a management practise to monitor the information obtained about competitors in each department	0.84
20. There is a management practise to monitor environmental legislation	0.84
21. There is a management practise to monitor the level of crime and public security	0.81
31. There is a management practise to monitor labour qualification	0.84
33. There is a management practise to monitor new ICTs	0.87
34. There is a management practise to monitor the life cycle of the products	0.86
39. There is a management practise to monitor energy costs	0.90
41. There is a management practise to cooperate with strategic alliances to develop new products and services	0.84

6. CONCLUSIONS AND FUTURE RESEARCH

If a company wants to survive and be successful, it has to be accomplished by means of least bias decision-making. Nowadays, it is a difficult duty as far as the environment is concerned due to its instability and turbulence, consequently it is indispensable to have a wide knowledge of it, in such a way that the environment information can be incorporated into decision-making.

For decades, companies have understood this, and many well-known companies, even the most limited in size and resources, are applying CI processes that allow them to have a better understanding of their environment.

In this paper we present a study of how CI processes should be applied in one of the most important sectors in many economies: tourism. Specifically, this work focuses on the proposal of a CI assessment model for hotels, on the basis of the two first stages of the CI cycle described by the Strategic and Competitive Intelligence Professionals (2014).

After a comprehensive literature review, in the first stage (planning), 51 items were obtained, and in the second one (gathering), 41. In each stage, Hernández-Nieto (2002) and Pasquali's (2010) content validation method was applied, and items were reduced to 21 in the first stage and 17 in the second.

The aim of this research is that the first two assessed stages of the CI cycle can be of used for hotels' decision-makers to get to know how their company applies CI processes, or to help them to establish structured CI process. Furthermore, we pursue an increase in scientific knowledge in business management.

In this line of research, and in accordance with the topic, we keep the possibility of completing the assessment of the CI cycle open,

following the methodology applied herein. Once the cycle has been completed, one may analyse its degree of implementation in hotels and examine their profitability, to be able to determine (as has already been done in the literature) the relationship between CI and profitability, but focusing exclusively on the hotel sector.

7. REFERENCES

Aaker, D. A. (1983). Organizing a strategic information scanning system. *California Management Review, 25*(2), 76-83.

Adidam, P. T., Banerjee, M. & Shukla, P. (2012). Competitive intelligence and firm's performance in emerging markets: an exploratory study in India. *Journal of Business & Industrial Marketing, 27*(3), 242-254.

Aguilar, F. J. (1967). *Environmental scanning*. New York: Macmillan.

Ahearne, M., Lam, S. K., Hayati, B. & Kraus, F. (2013). Intrafunctional competitive intelligence and sales performance: a social network perspective. *Journal of Marketing, 77*(5), 37-56.

Albagli, A., Dawson, P. & Hasnain, S. (1996). Competitive science and technology intelligence. *International Journal of Technology Management, 12*(3), 320-328.

Benjamin, W. A. (1979). Management of business information. *Industrial Marketing Management, 8*(1), 51-56.

Bisson, C. (2014). Exploring competitive intelligence pratices of french local public agricultural organisations. *Journal of Intelligence Studies in Business, 4*(2), 5-29.

Bose, R. (2008). Competitive intelligence process and tools for intelligence analysis. *Industrial Management & Data Systems, 108*(4), 510-528.

Brockhoff, K. (1991). Competitor technology intelligence in german companies. *Industrial Marketing Management, 20*(2), 91-98.

Calero, F. J., Parra, E. & Santana, A. (2010). Vigilancia tecnológica e inteligencia competitiva: un análisis de la demanda tecnológica en alojamientos turísticos en Canarias. *Revista de Análisis Turístico,* 9, 30-41.

Calof, J. L. (2008). Selling competitive intelligence. *Competitive Intelligence Magazine, 11*(1), 39-42.

Capatina, A., Nistor, R. & Bleoju, G. (2013). Empirical evidence on cultural dimensions related to competitive intelligence strategies adopted by the romanian software companies. *Business Management Dynamics, 2*(7), 20-27.

Casado-Salguero, G. & Jiménez-Quintero, J. A. (2016). Competitive intelligence in the tourism sector, with special focus on Southern Europe. *Tourism & Management Studies, 12*(1), 136-144.

Chen, C. F. & Chiou-Wei, S. Z. (2009). Tourism expansion, tourism uncertainty and economic growth: new evidence from Taiwan and Korea. *Tourism Management, 30*(6), 812-818.

Chonko, L. B., Tanner, J. F. & Smith, E. R. (1991). Selling and sales management in action: The sales force's role in international marketing research and marketing information systems. *Journal of Personal Selling & Sales Management, 11*(1), 69-80.

Cleland, D. I. & King, W. R. (1975). Competitive business intelligence systems. *Business Horizons, 18*(6), 19-28.

Cloutier, A. (2013). Competitive intelligence process integrative model based on a scoping review of the literature. *International Journal of Strategic Management, 13*(1), 57-72.

Davenport, T. H. (2006). Competing on analytics. *Harvard Business Review, 84*(1), 98-107.

Day, G. S. & Schoemaker, P. J. H. (2006). *Peripheral vision: detecting the weak signals that will make or break your company*. Boston: Harvard Business School Press.

De Carvalho, F. L. & Janissek, R. (2014). Uma proposta de relação de requisitos funcionais para um software de apoio ao processo de inteligência. *REAd: Revista Eletrônica de Administração, 20*(2), 425-460.

Dishman, P. L. & Calof, J. L. (2008). Competitive intelligence: a multiphasic precedent to marketing strategy. *European Journal of Marketing, 42*(7-8), 766-785.

Dos Reis, C., de Abreu, A. F. & Agrasso, M. A. (2013). Best practices in brazilian companies. *Journal of Technology Management & Innovation*, 8, 79-91.

Erickson, G. S. & Rothberg, H. N. (2013). A strategic approach to knowledge development

and protection. *The Service Industries Journal, 33*(13/14), 1402-1416.

Eugenio-Martín, J. L., Martín-Morales, N. & Scarpa, R. (2004). *Tourism and economic growth in latin american countries: a panel data approach (working paper 26).* Milán: Fondazione Eni Enrico Mattei.

Fahey, L. & King, W. R. (1977). Environmental scanning for corporate planning. *Business Horizons, 20*(4), 61-71.

Fahey, L. & Narayanan, V. K. (1982). The micro-politics of strategy formulation 1. *Academy of Management Review, 7*(1), 25-34.

Fatti, A. & du Toit, A. S. A. (2013). Competitive intelligence in the South African pharmaceutical industry. *Journal of Intelligence Studies in Business, 3*(1), 5-14.

Faust, D. & Gadotti, S. J. (2011). La inteligencia competitiva aplicada a las redes hoteleras brasileñas. *Estudios y Perspectivas en Turismo, 20*(2), 478-498.

Fernández, M. J. & Tañski, N. C. (2011). Inteligencia competitiva: propuesta de modelo sistémico como cambio organizacional para los hospitales del sur de Brasil. *Visión de futuro, 15*(2), 1-24.

Fleisher, C. S. & Bensoussan, B. E. (2007). *Business and competitive analysis: effective application of new and classic methods*. New Jersey: Pearson Education.

Fleisher, C. S. & Wright, S. (2009, June). Causes of competitive analysis failure: understanding and responding to problems at the individual level. In *Third European Competitive Intelligence Symposium*. Stockholm.

García-Alsina, M., Ortoll, E. & Cobarsí-Morales, J. (2013). Enabler and inhibitor factors influencing competitive intelligence practices. *Aslib Proceedings, 65*(3), 262-288.

Gatsoris, L. (2012). Competitive intelligence in greek furniture retailing: a qualitative approach. *EuroMed Journal of Business, 7*(3), 224-242.

Ghoshal, S. & Westney, D. E. (1991). Organizing competitor analysis systems. *Strategic Management Journal, 12*(1), 17-31.

Groom, J. R. & David, F. R. (2001). Competitive intelligence activity among small firms. *SAM Advanced Management Journal, 66*(1), 12-20.

Guarrochena, M. & Paul, L. M. (2013). Estrategias de gestión de la información asociadas a la inteligencia competitiva: apropiación práctica en organizaciones de apoyo a empresas exportadoras. *Visión de futuro, 17*(2), 148-167.

Guimaraes, T. (2011). Industry clockspeed's impact on business innovation success factors. *European Journal of Innovation Management, 14*(3), 322-344.

Hambrick, D. C. (1982). Environmental scanning and organizational strategy. *Strategic Management Journal, 3*(2), 159-174.

Hernández-Nieto, R. A. (2002). *Contributions to statistical analysis.* Mérida: Universidad de Los Andes.

Hughes, D. E., Le Bon, J. & Rapp, A. (2013). Gaining and leveraging customer-based competitive intelligence: the pivotal role of social capital and salesperson adaptive selling skills. *Journal of the Academy of Marketing Science, 41*(1), 91-110.

Jiménez-Quintero, J. A. & Aldeanueva-Fernández, I. (2016). *Dirección estratégica internacional.* Madrid: Ediciones Pirámide.

Jin, T. & Ju, B. (2014). The corporate information agency: do competitive intelligence practitioners utilize it? *Journal of the Association for Information Science and Technology, 65*(3), 589-608.

Johns, P. & Van Doren, D. C. (2010). Competitive intelligence in service marketing: a new approach with practical application. *Marketing Intelligence & Planning, 28*(5), 551-570.

Lee, C. C. & Chang, C. P. (2008). Tourism development and economic growth: a closer look at panels. *Tourism management, 29*(1), 180-192.

Maltz, E. & Kohli, A. K. (1996). Market intelligence dissemination across functional boundaries. *Journal of Marketing Research, 33*(1), 47-61.

Mariadoss, B. J., Milewicz, C., Lee, S. & Sahaym, A. (2014). Salesperson competitive intelligence and performance: the role of product knowledge and sales force automation usage. *Industrial Marketing Management, 43*(1), 136-145.

Montgomery, D. B. & Weinberg, C. B. (1979). Toward strategic intelligence systems. *Journal of Marketing, 43*(4), 41-52.

Nemutanzhela, P. & Iyamu, T. (2011). The impact of competitive intelligence on products and services innovation in organizations.

International Journal of Advanced Computer Science and Applications, 2(11), 38-44.

Opait, G., Bleoju, G., Nistor, R. & Capatina, A. (2016). The influences of competitive intelligence budgets on informational energy dynamics. *Journal of Business Research, 69*(5), 1682-1689.

Pasquali, L. (2010). *Instrumentação psicológica: fundamentos e práticas.* Porto Alegre: Artmed Editora.

Pearce, F. T. (1976). Business intelligence systems: the need, development, and integration. *Industrial Marketing Management, 5*(2-3), 115-138.

Pelissari, A. S., Defreitas, I. V., Vanalle, R. M. & Soares, M. L. (2012). Diagnóstico do uso da inteligência competitiva empreendedora em pequenas empresas da indústria de confecções da cidade de Vila Velha–Es. *Revista de Administração da UFSM, 5*(2), 183-203.

Pellissier, R. & Nenzhelele, T. E. (2013). The impact of work experience of small and medium-sized enterprises owners or managers on their competitive intelligence awareness and practices. *South African Journal of Information Management, 15*(1), 1-6.

Pepper, J. E. (1999). Competitive intelligence at Procter & Gamble. *Competitive Intelligence Review, 10*(4), 4-9.

Pérez-Rodríguez, J. V., Ledesma-Rodríguez, F. & Santana-Gallego, M. (2015). Testing dependence between GDP and tourism's growth rates. *Tourism Management,* 48, 268-282.

Porter, M. E. (1980). *Competitive strategy: techniques for analyzing industries and competitors.* New York: Free Press.

Ramírez, R., Österman, R. & Grönquist, D. (2013). Scenarios and early warnings as dynamic capabilities to frame managerial attention. *Technological Forecasting and Social Change, 80*(4), 825-838.

Rapp, A., Agnihotri, R., Baker, T. L. & Andzulis, J. M. (2015). Competitive intelligence collection and use by sales and service representatives: how managers' recognition and autonomy moderate individual performance. *Journal of the Academy of Marketing Science, 43*(3), 357-374.

Rothberg, H. N. & Erickson, G. S. (2013). Intelligence in the oil patch: knowledge management and competitive intelligence insights. *Journal of Intelligence Studies in Business, 3*(3), 29-36.

Rothschild, W. E. (1979). Competitor analysis: the missing link in strategy. *Management Review, 68*(7), 22-8.

Rouach, D. & Santi, P. (2001). Competitive intelligence adds value: five intelligence attitudes. *European Management Journal, 19*(5), 552-559.

Safarnia, H., Akbari, Z. & Abbasi, A. (2011). Review of competitive intelligence & competitive advantage in the industrial estates companies in the Kerman city: appraisal and testing of model by Amos graphics. *International Business and Management*, 2(2), 47-61.

Samtani, M. & Capatina, A. (2012). Achieving the next level of growth through competitive intelligence practices: an exploratory study of romanian offshore technology service providers. *Economics and Applied Informatics*, 3, 15-20.

Sashittal, H. C. & Jassawalla, A. R. (2001). Marketing implementation in smaller organizations: definition, framework, and propositional inventory. *Journal of the Academy of Marketing Science, 29*(1), 50-69.

Saxby, C. L., Parker, K. R., Nitse, P. S. & Dishman, P. L. (2002). Environmental scanning and organizational culture. *Marketing Intelligence & Planning, 20*(1), 28-34.

Sewdass, N. (2012). Proposing a competitive intelligence (CI) framework for Public Service departments to enhance service delivery. *South African Journal of Information Management, 14*(1), 1-13.

Sewdass, N. & du Toit, A. (2014). Current state of competitive intelligence in South Africa. *International Journal of Information Management,* 34(2), 185-190.

Shih, M. J., Liu, D. R. & Hsu, M. L. (2010). Discovering competitive intelligence by mining changes in patent trends. *Expert Systems with Applications, 37*(4), 2882-2890.

Søilen, K. S. (2015). A place for intelligence studies as a scientific discipline. *Journal of Intelligence Studies in Business, 5*(3), 35-46.

Søilen, K. S. (2016). Economic and industrial espionage at the start of the 21st century: status quaestionis. *Journal of Intelligence Studies in Business, 6*(3), 51-64.

Šperková, L., Škola, P. & Bruckner, T. (2015). Evaluation of e-word-of-mouth through business intelligence processes in banking domain. *Journal of Intelligence Studies in Business, 5*(2), 36-47.

Strategic and Competitive Intelligence Professionals (2014). *SCIP*. Retrieved from https://www.scip.org/

Sun, L. & Wang, Y. Z. (2015). Identifying the core competitive intelligence based on enterprise strategic factors. *Journal of Shanghai Jiaotong University (Science), 20*(1), 118-123.

Tiwari, V. (2011). Software engineering issues in development models of open source software. *International Journal of Computer Science and Technology*, *2*(2), 38-44.

Trong, L. (2013). Corporate social responsibility, upward influence behavior, team processes and competitive intelligence. *Team Performance Management: An International Journal, 19*(1/2), 6-33.

Tuță, M., Zara, I. A., Orzan, G., Purcarea, V. L. & Orzan, O. A. (2014). Competitive intelligence: an enhancement to business intelligence. *Economic Computation & Economic Cybernetics Studies & Research, 48*(2), 1-11.

Vedder, R. G., Vanecek, M. T., Guynes, C. S. & Cappel, J. J. (1999). CEO and CIO perspectives on competitive intelligence. *Communications of the ACM, 42*(8), 108-116.

World Tourism Organization (2015). *Panorama OMT del turismo internacional*. Madrid: WTO.

Xu, K., Liao, S. S., Li, J. & Song, Y. (2011). Mining comparative opinions from customer reviews for competitive intelligence. *Decision Support Systems, 50*(4), 743-754.

Yap, C. S. Rashid, M. Z. A. & Sapuan, D. A. (2013). Perceived environmental uncertainty and competitive intelligence practices. *VINE: The Journal of Information and Knowledge Management Systems, 43*(4), 462-481.

Zambon, A. & Anunciação, P. (2014). Inteligência competitiva: percepções de valor no setor da bijuteria. *Revista Portuguesa e Brasileira de Gestão, 13*(2), 41-60.

Zhang, X., Majid, S. & Foo, S. (2010). Environmental scanning: an application of information literacy skills at the workplace. *Journal of Information Science, 36*(6), 719-732.

Zheng, Z., Fader, P. & Padmanabhan, B. (2012). From business intelligence to competitive intelligence: inferring competitive measures using augmented site-centric data. *Information Systems Research, 23*(3), 698-720.

Zurub, H. H., Ionescu, A. & Constantin, V. D. (2015). Measuring the economic impact of tourism in european emerging markets. *Procedia Economics and Finance,* 32, 95-102.

Journal of Intelligence Studies in Business
Vol. 7, No. 1 (2017) pp. 48-69
Open Access: Freely available at: https://ojs.hh.se/

Key success factors to business intelligence solution implementation

José Manuel Villamarín García[a,*] and Beatriz Helena Díaz Pinzón[a]

[a]*Universidad Nacional de Colombia, GISTIC Research Group, Bogota, Colombia*

**Corresponding author: jmvillamaring@unal.edu.co*

Received 6 February 2017; accepted 27 February 2017

ABSTRACT Business intelligence (BI) solutions have been adopted within organizations as a mean to achieve a more grounded decision making process that results in better organizational outcomes. Nowadays, about 70% to 80% of business intelligence implementation projects fail due to both technological and managerial issues. Multi-methodology proposed by Mingers (2006) was followed to develop the research in four phases: appreciation, where documental search was conducted through a literature review; analysis, where hypothetical structures related with the key success factors were proposed; assessment, where key success factors were assessed along with experts; and action, where research results discussion was shown. As a result, 13 factors that affect the business intelligence solution's success were identified. Those factors contribute to improve planning and implementation of business intelligence projects, accomplishing in a greater extent the purposes of these projects.

KEYWORDS BI projects, BI success, business intelligence, critical factors, key success factors

1. INTRODUCTION

For companies and institutions to survive in the economy and in the business world, decisions must be accurate and made on time (Karim 2011; Olszak 2016). To have trusted, accurate and timely decisions, information needs must be ideally satisfied (Rajterič 2010) since the amount of time between making a decision and its feedback (which requires a new decision) is shorter every time (Folinas 2007). For companies to remain competitive in the new economy they must dynamically respond to both environmental changes and customer requirements (Velicanu and Matei 2008).

In practice and despite the facts mentioned above, it has been noticed that a great proportion of BI projects fail. According to Gartner Inc. about 70% to 80% of BI projects fail (Ortega 2013; SAP 2013). Pham et al. (2016) estimated a rate of failure approximately between 65% to 70%. Castelán et al. (2010) claim this proportion is about 40% to 50% for systems based on data warehouses, such as BI systems, because of issues that were not considered early on. This is consistent with another study that reveals that in addition to failing, they are also abandoned at the same rate (Herrera, 2011).

Failures in the use of BI implemented solutions are significant as well. In a few cases this type of solution tends to be discarded or fails to be implementations. About 10% to 20% of projects that did not fail in the pre-implementation stage are executed result sub-utilization by those users that were supposed to use them (Arnott 2010; Yeoh and Popovič 2016).

However, existing problems in the BI project field can be seen from different perspectives. From a general point of view, there are two groups that summarize the presented failures: managerial obstacles and technological obstacles (Sakulsorn 2011). From a specific perspective there are problems related to the project leaders, sponsorship,

solution requirements, designs, training, tools, tracing, posted objectives, estimated time to execution, data, data sources, problems with the technology handling, user needs, and investments, among others (Ahmed 2014; Castelán et al. 2010; EMC Consulting 2010; Gurjar and Rathore 2013; Herrera 2011; SAP 2013).

Those failures produce problems within organizations such as wasted of resources, time, and costs of opportunity of invested capital, as well as an inability to achieve expected benefits (Ortiz 2014).

Taking into account the given failures when thinking about BI solutions and the problems that arise at the time of sharing information at an organizational level, this research aims to give a conceptual framework of key success factors to improve BI solutions success within organizations. All of these take contributions from several authors, validate those contributions at an organizational level and generate factors or specific characteristics that allow organizations to get greater effectivity rates in the adoption and implementation of these type of projects.

2. THEORETICAL BACKGROUND

Given the high failure rates, sub-utilization and the withdrawal of BI solutions, the need to approach issues that encourage good planning, use, implementation and holding of these type of solutions is evident. For that, researchers have attempted to identify those factors that could contribute to BI solution success, and are linked to benefits that could be potentially achieved (Ramamurthy and Sen 2008; Srikant 2006; Solomon 2005; Shin 2003; Hwang et al. 2004 cited in Hawking and Sellitto 2010). These factors have been called "key success factors". Issues such as solutions adoption, complexities in implementation, and business purposes justify a more focused study of key success factors for BI solutions (Yeoh et al. 2008).

The challenge for organizations is to identify factors that have the greatest influence over their BI systems (Sangar and Iahad, 2013), which is why the topic of key success factors becomes a useful concept to understand the events during a BI project. Further, it becomes a construct easy to understand by managers, executives, technology information professionals and other people from areas that can carry theory into practice (Arnott 2008).

2.1 Key success factors

"The theory of KSFs gives good basis for stating what criteria should be followed during implementation of BI applications" (Olszak 2016, 112). Key Success Factors are defined in the literature as those critical areas where everything has to work correctly for business to flourish (Umble and Umble 2003, cited in Sangar and Iahad 2013). Equally, they are seen as high level considerations that differ from a set of deliverables at the end of a project (Yeoh et al. 2006). The definition made by Olszak and Ziemba (2012) goes further and claims that they are seen as a set of tasks and procedures that must be approached to secure the BI systems achievements during their formulation and promotion. This is used as the definition in this research.

2.2 Key success factor in BI solutions

Literature presents different key criteria to ensure BI solution success (Table 1). In turn, these factors present key characteristics that describe in a detailed way the meaning and composition of each factor.

2.2.1 Directives and top management

The engagement of the key members of the management team relates to the BI project (Table 1). According to Cidrin and Adamala (2011), a high level of top management support is associated with a high level of BI project success. Likewise, it helps to manage the change process and battle the resistance against project (Arnott 2008).

Leadership figures have important influence since if these executives exert a significant influence, they will be seen as leaders, and, employees will tend to follow them (Hobek et al. 2009).

2.2.2 Business linking

According to an interviewed person from the study by Yeoh et al. (2007, 1362), "a BI system that is not business driven, is a failed system". Also Salmasi et al. (2016, 26) stated that "For BI success in an organization, information systems must meet the business needs". A solid business model must incorporate all strategic proposals that the project will approach, needed working resources, possible risks, costs to take on and deadlines to execute the project (Table 1). Thus, the model will provide justifiable motivations by which the adoption of a new solution changes the existing practices (Yeoh et al. 2007).

Table 1 Collected key success factors (characteristics) based on the literature review.

Factor	***Key characteristics***	***References***
Directives and Top Management	- Committed support and sponsorship from top management - Continuous support and support from directives - Directive sponsor, informed and committed - Active participation from actionist - Well-qualified managers and managerial teams - Project that fulfil with the sponsor needs	Arnott 2008; Chan et al. 2013; Cidrin and Adamala 2011; Dawson and Van Belle 2013; Hawking and Sellitto 2010; Olszak and Ziemba 2012; Sangar and Iahad 2013; Yeoh et al. 2006; Yeoh et al. 2007; Yeoh et al. 2008; Yeoh and Koronios 2010; Olszak, 2016; Pham et al. 2016; Yeoh and Popovič 2016.
Business Linking	- To have well defined business process and problems - Strategic BI vision linked to company initiatives - Align business needs - To have well defined business requirements related to information - To have well defined business model - Identify key performance indicators (KPI) - Involve business affairs with the technical side - Establish metrics and classifications handled by business side - To govern the information handled by business - To formulate a methodology and a project management handled by business side - To have a theoretical and upgradeable framework managed by business side - To formulate a project approach handled by business side - Well-stablished business case	Arnott 2008; Cidrin and Adamala 2011; Hawking and Sellitto 2010; Sangar and Iahad 2013; Olszak and Ziemba 2012; Yeoh et al. 2007; Yeoh et al. 2008; Yeoh and Koronios 2010; Yeoh and Popovič 2016.
Project Leader or "Champion" set-up	- High-level person with business knowledge - Business oriented Champion - Project Champion	Sangar and Iahad 2013; Dawson and Van Belle 2013; Hawking and Sellitto 2010; Yeoh et al. 2006; Yeoh et al. 2008; Yeoh and Koronios 2010.
Strategy	- Clear mission and vision - Strategical vision of the BI project - Business vision - Clear business plan - Strategic and extensible technical framework -	Cidrin and Adamala 2011; Dawson and Van Belle 2013; Sangar and Iahad 2013; Olszak and Ziemba 2012; Yeoh et al. 2008; Yeoh and Koronios 2010; Olszak, 2016; Pham et al. 2016; Yeoh and Popovič 2016.
Change Management	- Suitable and effective change management due to BI Project - User-oriented change management	Hawking and Sellitto 2010; Olszak and Ziemba 2012; Sangar and Iahad 2013; Yeoh et al. 2008; Yeoh and Koronios 2010; Pham et al. 2016; Yeoh and Popovič 2016.
Project	- Project planning - To define and manage project scope - Project that delivers "quick wins" - Effective project management - Solutions design - Solutions design based on the end user - Clear link between business objectives - Project methodology - Project performance - Competent BI project manager - Respond to lack of flexibility and answer to user requirements - To build a project pilot which introduce incremental changes - Iterative development handled by business part	Arnott 2008; Cidrin and Adamala 2011; Hawking and Sellitto 2010; Olszak and Ziemba 2012; Sangar and Iahad 2013; Yeoh et al. 2007.
People and Human Talent Teams	- Support from an external consultant in the start phase - Formal an interactive engagement with participation of the end user during project life cycle. - Appropriate mixed skills team - Well defined user expectations - Balanced skills and composition of the team -	Arnott 2008; Dawson and Van Belle 2013; Olszak and Ziemba 2012; Sangar and Iahad 2013; Yeoh et al. 2006; Yeoh et al. 2007; Yeoh and Koronios 2010; Pham et al. 2016; Yeoh and Popovič 2016.
Learning and Skills	- Education and suitable and formal user learning - Easy learning solutions - In-site education, learning and support - Team knowledge and skills - Committed experience from the business side	Chan et al. 2013; Sangar and Iahad 2013; Yeoh et al. 2006; Yeoh et al. 2007; Olszak, 2016.

Information and Technology	- Suitable technology and tools - Technologies development - Evolving development - Set a strategic, extensible and upgradable technical framework - Contents according to the business - High data quality and confident sources - Sustainability - Tests - Interaction with other systems - Report strategies - Date government - Data security - Effective data management - Source data systems - Data and information integrity and accuracy - Partners for implementation - Friendly BI system use - Sustainability quantity and quality of data - Hardware and software sustainability - System confidence, upgradability and flexibility - Friendly user-oriented technologies - Solutions fit to user expectations - Dimensional model of data and metadata - Use of a test prototype - Source systems stable in site - Availability of information department - Customization - Devices security - Authentication - Device independency - Usability - Accessibility - Connectivity to networks - Flexibility - Consistency - Re-usability - Functionality - Support of interactive systems - Timely reports	Arnott 2008; Chan et al. 2013; Cidrin and Adamala 2011; Hawking and Sellitto 2010; Olszak and Ziemba 2012; Sangar and Iahad 2013; Yeoh et al. 2006; Yeoh et al. 2007; Yeoh et al. 2008; Yeoh and Koronios 2010; Pham et al. 2016; Yeoh and Popovič 2016.
Resources	- Intellectual suitable resources - Technological suitable resources - Suitable budget - Strategic human and financial resources	Arnott 2008; Olszak and Ziemba 2012; Yeoh et al. 2006; Yeoh et al. 2007; Chasanlow 2009 cited by Salmasi et al. 2016
Metrics	- Current system use - Perceived system utility - Net benefits obtained - User satisfaction - Use intention - Service quality - System quality - Information quality	Nemec 2011; Sangar and Iahad 2013.
Environment	- Organizational culture - Solving of non-technical issues - Cooperation with BI suppliers based on past experiences	Cidrin and Adamala 2011; Olszak and Ziemba 2012; Sangar and Iahad 2013.

The project must have a clear link to the business, this way it will be economically supported in terms of its economic value (Arnott 2008). According to Yeoh and Koronios (2010), the main cause of BI solutions failure is not technological but a poor alignment with the business, its vision and objectives. This result in the impossibility of satisfying both the business and the costumers' needs and objectives.

2.2.3 Project leader or "champion" set up

This makes reference to a team leader appointment, in a few cases it is the same Chief Information Officer (CIO) (Table 1). This person must have enough technical and functional knowledge and at the same time he/she must have excellent interpersonal

abilities to solve organizational conflicts (Yeoh et al. 2006).

This makes choosing a leader a challenge as that person will carry the project baton, and foresee organizational challenges and course changes on time (Yeoh and Koronios 2010). He/she will see the solution from an organizational and strategic perspective, not only technological. If he/she understands both business and technology, he/she could translate business requirements in the technological architecture and vice versa (Yeoh et al. 2007).

2.2.4 Strategy

The fixed strategic vision is summarized in the results obtained by Yeoh et al. (2007). Their findings suggest that a long-term strategy results in a continuum improvement at an organizational level, and the impact of the solution and the expected results depend on its understanding (Table 1). Top management must be committed and give the needed support for project success (Yeoh et al. 2006).

The project must have a vision of BI as well, it must provide needed resources to fulfil it and must insist on the use of information at the decision making process (Watson and Wixom 2007). Equally important are the goals or objectives. It is a fundamental input to have a clear way to which the organizations want to reach. It also works to dispose the resources, actions, processes and everything needed to reach a desired state. Although the company may fix it, sometimes there is doubt about their use from the employees in their daily operations (Popescu 2012).

2.2.5 Change management

A change management program is important in the sense that it reduces implementation resistance and in the way that it favors its adoption (Hawking 2013) especially when technologies are ongoing, because it is the moment in which there are greater possibilities for changes to happen (Hobek et al. 2009; Fourati-Jamoussi et al. 2016) (Table 1).

Communication is an important factor for the change management. It must appear in the project formulation step so employees can prepare on their own to receive change (Hobek et al. 2009) and for them to know first-hand the impact it will have at individual level (Hawking 2013).

2.2.6 Project

The BI project is one of the most important factors, considered to be a key one. The authors (Arnott 2008; Hawking and Sellitto 2010; Yeoh et al. 2006; Yeoh et al. 2007) claim a marked emphasis in the scope is an important issue for the success of the BI project. With that, the main objective of its formulation, deadlines, advances and final results can be achieved, framed and aligned with the business purposes strategically posted early by the top management (Table 1).

2.2.7 People and human talent teams

Individuals as project members must have appropriate experience, knowledge and skills (Arnott 2008; Rouhani et al. 2012; Salmasi et al. 2016).

According to interviews made by Yeoh et al. (2007), they showed that experts agreed that team conformation and the skills of people engaged in the project greatly influenced its implementation success. It is ideal that participant teams are composed of people from diverse areas, who have technical expertise and a deep business knowledge (Burton et al. 2006 cited by Yeoh et al. 2007) (Table 1).

2.2.8 Learning and skills

It is important that organizations provide workers with the skills and knowledge to use the BI solutions (McCalister 2012; Arnott 2008; Wixom and Watson 2001, cited by Chan et al., 2013).

Taking into account that this kind of project demands high technical engagement, it must dispose a team that gives support and more precisely training in order to educate and shape everyone about the BI project (Adamala and Cidrin 2011; Olszak 2016.) (Table 1). That team can be shaped by people supporting both the technical and human parties. Based on this training it is important that people give feedback about their experience since they will continue to use the BI solutions (Bălăceanu 2007; Muntean 2007).

Learning tools enter here to mediate. They must be offered and disposed to acquaint people with the new solution environment, since human behavior related to decision making is not generally aligned with tools capacity (Feng et al. 2009).

2.2.9 Information and technology

This key success factor is one of the most used in BI research, since it is focused on

architecture, software and tools development and tangible elements whose impact is reflected in practice by its operative characteristics (Loshin 2013).

According to Yeoh et al. (2007) the first step is to do a requirements analysis whereby a solution can secure the shape of organizational conditions over the time.

As second step that analysis must conclude in a match between organizational needs and their alignment in the company's strategic framework whereby it fulfills the proposed objectives and posted vision (Knoben and Oerlemans 2006).

A third step is related to information management, established sources and articulation of needed means, for instance strategic and tactical integration with other tools like BPM (Business Process Management), which offers innovative solutions to decision making (Linden et al. 2011), policies for processing and processing information. Not estimating the magnitude of unsolved information problems generally resonates in a project failure (Rosado and Rico 2010).

Choosing a solution is the last step; it should be matched to the organization's needs (Arnott 2008). It must require a detailed plan formulation. If the organization is supported only by tools without a plan, purchasing solutions will become a distraction to the proposed goals (Loshin 2013) (Table 1).

2.2.10 Resources

Generally, this factor is seen from a clearly economic view, mainly for the top management which assess this kind of project through cost-benefit relations. While it is not a mistake, is clear that intellectual, economic and physical factors have equal weight within a BI project since suitable handling and engaged management are key to real and verifiable benefits (Hobek et al. 2009; Yeoh et al. 2007) (Table 1).

2.2.11 Metrics

Metrics are always important to know projects results and in this case, it is not an exception. Following the research proposal of Nemec (2011) based on a literature review focused on DeLone y McLean studies, dimensions posted by these authors in their information systems success model can be seen as key factors when a BI project is assessed (Table 1).

Nemec (2011) formulates issues like benefits, utility, quality and satisfaction, which are perceived by users as influencing elements in a BI solution's success. It will result in relevant information about acceptance and real use that could be obtained by the project.

2.2.12 Environment

Organizations that do not have information to process, need information systems that can improve that situation and give them a better understanding about environment forces, with which they can improve their performance by producing and using useful information (Sangar and Iahad 2013).

Based on results from a big survey, Watson and Haley 1997 (cited by Yeoh et al. 2008), stated that critical factors for BI project success are organizational by nature. With a key success factor framework, engaged stakeholders can identify those necessary elements to improve efficacy and efficiency of planning and implementation activities, understanding the background, which is conducive to BI project implementation to success (Yeoh et al. 2008) (Table 1).

3. RESEARCH METHODOLOGY

The methodology used is the multi-methology proposed by Mingers (2006), which follows the phases: appreciation, where document search is conducted through a literature review; analysis, where hypothetical structures related with the key success factors are proposed; assessment, where key success factors are assessed along with experts; and action, where research result discussion is shown.

3.1 Literature review

Bibliography and references search were conducted in: Scopus and Web of Science and in a small amount in Google Scholar. Indexed journal articles, conference proceedings, book sections and corporate reports on BI were collected. It was conducted by equations restricted to databases: EBSCOHost (Business Source Complete and Academic Source Complete), Jstor, Emerald, IEEE, Science Direct, Springer Journal, Springer Books and Taylor & Francys. Once documents were obtained, a detailed check of abstracts and keywords was done to corroborate the material's relevance to the research. Table 2 shows the process outcomes. A total of 12 documents that explicitly treat the topic key success factors on BI solutions were found.

Table 2 Search and document outcomes. Table shows the equations used to retrieve important information to gather documents on the topic: "key success factors" in business intelligence which were applied to the database search.

Search equations
((Critical (or) (+) key (or) (+) csf (or) (+) ksf) and (success (or) (+) factors (or) (+) success factors) and (information systems (or) (+) business intelligence (or) (+) competitive intelligence (or) (+) information (or) (+) bi (or) (+) ci (or) (+) it))

Documents finally worked		
Academic	**Corporate**	**Total**
11	1	12

3.1.1 Document codification

According to Serbia (2007), a topics analysis was conducted. By using the NVIVO10 software, it was structured as: a primary node with the topic Key Success Factors on BI and twelve secondary nodes, ten of which are matched with the referred authors. Similarly, twelve tertiary nodes that represent the main identified factors according to a systematic literature review on this topic were formulated. This structure was established taking as reference the topics analysis conducted by Fernández Núñez (2006), referring to free text analysis through Key Words in Context (KWIC) to proceed to codify the contents on those nodes.

Next, this node structure is presented (Figure 1). The discontinuous line refers to contributions and its complement of author and exposed factors.

3.2 Information collecting

Interviews of seven experts in the field who have participated in research or

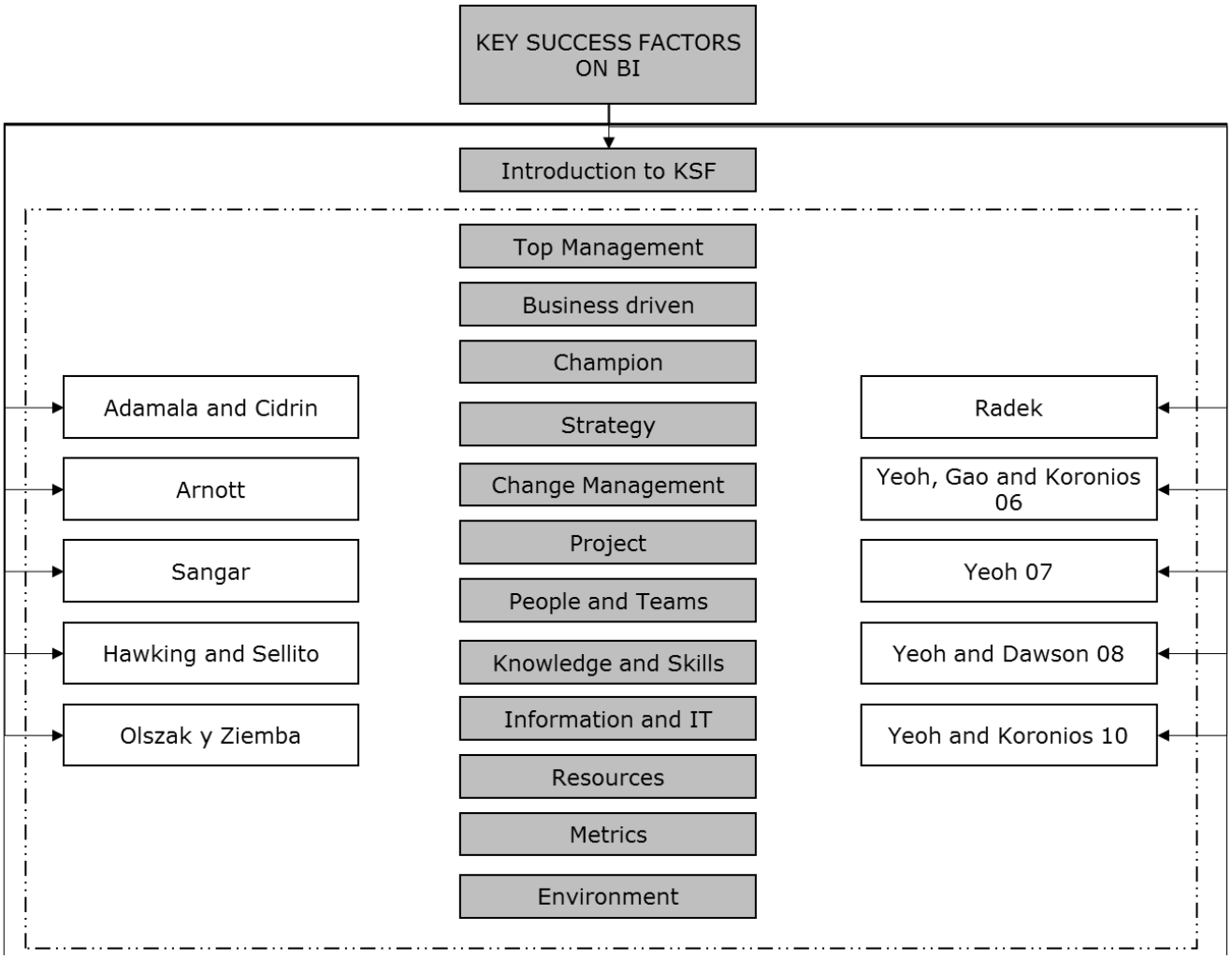


Figure 1 Node classification of key success factors on BI articles. This shows the node structure that is presented for the topic "key success factors on BI". The discontinuous line refers to contributions and its complementarity of each author to every exposed factor.

implementation of BI solutions were conducted (Table 3). According to Morse (1994) and Kuzel (1992) cited in Guest et al. (2006), a suitable number of interviewed participants in a qualitative study ranged from 6 to 8 people. Other studies (Fairer-Wessels and Malherbe, 2012; Fusch and Ness 2015; Mason 2010) argued that despite not having an ideal number of participants, saturation of information is a good stop index.

Each interview was made up of 30 questions (Appendix 1), two general questions to begin and end with a closer and conclusive conversation and 28 more focused on key success factors identified on literature that was exposed early on.

Based on the application, interviews duration ranged from 35 minutes to 82 minutes. Six were conducted in person and one on Skype.

Table 3 Experts participating in the study. This summarizes the main information about the experts who participated in the research. It contains basic information like degrees and practical and academic experience. Note: The distribution number is based on the order in which experts were interviewed, so this is not an important or significant factor in this research.

No.	*Position*	*Education*	*Experience*	*Means*
1	**Director** Information Technologies and Communications DNTIC - UN	Systems Engineer and Master in Systems Engineering	He has worked in the BI solutions industry for more than 25 years, 10 of which he worked as businessman and partner of a firm with which BI projects were designed and implemented in Colombia and Central America. He has been consultant and lecturer (outliner) in BI graduate courses.	Personal
2	**Professor** National University of Colombia	Mechanical Engineer, Telecommunications Engineering Specialist and Master in Systems Engineering.	20 years of experience in BI. He has worked with companies like *Latino BI* with the product *Cognos* in both, academic and industrial fields. He teaches BI subjects and works jointly with BI vendors like *IBM* and *Oracle*, developing events of presentation of solutions and consultancy by those vendors in the university.	Personal
3	**Professor** Konrad Lorenz University	Economist, Statistical Specialist, Master in Administration and PhD in Industry and Organizations	BI analyst for '*Casa Editorial El Tiempo'*. Also, BI and marketing research Director in the '*New Means and Transactional Portals Unit'* in the same organization, BI consultant and professor.	Personal
4	**Professor** University of the Andes	Systems Engineer, Master in Systems Engineering and PhD in Informatics	More than 20 years of experience in BI topics, data warehouses, physical designs and ETL in different sectors. She has served as project intervener, consultant, adviser and professor mainly in subjects like BI and business analytics.	Personal
5	**BI Manager** Philips Mexicana	Business Administrator, Marketing Specialist and Master in Multinational Administration	She has worked in the BI field since 2011 in worldwide companies like *Jhonson & Jhonson* and *Philips Mexicana* in data analysis as specialist and manager. She jointly works data analysis and financial analysis topics.	Skype
6	**Senior Analytics Architect - Cross Unit** IBM Colombia - S&D	Systems Engineer and Master in Systems Engineering	*Latino BI* partner jointly with *Cognos Corporation* and *Procalidad,* working on BI projects for companies in Colombia. *Cognos* Partner for Spanish companies. He worked with *Cognos Corporation* developing projects in Latin America. Since 2008 he served as Specialist and Architect in BI solutions, statistical and predictive solutions, operative and financial risk solutions and fraud solutions at *IBM*.	Personal
7	**Business Intelligence Project Director** On Data S.A.	Systems Engineer, emphasis in organizational information systems. Certificate in Management of information systems	She has served in BPM and BI as well as software quality insurance. Software quality Leader and BI Project Director for *On Data*. She focuses in planning, development and implementation of BI solutions for important companies both national and international located in Colombia in different sectors.	Personal

3.3 Information analysis

Interview processing was done with the NVIVO10 software based on a word frequency query applied to the seven documents of the interviews. It was a primary landscape of terms and keywords that were important in context, which were coincident with the early identified factors in the literature on key success factors in BI. With those terms a node structure was generated to classify and group information obtained from interviews. Table 4 shows the node classification and denomination that was used in the interviews processing.

Table 4 Node classification to interviews analysis. This shows the node classification and denomination that was used to the interviews processing with the NVIVO software.

Name	Resources	References
1. Directives and Top Management	7	20
2. Business Linking	7	25
Organizational Structure	7	12
Central control entity	5	7
3. Project Leader or "Champion" set up	7	24
4. Business Strategy	7	13
5. Change management	7	17
6. BI Project deployment	7	25
Requests	4	6
7. People and Human Talent Teams	7	22
People	7	14
Trust	5	9
Collaboration	2	8
Communication	5	8
Coordination	4	5
Engagement	3	4
Cooperation	3	4
8. Learning and Skills	7	33
9. Information and Technologies	7	45
10. Resources	7	35
Economic	7	9
Intellectual	7	9
Technological	7	17
11. Metrics	2	2
12. Environment	3	7
Argumentations	6	19

Table 4 shows the number of resources that were linked to the codification, which range from 0 (when no resources allude to each factor) to 7 (the maximum number of documents of experts interviewed). Likewise, it shows the number of references (codifications) made for each considered node. Almost all of the factors achieve the maximum number of resources, which means that most factors were treated by the experts in the interviews.

After identifying the primary and secondary nodes based on interviews, one-by-one-factor analysis was made. Pieces of interviews were taken to support the exposed ideas and outcomes as well as a text matrix summarizing the experts' arguments that support the outcomes.

According to the gathered information from the experts, a general structure which characterizes success factors in BI solutions in organizational environments was posted (research results). This structure is aligned and matches with the reviewed literature and is a product of a detailed content analysis of conducted interviews with the NVIVO10 software.

3.4 Proposition of hypothetical explicative structures to study the phenomenon

According to the identified factors from the literature, a single applicable hypothetical structure was formulated for each factor:

HS_0: *The identified factor does not affect the BI solution's success*

HS_1: *The identified factor affects the BI solution's success*

4. RESEARCH RESULTS

From the topics analysis of conducted interviews, results show that twelve pieces of literature identified factors that are consistent with experts' perceptions about BI solutions success, adding the *Professional Networks* factor according its importance to the experts. Figure 2 shows the obtained results.

Figure 2 shows the importance of every factor to the experts based on keywords attributed to each one, depending on the context in which each keyword was used by the experts. It should be noted that for this analysis 25% of the interviewees' transcript in the interviewed documents was used. Words or elements with less importance (which did not have a strong enough consistence to constitute an independent factor) according to this

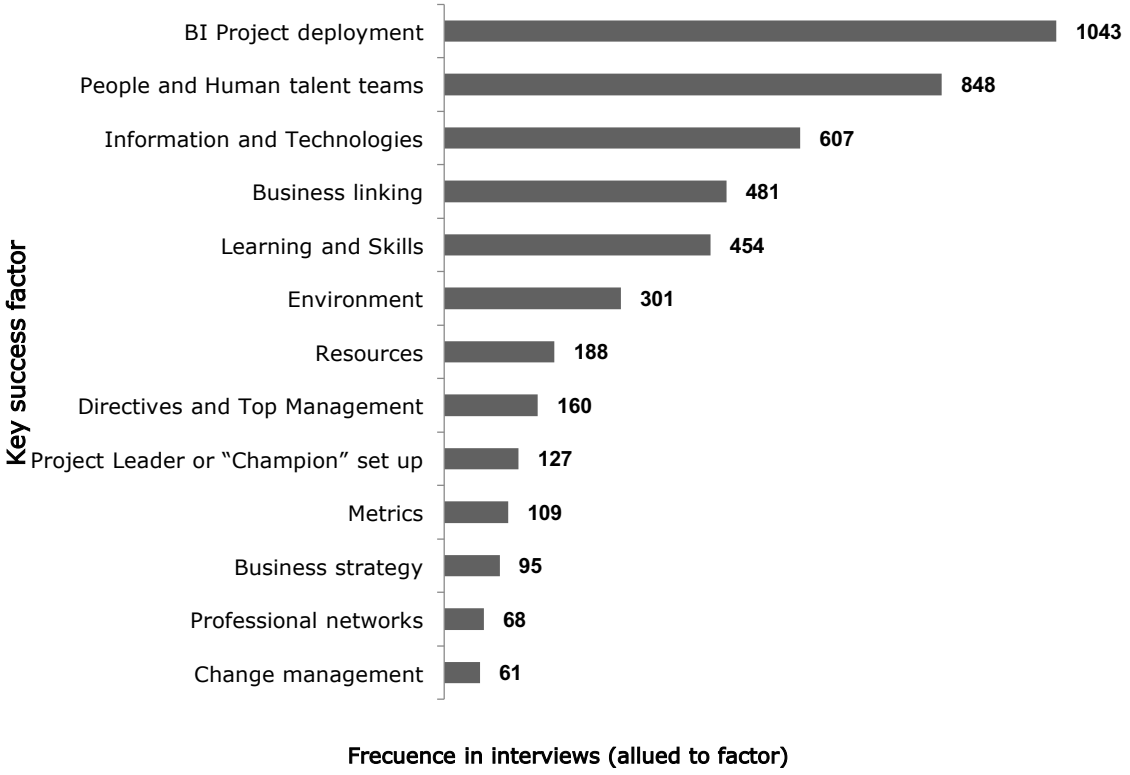


Figure 2 Importance degree of key success factors of BI solutions. shows the importance of the thirteen identified factors to the experts based on keywords attributed to each one, depending on the context in which each keyword was used by the experts.

analysis, were classified within the thirteen posted factors.

The next part focuses on presenting detailed research results after making an analysis of content based on the codification. Table 5 summarizes some of the experts' arguments taken from the documents of the interviews in support of the affirmations.

4.1 Directives and top management success factors

According to the experts there are four important characteristics around this factor. As a first step, making a decision about developing a project or implementing a solution is a top management affair: a manager, an owner, a steering committee or, by default, a third party with influence at the managerial level. All this leaves aside suppositions that the decision is made by organizational technology areas, as is commented on by the experts.

A second step is the deep knowledge about the request. A manager or top management executive of an organization is who decides what he/she needs. Although it could lead to misrepresentations and, sometimes, to incorrect BI project conceptions and developments due to the power or the political position these people may have within organizations, bad decisions could be made with expensive and useless projects, and may also discard more useful and viable projects because of individual decisions.

The third characteristic is the existence of a sponsor who is going to authorize and fund the idea of developing a BI project in an organization. The future of this kind of solutions depends on the top management's credibility since they will provide resources (mainly financial) and will sponsor efforts to achieve their objectives and goals.

Finally, handling of power and politics plays a fundamental role. It is evident that when experts say that these are projects focused on the top management, which is political by nature, forces that go beyond single decisions, requests and social relations are played. For instance, there are deep-root personal interests when there is a pursuit for personal favoring or figuration. In spite of that, it may be a positive point since it helps to analyze engaged actors in the project, and by this way to determine the best way to reach them, taking into account that there will always be detractors and followers with different levels of power and influence.

Table 5 Expert's arguments regarding to identified factors. This summarizes some of the expert's arguments taken from the documents of the interviews as support of the affirmations made within the article.

Validated factor	***Contributions by Expert***						
	E1	***E2***	***E3***	***E4***	***E5***	***E6***	***E7***
Directives and top mgmt	*It has got to have the top management's credibility and sponsorship or neither buy nor install.*	*(...) directive is who says what he/she needs. Simple! Put the request*	*[Projects] sometimes it depends a lot on directive's strength*	*If they are not convinced of benefits, it has little success probabilities*	*You Have to buy the idea 100%. If the initiative does not emerge from them, you should get a good sponsor with good influence*	*Nowadays there is not BI initiative if it does not come from a directive or VP*	*Manager contact us, we make him an offer and he is who say if products are bought or not*
Business linking	*[Important] is what concerns with indexes, objectives, goals and monitoring. It is the opportunity to accompany the business.*	*Enterprise structure is determinant especially for functions and responsibilities*	*The System must adapt to the organization as well as the organization to the system*	*(…) You start by understanding the sector in which the enterprise is into. You Understand the business and then needs and opportunities*	*You need to know what works, what doesn't work, and what you want to improve.*	*You have to define a strategy, where it goes to, what you want to get and how, how much you want to bet and what will be the earning.*	*You cannot implement anything if you do not know the business and customer's needs.*
Project Leader or "Champion" set up	*Generally all projects need a manager, particularly in informatics projects*	*Projects managers or project leaders have a different scope depending on their self-organization*	*This is a person who have to survive between daily fires and technological stream adoption*	*It is required, you have to have a specific leader there.*	*It is mandatory needed.*	*He/she Must be from the start, and, generally, it does not work with a single person, but with several leaders*	*It is a role which is totally indispensable*
Business strategy	*Implementation supports strategy*	*If I fix a strategy, I have to carry it out. It is just what makes a manager or a leader.*	*To the extent that the environment changes, strategy changes*	*It is necessary to know what the business strategy is, weaknesses and strengths [to know] where it goes to*	*Everything have to be routed to strategy*	*This project does not exist if there is not data, people, technologies and business strategy.*	*Who buy our products and services are not IT areas but strategy and decision making areas.*
Change mgmt	*In any project and generally an informatics project, change management is needed*	*Sometimes changes are due to a greater control and it does not like to people*	*I think there is a change resistance given more in a group than at individual level.*	*First I need to start evangelizing people regarding to what this is.*	*It is the main barrier, as I told you.*	*Human resources are needed to operate all this kind of solutions and an important process of change management is needed as well.*	*We are in a great paradigm shift which is to leave the Power Point to use Tableau*
BI Project deployment	*All informatics project needs planning.*	*(…) with that you can fix needed tasks, schedules and resources.*	*It implies a process organization, planning, collection, control and infrastructur e to generate data.*	*There is a follow-up, from business and the technical side. Posing how to conceive and how to implement.*	*From the beginning you need to know what you are looking for.*	*We assemble role pyramids: manager, technical leader, functional leader, solutions architect and consultants.*	*This kind of projects does not have neither a beginning nor an end, has a continuity.*
People and Human talent teams	*People who belong to a functional area are going to be engaged within the solution.*	*A single person cannot make everything, but the whole team can know about all of them who are needed.*	*A topic that is important for me is the forces' organization or work teams around this kind of projects.*	*He/she might not have the experience but he/she may know where people who have it are, and it helps the project to be more effective.*	*If you have well assembled a team than can implement and execute, they really could work better or worse with one or another technology.*	*[they are] vital because if not, project tend to fail*	*Team support makes valid why I am the projects' director, for instance.*
Learning and Skills	*In BI solutions value creation is*	*You need to train people*	*Learning is given at the*	*In the extent they*	*Technologies help you and*	*It is necessary to start doing*	*Agreements are*

Validated factor	*Contributions by Expert*						
	E1	***E2***	***E3***	***E4***	***E5***	***E6***	***E7***
	so evident, it makes all people get engaged.	*and remove their fear to the obstacles.*	*slowest person pace, this to avoid barriers in the process.*	*understand, information is obtained and a set of requests is collectively built.*	*facilitate learning.*	*knowledge transfer works.*	*fundamental. Training, consultancy.*
Information and technology	*Solutions are not expensive per se, They must be seen in a cost-benefit way. Solution choosing depends on cost-benefit relation.*	*By using technology you can do whatever you want, good and bad, It depends on how you look at this. Technology is able to make a lot of things, even imaginable things.*	*You have to change perspective about "this" is only technology nor just to buy a software, a hardware or to make a databases, etc.*	*I think that we are still in the first maturity levels in the adequate information treatment.*	*I think that tools are as good as information you enter, so you have to start with that.*	*There is a lot of information. It depends on what it is needed to the project and the working area.*	*Obviously there is a strong relationship, but there is no conditionality, that is to say, you do not depend on any technology to make anything.*
Prof networks	*Value creation is so evident, it makes all people get engaged.*	*It is so important that now all what is about networks, it is an input. Here I talk about professional and social networks.*	*External consultants and competence are the most important actors in that network.*	*The more you go expanding your circle, the more you enrich your learning.*	*It helps you a lot if you are leading a project. You receive opinions about how to implement or how to carry out the systems.*	*I look internally to see who has the skills to do it. Or externally, and see how experienced they are. That is how my network gets bigger.*	*Network is outsize and united, and I think it is valuable to know about what the others are doing.*
Resources	*To acquire a solution, a cost-benefit analysis must be done, it implies resources.*	*It must be allocated since the project planning stage.*	*There Must be people with intellectual capacities.*	*Online social networks are an important resource.*	*If I would have to decide, I would choose intellectual resources. I greatly appreciate technologies but they are just tools.*	*Solutions must be upgradable in all senses.*	*There Must be agreements with suppliers.*
Metrics	*Indexes allow to measure goals achievement, these allow to measure objectives achievement and objectives allow to make strategies.*	*When I have a decision, I do not think about what my heart feelings and my experience say, but I have a support on some indicators.*	*The project must have clarity about what results it targets and what are its KPI and its performance indicators.*	*One of the problems from the technical side is that you get indicators and deliver that, but, Does it have any sense?*	*You can measure all of your KPI with one or another tool. It facilitates your life and makes it fast.*	*I must take into account those indicators to which I want to reach and how I get it.*	*To be perceptive about what you have to sell: What generates value. Which indicator you can set. Why do not to formulate a metric?*
Environ-ment	-	*Now there is a globalized world because the sources, the sizes, the ways to work and the approaches are different. Paradigms have changed. Then notice that is not only that but all the environment.*	*The Project must not change if environment changes.*	*If you do not take into account organizational culture when you design a project like this, it could be a problem or a critical success factor of your project.*	-	-	*Value chain has to be transversal, it must have an amazing synergic to get this really arisen.*

4.2 Business linking success factors

Business linking is the starting point of any BI project. There is a consensus among several experts around the first-hand knowledge of the kind of business or organization and, derived from that, the sector in which it operates, activities developed by organization and, in itself, its position in economy. Furthermore, addressing business strategy becomes the second essential element in this factor since it represents the mission, vision, strategies, objectives, needs and, generally, all issues than have led the organization to think about a BI solution. Based on that, further actions can be determined in order to make a more optimal and efficient project.

This factor is the roadmap to project development since it sets a frame to follow according to the collected information that characterizes conditions in which an organization operates both internally and externally. Thus, subsequent actions can be stated to achieve results and fulfil the initially posted goals which justify the BI project development.

4.3 Project leader or "champion" set up success factor

It is vitally important to establish the project leader role. As experts stated, it is not reduced to a person but a position regardless of its denomination. They also emphasize the strategic importance that this role has within the project development.

This person is integral at technical, operative and personal levels. They must always be at the knowledge vanguard in favor of the BI project, and guiding all participant members according to that acquired knowledge and experience, not only technically but professionally and personally.

He/she must be influential in order to persuade other people of the benefits and the individual role within the project. Equally, he/she must be strategist at forming teams and groups in such a way that he/she exploits individual and group capacities for the common benefit.

He/she must be a person with values, always transparent to avoid influences from the top management or the operative side, understanding each one. This person will be in charge of negotiations among the parties involved, both internally and externally, dealing with problems and situations derived from the development and execution of the project.

This person must match efforts through technological, intellectual and personal resources coordination, exploiting individual capacities, serving as a central project axis and propending for centralization of activities and delegating responsibilities to all participants.

4.4 Business strategy success factors

As a first step, business strategy works to align input between project development and its proposed objectives and its implementation. As Expert 5 says *"all has to be routed to the strategy. That is why it also has to be aligned with the top management, it will be the primary line"*.

What is the importance of business strategy for a BI project? In the words of Expert 6 *"any process and in this case a BI process, it is part of a strategy. The first thing to define is: what is going to be the strategy? What do you want and where do you want to go to? What are the goals and objectives you want to achieve? That is the first thing you have to establish. Then you define a plan: how can you achieve that?"* It indicates what works as a support factor for the organizational processes.

In relation to the above, Expert 4 states that *"it is required to know what the strategy of the business is, weaknesses and strengths to know where it is oriented"* It summarizes that the business strategy factor works as a diagnosis tool, allowing one to know what the initial situation is without BI project, and what the desired state to reach with the project is.

Business strategy is not static. Thus, it is also presented with a factor of dynamism. According to the experts "*There must be clarity that strategy is normally emergent"* and it is dependent from the organizational environment, *"to the extent in which the environment changes, strategy changes"* otherwise the expected results could not possibly be achieved" states Expert 3.

It is evident that business strategy becomes a guide and at the same time a driving force that promotes the planning and implementation of a BI project, specifically its execution since the project will match the initial requests posted by the top management and the other people engaged.

4.5 Change management success factors

It is a linked factor to the organization's culture in which the BI project will be developed. According to Expert 1 *"there should be an early and simultaneous preparation. In any project,*

generally an informatics project, change management is needed. More in business intelligence. You need it as a key success factor to technology implementation"

Fear of change, as in any daily life situation, is present in this kind of project. Linked to that, the perception of BI tools in the project as a means of control, makes users and affected people in general take negative attitudes towards the BI initiative. Added to that, reactivity to carry out new processes and change the ones that exist, along with people's perceptions about being replaced by technical tools, reaffirms negative perceptions regarding actions in the BI project.

Although the above is not positive for the project, positive perceptions are also found at the moment of managing the change. According to the Experts' opinions, to innovate with a BI project in an organization allows the organizations to optimize processes that were tedious before, improving developed activities and achieving better results.

Likewise, there is the perception of specialization, which gives the person an image opposite to which he/she can form based on the established organizational culture, receiving benefits and learning new ways to perform the same processes.

4.6 BI project deployment success factors

According to the interviews with experts, the word *Project* holds the first use-frequency place (number of times it is repeated within the texts) by experts interviewed. It is no wonder, since it is the most important part of a BI solution. It includes in detail all issues, from the beginning to the end, being the center of all activities.

Consistent with the experts, the first step to follow must be evangelization and engagement of all of the actors who are going to be immersed in the project. In order to make them participate in its development, one must take them into account and show them the importance that it is going to represent to both their individual work and the organizational processes. This is achieved by training, meetings and constant and accurate information exchange.

At a general level, the BI project must start by setting its scope, thus, the relevant actions to formulate the project in detail should be set. That scope must obey the already set business requests mentioned, which indicate the need and relevance of formulating a BI solution, taking into account the expected goals.

Once those elements have been established, next one must undertake the project planning, which will determine in detail the schedules, tasks, and necessary resources (economic, intellectual and temporary) as well as business processes that will be engaged to achieve the goals established. Equally important is the responsibilities and role distribution for the process development.

Within these business processes, experts ensure that is important to detail issues such as: planning, and data collection, structuring, control and quality, as well as infrastructure, feedback and environment adaptation, continuity of activities and their follow-up. The latter is very important since it must be seen from three different points of view: business, technical and analytical, always guaranteeing business continuity.

4.7 People and human talent team success factors

Although social relations present difficulties due to their dependence on emotional, cultural and personal factors, among others, BI solutions are developed in environments where everyone has their role, responsibilities and an awareness of being part of a team that aims to achieve the agreed objectives.

The work team and the experience that members acquire are essential elements when developing a BI project. Based on this, the knowledge building, meanings and experiences that will benefit both individuals and organizations are important. Similarly, it is shown that the work team and its composition are mediated by six characteristics that could grow or limit its performance and development: collaboration, engagement, communication, trust, cooperation and coordination.

Collaboration is the first characteristic. According to Expert 6, along with coordination, *"[They are] vital because the project could tend to fail*", it must be immersed within the project from the conception because *"[within] the plan there must be all details of collaboration strategy in different fronts*" in order to know where you want to go with that collaborative work, and who must participate.

The second characteristic is engagement. According to Expert 2, *"engagement [must be] formal, formalized engagement works well because when it does not, it ends badly. [It] is the first thing to be workable, to have engaged people. When people are engaged, they will*

surely be responsible" but that is not so easy in practice because *"engagement is usually too low since we are hunters of opportunities and to the extent in which we find a better one, we will go behind it"* stated Expert 3.

Communication appears in the third place. It *"has to be open"* said Expert 6. According to Expert 5, everything that happens, regardless of the kind of information, must be communicated. *"(…) it is conveyed alike, if there is a day I do not inform people, small or big things, they work well or not*" problems could appear, so *"[it] must be as transparent as possible"*.

Trust is the fourth characteristic. As Expert 4 states, "*is an essential element*", also for Expert 5 who comments that *"it is indispensable and it must be totally transparent in order to achieve integration of all engaged people in your project"*. As Expert 6 states "*trust has to be vital, because everything that will be implement from the BI point of view is to improve the business"*.

The fifth place, and not the least important, is cooperation, which is essential because of the interdisciplinary nature of BI projects. As an Expert states *"if we do not cooperate between business, technical and analytic parties, it will be a failure"* which is shared by another Expert who states that *"cooperation is important because these kinds of solutions or systems are naturally made for several working teams, they are not made for a single person"*. Indeed, cooperative work ends up being synergic by nature.

Finally, coordination is the last characteristic. This one "*goes hand in hand with activities and responsibilities of each one and how I coordinate myself, with my pairs, my partners, to achieve the common goal, what is expected from all of these implementations*" states Expert 6. It is *"one of the needed skills for a person who wants to be on BI"* remarks Expert 5.

Besides those elements and characteristics that are present in the teamwork, there are other cross constructs in group activities which are essential to the job. Those are: involvement, empowering and participation which depend on organization of individuals.

4.8 Learning and skills success factors

Learning processes, according to experts, are generated at several levels. First, at a macro level, in which there is a conception of value generation for collective learning. Thereupon, there is a meso level, which is referred to as the existing relationship with external agents who foster learning through practices and knowledge that are initially foreign to the organization. Finally, there is a micro level, which involves technology as a tool or a way to learn and apprehend knowledge in a suitable environment. That environment counts on issues such as the individual insertion within the project, involvement, constant communication, a continuing information flow to get feedback and improvement, and a practice and operation stage that will work as a foundation to gain knowledge and then create new knowledge.

To promote that learning, an individual must possess certain types of skills, which make him/her liable to get and generate a specialized knowledge within a BI project. Both technical and non-technical skills shape the set that will give a result of specialized knowledge and learning in the field. According to Expert 3 *"people's skills in all levels are very heterogeneous"* and likewise *"they will depend on the role that individuals have within the project"* states Expert 6.

In agreement with what the experts say at a general level, it is important to have technical and non-technical skills that carry them to be "*people with a lot of negotiation skills, they must know how to listen to the internal client's needs and have an open attitude, they have to be very analytic people that solve conflicts"* affirm Expert 5. Concordant with that, they must *"learn and apprehend"* and *"develop the ability of questioning, this for them to talk the same business language"* state Experts 3 and 4.

On the other hand, it is necessary to have certain technical skills "*which are related to structuring and designing a project of this nature. That is done by specialized people in BI"*. According to Expert 1's opinion. *"If the part of models is worked, analytic models, statistical models, [there] must be a person who has this skill, this knowledge; a person who does not know about it cannot be there"* concludes Expert 6.

According to Expert 4 it can be summarized in professional and cross skills, which allow one to understand a business situation, give a suitable use and interpretation, and thus *"[be] able to carry this business request to a specific technical request."*

4.9 Information and technologies success factors

One of the essential inputs of BI solutions is information. According to the experts, it is more important than technologies because it could take the second or even third place when it is about seeing the importance of the component of the solutions.

Although data and information that could be generated are abundant, experts agree that information depends on the kind of project to be handled, for instance, financial projects, marketing projects, or human resources projects. With that, the kind of structure and design needed for its development can be established.

To have access to that information, the first thing is to conceive the study and design access roles. Not all users have the right to access to the same information and equally it must be ensured that the information they can access is pertinent to his/her task development. It happens to both internal information and external information coming from suppliers, customers and all related stakeholders.

However, to discern, use, analyze and get meaning from the information obtained, an operation by using technologies is needed. Those depend on the project scope, size of the organization, purposes, available resources and all elements analyzed above in the success factor of the BI project's development. According to the experts, technology does not take a privileged place when thinking of a BI solution because it is only a tool that gives options and facilitates the development of actions that could not be done without it.

In the words of one of the interviewed experts, there is a *"very strong relation, but there is not conditionality, that is to say, it does not depend on any technology to do anything. Not even on the use of Excel [since] you can do an analysis generated by the experience, an industry analysis [for instance] with the simple fact of knowing how many new clients came"*. It is concordant with the opinion of a second expert who says *"they are marvelous but sometimes are overvalued, I can tell you that there are BI projects that perfectly work with Excel"*.

According to Expert 6 *"whether it is wanted or not, technologies are important. (…) those tools exist for any reason, they are made for a different type of requirement"*. Those tools "*must possess both functional and non-functional characteristics"*. They must be also intuitive, friendly and accessible, as much as possible, always thinking about the users. As Expert 1 states, maybe the most important issue of those technologies must be their usability, since "*it must be addressed to final user, not to the informatics technicians"*. Likewise *"they are made to be a tool for the functional areas, not only for technicians' use, it is not a tool for the informatics area, but from this area tools are enabled to be used by final users"*.

Technologies in BI solutions must work as learning tools in order to improve skills and facilitate issues such as communication, relationship consolidation and the strengthening of organizational processes. They should be used as complementary tools, generating timely advantages, even when it is only a supporting tool. This must be done without omitting key issues such as security and the collaboration developed jointly with new information technologies.

It must be taken into account that technology, regardless of it costs, brand or reputation, must obey a need and must work under a cost-benefit logic, regarding the organization's needs. *"Tools are as good as information you enter, that's where all should start"* states Expert 5. *"Its investment will depend on its future return*" argues Expert 1.

4.10 Professional networks success factors

Despite the fact that "Professional Networks" is not one of the most used terms in the experts' speeches, it is also one of the key success factors for BI solutions as it could be observed. This is based on statements made by the six interviewed experts, who agreed that the fact of belonging or keeping up with what happens in professional networks, more exactly about BI topics, potentiates some faculties for professional and personal development in order to get more successful BI projects and solutions.

According to the collected information, six features that characterizes professional networks as BI key success factor could be observed. First they work as input sources for the project development because they find information from third parties, which could complement specific project developments, according to their characteristics and past experiences.

As a second step, an element to overcome obstacles is used, allowing one to beat possible personal and organizational barriers presented during the development of this kind of project.

Linked to the above and with a remarkable importance, it works as a synergy source, meeting and centralizing the resources available in the network to the project benefit. This, taking into account that complementary visions could be reached, and concepts, roles, experiences and resources, among others, could be shared.

An enrichment source is the fourth feature, having access to information and resources which allow a continuing learning and updating, based on interactions with third parties. Similarly, resource sources that provides knowledge, human and intellectual capital, both internal and external, depend on the organizational needs and itself the BI project through collaborative work.

Finally, an associated source achieves the constant articulation and communication among parties which will contribute resources, source and whole network quality improvement. It is important to mark that this feature goes hand in hand with communication and tracking to have knowledge about activities that other parties, which belong to the network, are developing.

4.11 Resource success factors

4.11.1 Economic resources

As Expert 1 states, BI project or solution choice is based on a cost-benefit relation, for him *"a solution is not expensive by itself, it must be seen in a cost-benefit context. Solution choice depends on this relation"*. Although this topic is sensitive at an organizational level since it involves monetary resources, it is essential when working on a BI solution. As Expert 2 states, "*those are resources that must be used from the [project] planning stage"* because *"when there is money involved, the first word is always NOT. Second is for what?"* States Expert 5.

Expert 3 asserts, *"these kinds of projects are not usually cheap and enterprises are prevented because they have invested a gross quantity of money and do not see quick incomes"*. This makes it more sensitive because when immediate results are not seen, BI solutions begin to be seen as great investments without any contribution or earning.

Regarding this topic, Expert 6 affirms that it is viable to have two concepts of financial resource planning in the projects. As a first step, top down planning could be set "*where [you have] a budget, a resource and [you plan] from that, trying to see what you do with what you have"*. The second option is the reverse, a bottom up plan where *"a series of plans and strategic initiatives are defined and consolidated, then give as a result a money quantity and then you see and look for funding, where money comes from and what to do to guarantee this resources"*.

4.11.2 Intellectual resources

According to Expert 3, *"there is not [any] technology that works without the human element and intellectual capacity for processing and analyze information. You could have marvelous systems but if you do not have people behind it, who have the capacity to exploit it to the maximum, there is no way to make it work"*.

Meanwhile Experts 1 and 2 state that *"when [there] is a project, [it] is necessary to know which experts [are] needed to be involved"* given that and to develop it, *"a specialization is necessary (…) [Since it involves] specialized people in the BI field, [which] cannot be done by anyone, that is why there are firms specialized in BI"*. It makes evident the importance of the kind of requested resource, facing also that it is *"a fundamental intellectual resource, [which makes it] so difficult to get an expert person in the field"*.

As a conclusion and as Experts 4 and 5 affirm, *"If there is a well-formed team which can implement and execute it, they really could work better or worse with one or another technology but they will carry out and will get the best from that. If you have the best technology but you do not have the people who could carry it out, it will not work"* therefore *"you need the technology knowledge and you need people who have the knowledge around it"*.

4.11.3 Technological resources

According to Expert 6: "*A technological resource is important because it often determines the success or not of the BI initiative. (…) it is not the same to make it with a software, product or hardware resource of low performance, poor upgradeability which does not have the capacity to grow in a corporate environment with all of what it involves: security, versioning, collaboration and all corporate issues you could have, compared with a tool that gives us this kind of possibilities"*.

It is concordant and it goes hand in hand with the affirmation of Expert 7 saying that "*technologies will be used, it should be the best existing in the market"* and it is advisable that *"a project like that (BI project) must have an alliance with infrastructure organizations, because [it] needs servers, machines, etc."* With

that you get constant updates and avant-garde technologies are promoted.

In this point, Online Social Networks (OSN) are presented as *"a still well-unexplored field",* Expert 4 states, and adduces that: *"there is an opportunity. (…) one of the current trends is: why do we not take advantage of that which is in social networks? Why do not we bring it and transform it? Since those data exist there, why do not we transform it into knowledge for the organization?*

Although OSNs were not considered to be a key success factor in BI solutions, they are involved at the time to think in sources, data handling, ETL, market analysis, brand perception and generally, issues related with marketing, as experts said.

4.12 Metrics key success factors

According to information gathered from the experts, metrics allow one to fix goals and to know where to go with the project development or what one wants to achieve. Accordingly, indexes allow one to do a follow-up of the project development, showing results based on the initial goals.

Metrics also allow one to determine behaviors during the development and execution of the project, which allows them to handle it in less uncertain environments, and establish proactive and reactive actions. It allows the organization to identify the degree in which objective fulfilment has been achieved and thus the achievement of dependent activities of the strategy that gave rise to the project development.

They are also immersed as management tools as part of the advanced reports or the project's results, and this works itself, supporting the management decisions based on real and consolidated information backed up by reliable systems or technologies. This success factor is key as a management tool since it allows one to analyze, diagnose, preview and make decisions in favor of the project development in order to be successful.

4.13 Environment key success factor

This success factor refers to the conditions that are inherent to the BI project during its planning, development and execution on behalf of both internal and external environmental factors, which have influence and direct involvement in the project activities and the people involved in the project.

Since environment is changing, project condition must change as well according to new demands. It is part of the paradigmatic rupture of always doing things the same way.

As is evident in interviews, BI solutions, by engaging a set of processes and new or improved technologies, present a resistance on behalf of individual and/or the group culture that is formed at an organizational level, or by the sum of the individual cultures that generate environmental conditions both positively and negatively.

These environmental conditions, despite the fact that they generate barriers, also generate benefits as joint problem solutions on behalf of positive issues formed by the organizational culture. Factors like founded organizational structure are influential in solving problems, since bases of personal and group relationships that operate through past experiences have been settled.

5. CONCLUSIONS

Up to now, academic research on the key success factors of implementing BI systems were still rare, limited in the scope of analysis (Pham et al. 2016) and poorly understood (Yeoh and Popovič 2016). Although BI solutions try to focus on success in the technological component, they adopt an approach that puts business needs first (Yeoh and Koronios 2010; Yeoh and Popovič 2016). Thus, BI solutions must be part of the company strategy, managed in a centralized way, involving all users from the first initiative, appropriating skills and suitable and needed knowledge.

Research exhibits 13 factors that contribute to improve the success rate of BI solution implementation. These solutions must involve a sponsor from the top management, permanently developing and adapting the expectations and challenges that face the organization, providing training as well as human, material, technical and economic resources needed for its development (Olszak and Ziemba 2012), all aligned with the strategy and the environment in which the organization operates. When all of these elements are identified from the beginning and are used as drivers for the implementation effort, there is a greater probability of success in the BI solutions implementation (Yeoh and Koronios 2010).

Although this literature review identified a total of 12 key success factors for BI solutions, another contribution from the research was the Professional Networks key success factor. This has emerged due to new trends in practice communities, a disseminated access to

knowledge and the narrowing of the professional ties among professionals from different or even the same industries or economic sectors.

For further research, this work may involve a greater sample of experts that allow for a more detailed analysis by economic sector, industry and likewise by distinguishing the kind of affiliation (public and private). Also, it could include participants who participated in projects as final users, since this research was developed based on experts who participated as implementers or were part of the top management team that was not necessarily implied to be a user.

6. REFERENCES

Adamala, S., & Cidrin, L. (2011). Key Success Factors in Business Intelligence. *Journal of Intelligence Studies in Business*, *1*(1), 107–127.

Ahmed, S. (2014). *Towards a Utility Framework for Enterprise Business Intelligence Mashups*. University of Ottawa.

Arnott, D. (2008). Success factors for data warehouse and business intelligence systems. In *ACIS 2008 Proceedings - 19th Australasian Conference on Information Systems* (pp. 55–65).

Arnott, D. (2010). Senior Executive Information Behaviors and Decision Support : A Research Agenda 1. *Bridging the Socio-Technical Gap in Decision Support Systems*, (July 2009), 37–48. https://doi.org/10.3233/978-1-60750-577-8-37

Bălăceanu, D. (2007). Components of a Business Intelligence software solution. *Informatica Economică, 2*, 67–73.

Castelán, L., Hernández, O., & Octavio, J. (2010). Diseño de un Almacén de datos basado en Data Warehouse Engineering Process (DWEP) y HEFESTO. *Research on Computing Science*, *50*, 125–135.

Chan, L. K., Tan, H. K., Lau, P. Y., & Yeoh, W. (2013). State-of-the-Art Review and Critical Success Factors for Mobile Business Intelligence. In *Communications of the IBIMA* (Vol. 1, pp. 708–717). International Business Information Management Association, IBIMA.

Cidrin, L., & Adamala, S. (2011). Key Success Factors in Business Intelligence. *Journal of Intelligence Studies in Business*, *1*(1), 107.

Consulting, E. (2010). *Overcoming the barriers to business intelligence success*. Hopkinton, MA.

Dawson, L., & Van Belle, J.-P. (2013). Critical success factors for business intelligence in the South African financial services sector. *SA Journal of Information Management*, *15*(1), 1–12. https://doi.org/10.4102/sajim.v15i1.545

Fairer-Wessels, F. A., & Malherbe, N. (2012). Sustainable Urban Event Practice: The Role of Corporate Sponsors within Gauteng. *Urban Forum*, *23*(1), 93–106. https://doi.org/10.1007/s12132-011-9128-7

Feng, X. F. X., Richards, G., & Raheemi, B. (2009). The Road to Decision-Centric Business Intelligence. *2009 International Conference on Business Intelligence and Financial Engineering*, 514–518.

Fernández Núñez, L. (2006). ¿Cómo analizar datos cualitativos? *Butlletí LaRecerca*, 1–13.

Folinas, D. (2007). A conceptual framework for business intelligence based on activities monitoring systems. *International Journal of Intelligent Enterprise*, *1*(1), 65–80.

Fourati-Jamoussi, F., Narcisse Niamba, C., & Niamba, C. N. (2016). An evaluation of business intelligence tools: a cluster analysis of users' perceptions. *Journal of Intelligence Studies in Business*, *6*(1), 37–47.

Fusch, P. I., & Ness, L. R. (2015). Are we there yet? Data saturation in qualitative research. *The Qualitative Report*, *20*(9), 1408–1416.

Guest, G., Bunce, A., & Johnson, L. (2006). How Many Interviews Are Enough ? An Experiment with Data Saturation and Variability. *Family Health International*, *18*(1), 59–82. https://doi.org/10.1177/1525822X05279903

Gurjar, Y. S., & Rathore, V. S. (2013). Cloud Business Intelligence – Is What Business Need Today. *International Journal of Recent Technology and Engineering (IJRTE)*, *1*(6), 81–86.

Hawking, P. (2013). *Factors Critical To The Success of Business Intelligence Systems*. Victoria University.

Hawking, P., & Sellitto, C. (2010). Business Intelligence (BI) critical success factors. In *ACIS 2010 Proceedings - 21st Australasian Conference on Information Systems* (p. 11).

Herrera, E. (2011). *Metodología para el desarrollo de un sistema de inteligencia de negocios basada en el proceso unificado*. Universidad Nacional de Colombia.

Hobek, R., Ariyachandra, T. R., & Frolick, M. N. (2009). The Importance of Soft Skills in Business Intelligence Implementations. *Business Intelligence Journal*, *14*(1), 28–36.

Karim, A. J. A. J. (2011). The value of Competitive Business Intelligence System (CBIS) to Stimulate Competitiveness in Global Market. *International Journal of Business and Social Science*, *2*(19), 196–203.

Knoben, J., & Oerlemans, L. a. G. (2006). Proximity and inter-organizational

collaboration: A literature review. *International Journal of Management Reviews*, *8*(2), 71–89. https://doi.org/10.1111/j.1468-2370.2006.00121.x

Linden, M., Felden, C., & Chamoni, P. (2011). Dimensions of Business Process Intelligence. *8th International Conference on Business Process Management, BPM2010*, *66*, 208–213.

Loshin, D. (2013). *Developing Your Business Intelligence Roadmap*. *Business Intelligence*. Elsevier.

Mason, M. (2010). Sample Size and Saturation in PhD Studies Using Qualitative Interviews. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, *11*(3), Art 8. https://doi.org/ISSN 1438-5627

Mingers, J. (2006). Management Science and Multimetodology. In Robert L. Flood (Ed.), *Realising Systems Thinking: Knowledge and Action in Management Science* (pp. 197–255). Springer.

Muntean, M. I. (2007). Business Intelligence Solutions for Gaining Competitive Advantage. *Informatica Economica Journal*, *XI*(3), 22–25.

Nemec, R. (2011). Business intelligence system success factors in context of DeLone & McLean's information system success assessment model with some application scenarios. In *9th International Conference on Strategic Management and its Support by Information Systems, 2011* (pp. 105–111). Technical University of Ostrava-VSB.

Olszak, C. (2016). Toward Better Understanding and Use of Business Intelligence in Organizations. *Information Systems Management*, *33*(2), 105–123. https://doi.org/10.1080/10580530.2016.1155946

Olszak, C. M., & Ziemba, E. (2012). Critical success factors for implementing business intelligence systems in small and medium enterprises on the example of upper Silesia, Poland. *Interdisciplinary Journal of Information, Knowledge, and Management*, *7*, 129–150.

Ortega, I. (2013). *Systematic Prevention of Business Intelligence Project Failures*. Munich.

Ortiz, G. A. (2014). Business Intelligence or Intelligent Business? *Computer Science and Information Technology*, *2*(4), 192–196. https://doi.org/10.13189/csit.2014.020402

Pham, Q. T., Mai, T. K., Misra, S., Crawford, B., & Soto, R. (2016). Critical success factors for implementing business intelligence system: Empirical study in vietnam. In *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*. https://doi.org/10.1007/978-3-319-42092-9_43

Popescu, S. (2012). Business Intelligence Solutions - A way of General Improvement of Efficiency and Effectiveness. *Review of International Comparative Management*, *13*, 88–96.

Rajterič, I. H. (2010). Overview of business intelligence maturity models. *Management: Journal of Contemporary Management …*, *15*(1), 47–67.

Rosado, A., & Rico, D. (2010). Inteligencia de negocios: Estado del arte. *Scientia Et Technica*, *XVI*(44), 321–326.

Rouhani, S., Asgari, S., & Mirhosseini, S. V. (2012). Review Study: Business Intelligence Concepts and Approaches. *Scientific Research*, *50*(50), 62–75.

Sakulsorn, P. (2011). *In-memory Business Intelligence In-memory Business Intelligence*. Stockholm University.

Salmasi, M. K., Talebpour, A., & Homayounvala, E. (2016). Identification and classification of organizational level competencies for BI success. *Journal of Intelligence Studies in Business*, *6*(2), 17–33.

Sangar, A. B., & Iahad, N. . (2013). Critical Factors that Affect the Success of Business Intelligence Systems (BIS) Implementation in an Organization. *Int. J. Sci. Technol. Res.*, *2*(2), 176.

SAP. (2013). *SAP BI Strategy*.

Serbia, J. M. (2007). Diseño, muestreo y análisis en la investigación cualitativa. *Holográmatica*, *3*(2007), 123–146.

Velicanu, M., & Matei, G. (2008). A Few Implementation Solutions for Business Intelligence. *Informatica Economica Journal*, *XII*(3), 138–146.

Watson, H. J., & Wixom, B. H. (2007). The Current State of Business Intelligence. *Computer*.

Yeoh, W., Gao, J., & Koronios, A. (2007). Towards a Critical Success Factor Framework for Implementing Business Intelligence Systems: A Delphi Study in Engineering Asset Management Organizations. *Information Systems*, *255*, 1353–1367.

Yeoh, W., & Koronios, A. (2010). Critical success factors for business intelligence systems. *Journal of Computer Information Systems*, *50*(3), 23–32.

Yeoh, W., & Koronios, A. (2010). Critical success factors for business intelligence systems. *Journal of Computer Information Systems*, *50*(3), 23–32.

Yeoh, W., Koronios, A., & Gao, J. (2006). Critical success factors for the implementation of business intelligence system in engineering asset management organisations. In

Proceedings of the 1st World Congress on Engineering Asset Management, WCEAM 2006 (pp. 344–351).

Yeoh, W., Koronios, A., & Gao, J. (2008). Managing the Implementation of Business Intelligence Systems. *International Journal of Enterprise Information Systems*, *4*(3), 79–94. https://doi.org/10.4018/jeis.2008070106

Yeoh, W., & Popovič, A. (2016). Extending the understanding of critical success factors for implementing business intelligence systems. *Journal of the Association for Information Science and Technology*. https://doi.org/10.1002/asi.23366

Appendix 1

Conducted interview to experts

Objective: To explore and to know about experiences that have had people considered as experts due to their academic and practice knowledge in business intelligence solutions implementation.

General question

1. Please shortly tell me about your professional and academic background regarding business intelligence and implementations of this kind of solutions.

Top management and directives block questions

2. How do you think people of top management influence on this kind of implementations?
3. How has the communication between top management and the rest of organization's people at the time to think in this kind of implementations been?
4. Describe in a single phrase the role that the next factors play between people and top management at the time to make BI solutions implementations:
   a) Trust b) Cooperation c) Coordination
5. How do you think power or people political influence impacts on the BI solutions implementations?

Business issues block questions

6. How do you perceive the influence of business in the BI solution implementation planning?
7. Likewise, how do you perceive the role of technologies and information inside the business issues?

"Champion" block questions

8. How do you perceive the idea of establishing a leader of the project for the BI solution implantation? Is it necessary?
9. How do you think the engaged people's trust is influenced by the fact of having a leader figure?
10. How do you perceive the influence of a leader within the negotiations that there may be among people involved in the project?

Strategy block questions

11. From your point of view, what is the role of the strategy in the project planning?
12. How do you think the adopted strategy to the BI project influences the collaborative processes performed in the organization?

Change management block questions

13. How do you see the impact in the change resistance on behalf of individual and group culture at the time to make an implementation?
14. How do technologies impact the change management at the time of making an implementation?

Project developing block questions

15. How do people's participation within the project usually happens?
16. How are learning topics and knowledge management handled at the time to conceive the project and implement it?
17. Have a central control entity figure to make the implementation been stablished? How does it work?
18. Do you think organizational structure influences in some way the BI solutions implementation? If yes, how does it happen?
19. How do technologies influence the project implementation?
20. What kind of information is handled during the project development? Who has access to that information?

People and human talent teams block questions

21. Which role do people's networks play when thinking about BI solutions? (it is not referred to online social networks)
22. What do you think about the influence of proximity among people in their collaborative work under the project execution? Understanding proximity as common issues existent among people.

Learning and Skills block questions

23. How learning processes happen and what abilities are required from the people participating in these implementations?
24. How do people's communications and commitment influence their learning processes and skills development?
25. How do people's networks influence their learning and skills development?

Technologies and Information block questions

26. How do you describe the role of social networks and its relation with

technologies and information used in Bi solutions?

27. Describe in a single phrase the relation (if there is any) that you find between technologies and information in a BI solution and:
    a) Learning
    b) Abilities
    c) Communication among participants

Resources block questions

28. What is your opinion about the relation between planning and economic resources used in a BI solution?
29. How do you define the importance of technological and intellectual resources in BI solutions?
30. What additional factors do you consider that affect/impact? Is there anything else, positively or negatively, related to this collaborative work?

Journal of Intelligence Studies in Business
Vol. 7, No. 1 (2017) pp. 70-78
Open Access: Freely available at: https://ojs.hh.se/

Business intelligence and SMEs: Bridging the gap

Ekavi Papachristodoulou[a], Margarita Koutsaki[a] and Efstathios Kirkos[a,*]

[a]*Department of Accounting, ATEI of Thessaloniki, Greece*

**Corresponding author: stkirk@acc.teithe.gr*

Received 15 February 2017; accepted 1 March 2017

ABSTRACT According to research findings, small and medium enterprises (SMEs) are facing problems such as an excessively large volume of data, lack of information and lack of knowledge. Therefore, in order to make decisions on time, the managers of SMEs use mainly their experience, which implies a high risk of failure. Business intelligence (BI) is a useful and helpful tool, which brings many advantages and benefits to businesses. However, like any technology, it is accompanied by some limitations that must be overcome in order to help businesses to develop. This paper summarizes current research findings addressing the issue of the development and application of business intelligence systems for SMEs. The issues addressed are models for the estimation of the readiness of a SME to establish BI tools, alternative BI solutions for SMEs, benefits and challenges of BI in SMEs, implementation methods for BI systems in SMEs and finally, BI systems in cloud computing platforms. Research papers dealing with these issues are analyzed and the results are presented. This paper contributes to the understanding of problems and potentials regarding the development and application of BI systems in SMEs.

KEYWORDS Business intelligence, competitive intelligence, SMEs

1. INTRODUCTION

Despite the economic size of each company, access to relevant and important information is very important to ensure the success of the acquisition of a market share. Business intelligence is considered a very important tool to achieve such a goal. According to the Gartner's surveys, business intelligence (BI) and analytics systems are ranked as the top technological priority of companies in the last years worldwide. The main objective of BI systems is to facilitate the decision making process by providing quality information, based on the analysis of large amounts of internal and external data. However, BI systems are characterized by their difficulty and complexity to handle. Also, economic factors are the ones that make many SME's administrations fail to proceed to the acquisition of a system. Normally, the development and maintenance of a BI system requires considerable funding. Moreover, the majority of SMEs do not have a specialized IT department. Many SMEs are run by the owners, who might not have advanced technological knowledge. It is known that the applications of BI are not primarily accessible to SMEs. The available systems are expensive, difficult to use and require excellent technological training of business staff. Commonly, these applications meet the needs of large enterprises, that have all the appropriate resources for their proper functioning.

Despite these limitations, better information provision, facilitated by a BI system, may lead to better decisions and become a consistent competitive advantage. A prerequisite is the successful confrontation of problems, stemming from the specific characteristics of SMEs. With the evolution of

technology, BI suppliers have designed and developed applications and tools to meet real small businesses needs. There are BI systems that are available online. These systems are affordable, easy and they belong to the category of cloud systems. Such solutions are suitable for SMEs, as they do not incur additional installation and maintenance cost. Tools and IT system applications are not considered a privilege of large companies, as the services offered are designed for the needs and requirements of SMEs, which can be just as competitive and successful. The present paper addresses a wide spectrum of issues related to the application of BI systems in SMEs. BI practitioners and SME managers might find this brief but concise summarization useful in their attempts to apply this cutting-edge technology in this specific business sector.

2. READINESS OF AN SME FOR BI

Hidayanto et al. (2012) conducted research to assess the readiness of a SME to establish a BI tool. For the development of the framework, the researchers used as their tools the Critical Success Factors and the Analytical Hierarchy Process. They focused on three categories of functions found in an SME. The framework formed by researchers primarily focuses on three main categories that are identified, which were developed and evaluated. These categories are organization where nine relevant factors were explored, process where four factors have been analyzed and technology where five factors were explored.

In this study the researchers initially make a theoretical presentation on the development of the model and then they proceeded to a more detailed description. Finally, the proposed framework is applied to a real case of a SME. Through this research, they explored and evaluated the critical success factors, namely the elements that are necessary to ensure the success of such a venture in the evaluation and acquisition of a BI system.

We chose the Analytical Hierarchy Process method for the development of the proposed framework, because this method allows the analysis of a complex problem in a more simple structure and selects the most effective solutions that lead the administration to better decisions (Taylor 2005, Cheng 1997). The researchers define the three steps of this method.

The first step is the decomposition of the model into three levels (objective, criteria and alternatives). In the second step, the comparisons between pairs of criteria and alternatives were created. The comparison was made with a rating scale of 1-9. The third and final step is the weight of each pair. This method was used to give the weight of each factor based on specific criteria and the better alternative was the one with the higher weight.

To be valid comparisons, the researchers chose values less than 0.1 (consistency ratio <0.1). Then, they began to develop a framework that would apply in a real and not virtual enterprise. The target frame raised the level of readiness of BI in an SME (level 1). Criteria joined the function categories of business (level 2), while the critical success factors were considered alternatives (level 3). For the purpose of the study, Hidayanto et al. (2012) used 18 factors based on the scientific literature references by Atre (2003), Williams and Williams (2004) and Yeoh and Koronios (2010).

For the category of organization, the critical success factors selected were committed management support and sponsorship, clear vision and well-established business case, strategic alignment, effective business/IT partnership for BI, BI portfolio management, continuous process improvement culture, culture surrounding the use of information and analytical applications, cross-organizational collaboration and decision process engineering culture.

For the process category, the factors chosen were balance team composition, availability of skilled team members, business driven development approach and iterative development approach and user oriented change management.

For the technology category business driven scalable and flexible technical framework, sustainable data quality and integrity, importance of metadata, BI and DW technical readiness and the silver bullet syndrome were selected.

Once the problem decomposition process was completed, the researchers proceeded to create pairs of criteria and alternatives, with the help of four specialists in BI. Experts, using the Delphi technique, gave values to results which arose from four comparisons: i) the inter-category pairwise comparison, ii) the pairwise comparison for organizational category, iii) the pairwise comparison for process category and iv) the pairwise comparison for technology category. Finally, the validity of comparisons of each class of the consistency ratio was

calculated (consistency ratio < 0.1) and the weight of each factor was calculated.

To give a more accurate and fair decision about the value of each factor in business, the researchers used the e-GP model (electronic government procurement) Readiness Self-Assessment. Thus, they evaluated the level of readiness of each factor using a scale (0-3) measuring each factor's readiness level.

The results of this research reaffirm the findings of previous research, mainly conducted by Williams and Williams (2004) and Yeoh and Koronios (2010). According to the BI experts the most crucial factors in developing BI systems are the following:

- Strategic alignment between business and IT. Consistency is required between business strategy, organization and processes and IT strategy, infrastructure, organization and processes.
- Managements support and sponsorship. The determination of the management to support the project secures the availability of resources such as funding and human skills.
- Clear vision and well established business. A clear strategic business vision is required. Such a strategic vision is needed for the establishment of a solid business case. Misunderstanding of the long-term vision and objectives may derail the BI project.

Other important issues are the composition of the BI team and the quality of the data. It is critical to include business experts who understand the strategic vision in the BI team so they can foresee the organizational challenges.

After the comprehensive development of the model, the researchers applied it to a real SME. They randomly chose an SME in Indonesia, which did not use a BI system. Through semi-structured interviews they assessed the level of preparedness of each factor separately and then multiplied it by the weight factor of the level of preparedness. After, they added all the results to give the final grade. The company managed to collect 58.05%. The result showed that although the company understood the importance of the factors for the implementation of BI, it had to face some obstacles and then proceed to the implementation of BI.

By applying a similar model, businesses will be able to analytically evaluate their readiness and then they can decide whether they will be able to deploy BI software, as they may be confronted with unexpected situations that may arise during the project. Management should be aware of the real needs of the enterprise and adopt corresponding services to manage and support them.

3. BI SOLUTIONS FOR SMES

Tutunea and Rus (2012) study alternative BI solutions for SMEs. In their research, they tested and evaluated the available commercial BI solutions, open source solutions and IT systems tools offered for small and medium businesses. The software tested was available on the websites of companies that provide BI solutions. For the evaluation of commercial solutions, they set two criteria. The first criterion set was the complexity that characterized the provided solutions. The variables set for this criterion were the functionality, maintenance and system support, accessibility and user interface and the final purchase price. The second criterion was characterized as the reputation of the company that was on the market.

By conducting this research, they have concluded that, depending on company size, the management and some specific internal factors, there are three types of BI solutions that allow companies to choose the one that best fits their requirements and needs.

As a first choice, they ranked the solutions developed within the company and did not involve specialized BI providers. These solutions mainly focus on static or dynamic analyses of the data with the help of Excel spreadsheets, Open Office Calc, Lotus 1-2-3, computer graphics, and what-if type analysis. Such BI solutions are part of SaaS (System-as-a-Software) and have gained ground in their acquisition by SMEs. This is because the final purchase cost is low, it is easy to use and the installation time is very fast. Also, there is no further staff training. The products are hosted in a secure online platform where the company has access without leaking data.

As a second option, the researchers ranked the commercial BI solutions. Of the software that was tried, they found that there are two types of providers.

The first category includes specialized software companies that provide exclusive BI tools. Businesses rely on a specialized team to design the software according to their needs

and requirements. Such providers are Information Builders, MicroStrategy, and QlickTeck.

In the second category, they identified companies that have a greater variety of interests. In this category are the BI solutions that are aimed at a particular sector such as education, banking or insurance systems. Such providers include Oracle, Microsoft, SAP, and SAS.

As a third option, they ranked BI solutions and open source solutions. The motivation that drives companies to proceed to the acquisition of such solutions is the low cost. Therefore, the architecture, the functionalities and their environment are considered to be the main criteria on which SMEs choose a BI tool. Providers of open source software are Actuate, Jaspersoft, Pentaho and SpagoBI.

Enterprises can choose a suitable solution, taking into account the quality of the information provided, data analysis tools and visualization, cost, accessibility and effectiveness of the decisions. Thus, companies depending on resources choose the best solution that will bring advantages

4. BENEFITS AND CHALLENGES OF BI IN SMES

In this section two surveys aiming at identifying the benefits and challenges of BI adoption in SMEs are presented. Also, through the research, they identified the sections of their application. For this purpose were used two research studies by Scholz et al. (2010) and Nenzhelele (2014).

Scholz et al. (2010) were able to identify the beneficial factors, challenges and types of SMEs that adopt BI tools. The authors study the adoption of BI by German SMEs by examining 214 firms in Saxony.

The method applied was based on references of other authors and researchers. The study was based on Exploratory Factor Analysis (EFA), which identifies the perceived benefits and challenges of implementing BI. Initially, to verify the suitability of the sample they used the KMO measure as proposed by Kaiser and Rice (1974). Then, they applied the MSA measure to validate the sample and then applied the PCA measure to extract relevant information. A number of factors have an impact on businesses, including applied graphics and an Eigenvalue with EV>1 according to Thompson and Daniel (1996, 200).

After identifying the strengths and challenges, they focused on identifying the type of businesses applying BI. For this, they used a cluster analysis, namely the k-means algorithm and the proximity measure ED. The numbers of clusters were defined by the use of a FC measure (Fusion Coefficient) (Toms et al. 2001).

To collect the necessary data, the researchers assessed 4960 Saxon firms, where the operators responded to an on-line questionnaire via e-mail, which covered a wide range of issues focusing on BI. The questionnaire was validated in two ways (Fowler 2001): it was originally created and written by experts in the field of information technology and then evaluated by conducting a preliminary test. In this way, they managed to ensure that respondent companies fully understood the terms and the importance of the questions in the questionnaire.

In total they collected 452 questionnaire responses. Of these 452 companies, 214 already had a BI tool. In these companies, they applied the technique of cluster analysis, to find the kind of companies that implement BI.

From the research conducted, they managed to identify three main beneficial factors including improvements to data support. In this factor the main benefits are reduced effort of data analysis and reporting, reports are available faster and with better quality, easy access to information and flexible reactions to new information. The second beneficial factor was improvements to the decision process where the main benefits are that business decisions are being eased by more precise and current data analyses, risks and chances are supported in a higher level and the company's results are improved. The last beneficial factor is savings and it's characterized by savings on personnel in different departments that can be achieved, competitive advantages can be achieved and cost savings in IT that can be achieved.

On the other hand, they were able to identify the main challenging factors. These were the challenges depending on usage. The main challenges are that the handling of the solution is too complicated and reports are to complex, data is poorly structured, capabilities do not cover business needs and BI staff are not qualified enough.

Challenges related to data such as software errors, inadequate security function, range of BI tools and functions don't match with the business needs.

The last challenging factor is the interface challenges. In this factor the main challenges

are limited data export and also that the data are not usually enough

Finally through the cluster analysis, they were able to identify four categories of companies using BI (Rapidly growing B2C, lightly regulated companies with a focus on collaboration, service-oriented B2B companies, and high-regulated product-oriented companies).

The research carried out by Scholz et al. (2010) showed that companies and organizations that do not have a BI tool should not only focus on the positive effects that could generate from its use. They should study and all those challenges and constraints that may arise, e.g. software errors, reduced resources, and unnecessary costs. Through cluster analysis, they concluded that product-oriented companies have better prospects in the application of BI. Also, through cluster analysis BI providers can identify the real needs of SMEs.

In the second examined paper, Nenzhelele and Pellissier (2014) identify which business areas mainly applied business or competitive intelligence and whether they understand the concept. According to Bernstein (2009) competitive or business intelligence is formed by processing the data, which produce information, processed information which produces knowledge and processed knowledge which leads to intelligence.

The data collection was done by using a questionnaire sent to a hundred SMEs in the greater region of South Africa. Their original purpose was to discover whether SMEs are aware of BI and then to identify the main challenges they face. Also, they tried to find the sections where companies apply BI. From the research, the researchers concluded that although companies understood the importance of BI, they did not apply an equivalent tool. Businesses using a BI tool asked about the main challenges and discovered that three restrictions are common to all businesses. The lack of time working with the system shows that small businesses do not have the needed time to manage a competitive intelligence system, the lack of human resources and economic factors were the main problems they face. The application area is not located in a particular part, but somewhere independently. This is because SMEs have no formal organizational structure, but one very important role is the application of competitive intelligence in market research and marketing department. Apart from the various challenges and benefits identified, SMEs are trying to be more competitive to be able to achieve higher profits and more sales. In this case, it is stated that SMEs choose to spend more money and establish BI software in market research and marketing departments.

5. IMPLEMENTATION METHODS FOR BI SYSTEMS IN SMES

Frion and Yzquierdo-Hombrecher (2009) present a new competitive intelligence model for the management of large amounts of data and information entering business. Initially they conducted a literature reference which focused mainly on the concept of BI. The second method was based on their long experience in competitive intelligence systems and their application mainly in small businesses. Also, through their experience, they managed to develop and present a new information management model: the Acrie Model.

From the literature, research is found that studies and research are carried out based on large companies. For this reason, the authors noticed that there are many different ways and methods to apply competitive intelligence. The literature survey was completed with the presentation of the new method and the new competitive intelligence information management model was developed. The model was called the Method Acrie.

The basic principles of this model are less data, more inductive reasoning tests and analysis and less information, more curiosity about the problem, focuses on human behavior and on information approach through questions.

The method takes place in three steps. The first step is a formal command formulation and an informal discussion to reformulate the first vague intent. The second step is a question plan, which consists of three levels and is formed by ten questions. This is to help the manager reach his expectations in a specific field. The third step consists of ten seeking plans, one for each question.

It takes a few weeks to prepare a small company for the Acrie Method. When the preparation process is achieved, experts implement the proposed model in the company. According to Frion and Yzquierdo-Hombrecher (2009), a small company is doing BI when the company is running an outgoing coordination prior to the five mail skills of BI activity: questioning, information seeking, information treating, distribution and protection of information.

The large amount of data and information entering business is not always a good phenomenon. This is why the authors developed a new information management model. Through this model, the Acrie Model, the leader creates plans and plans with the rest of the team to help to reach a better result for the company's interest. This method is used by small and large companies, with various tools to suit the needs of each company individually and to ensure the continuous coordination of the five main skills of competitive (business) intelligence. The Acrie Method is a proposed model of information management that can manage data and also focus on people who are involved in this process.

6. CLOUD COMPUTING AND BI

In the present section two papers, which aim to present BI in cloud computing platforms are discussed.

Agostino et al. (2013) identified the key success factors in their study for the adoption of cloud BI for SMEs and their characteristics based on the needs of BI users and suppliers. Past approaches based on Scholz et al. (2010) and Yeoh and Koronios (2010) have discovered three categories of factors. The first category is distinct from the organization, the second by processes and third by technology. According to Rockart (2009), the critical success factors represent a number of areas where satisfactory results will ensure a competitive position for the individual, the enterprise or a company's section. Little has been said about the association of SMEs with BI software in a cloud level and therefore there is no framework to analyse their connection. The categories of factors to assess the SaaS software level cloud according to Godse and Mulik (2009) are functionality, system architecture, use, reputation, costs and risk.

Researchers' methodology consists of two stages. The first stage was characterized as qualitative. Researchers interviewed four experts (BI suppliers and BI users) in cloud BI software. At this level, they tried to identify the weaknesses and the improvements through interviews given by BI users and suppliers. Critical success factors are divided into six categories: performance-functionality, integration, adaptability, reliability, support and cost of ownership.

The second stage was considered to be a quantitative stage. At this level, researchers tried to rank the key success factors for the adoption of a BI system. For this, an electronic questionnaire was created, which aimed to rank the importance of success factors. The use of cloud BI for SMEs was always a challenge for researchers, as the number of enterprises applying such a system was limited.

In this stage, scholars gathered information from 36 companies through a questionnaire on the issue of BI. The questionnaire was created by Bryman and Bell (2011).

The findings of the first phase were that the main factors for the adoption of BI systems was that they must have reduced costs, installation time and implementation and a quick response to user requests.

The results of the second stage showed that the main factors to be taken by an enterprise BI are the functionality of the system, continuous data access, rapid response to user requirements, a large amount of data management and implementation costs. Both stages have shown that users are looking for easy tools to use as they have the necessary expertise. The economic factor plays a very important role because SMEs have very limited resources. Cloud software is an economic solution, which outlines additional requirements adopted by SMEs.

Both stages have shown that users are looking for easy tools to use as they have the necessary expertise. The economic factor plays a very important role because SMEs have very limited resources. The cloud is an economic solution, which outlines additional requirements adopted by SMEs.

Sheshasaayee and Swetha (2015) present the challenges of BI software combined with cloud computing. The combination BI with cloud software has many important advantages.

The most important advantages are the speed of construction and speed of services, reduced costs of organization and payment of services depending on the use (Henning and Kemper 2010).

Over the years, it has been observed that the application of BI at the cloud level is increasingly of interest in the field of information technology. The goal of cloud services is the acquisition and provision of resources to meet the maximum requirements and needs of users.

According to scholars, cloud software consists of a three level structure: infrastructure, platform and software.

Cloud software is easy to use and flexible, but has some problems. The most common

problems according to the scholars are the different compatibility models, risk performance, and the variable price and cost ratios.

According to Sheshasaayee and Swetha, BI refers to technologies that convert users' available data resources and exportable information into business solutions.

The cloud combined with BI is considered to be one of the most modern technologies in the field of information technology and this is the main reason it is facing some serious challenges. In studies, it is argued that the combination of BI and cloud software encountered some obstacles.

The main challenges are the introduction of new technologies to the general public, the absence of idealized suppliers of specific software systems, the lack of control over the cloud services as all activities are done online and the movement of some compatible models that attempt to replace the actual abilities of cloud systems (Henning and Kemper 2010).

This together leads to the conclusion that cloud software is aimed at companies with reduced financial resources, such as SMEs, but is easy to use and functional. The functions that cloud BI offers have been designed specifically for the needs of SMEs.

7. CONCLUSIONS

Through studies and surveys, many researchers have reached the conclusion that SMEs are the largest part of the market, and therefore of the economy, in most European countries. They are the driving force of the economy as they provide the majority of jobs in the private sector, so they compete with larger companies. The main tool in the development and support of competitiveness among SMEs is BI. The decision support systems that are based on computer applications offer tools so that businesses can process data to extract information and to make better business decisions

Many researchers have researched the topic of BI in SMEs as well the benefits and challenges arising from the implementation of BI.

Hidayanto et al. (2012) shaped and developed a framework so that businesses can know in advance their level of readiness to adopt BI systems, as to avoid unpleasant results.

Tutunea and Rus (2012), undertook more commercial research. They focused on the available BI tools and their capabilities according to the type of business and their needs.

Scholz et al. (2010) found that the main beneficial factors from the application of BI are the improvements in data support, improvements in decision support and economic factors, while the main challenges they face are the errors and failures of software, the complexity of handling the failure of appropriate data and often inadequate data protection.

Nenzhelele and Pellissier (2014) were able to identify in which sections companies applied BI and what challenges the enterprises face. The main application areas are market research and the independent sector, since businesses have no formal and specific organizational structure. The challenges identified in this study proved to be the lack of resources, lack of time to learn and economic restraints. Decision support systems don't only have benefits but they also have challenges and obstacles.

Frion and Yzquierdo-Hombrecher (2009) created a new competitive intelligence model to help companies reach better decisions by managing a large volume of data. The proposed model (the Acrie Model) takes a lot of time to implement and, according to previous studies that have been conducted, SMEs don't have the necessary time to deal intensively with the software learning process.

Some researchers have focused on the new technology of cloud computing combined with BI. Agostino et al. (2013) identified the key success factors from adopting BI in cloud software. Through questionnaires and interviews given by businesses using similar systems and BI suppliers, they concluded that continuous data access, ease of use, reduced costs and quick installation time, implementation, and responsiveness are the main features that lead users to purchase software. But even this technology faces some challenges. According to Sheshassayee and Swetha (2015), the main challenges of cloud software are the extra costs that may arise from their use, the limited checking services and the non-establishment within the general public.

The main tool to create and support competitiveness is considered to be BI or otherwise competitive intelligence. Decision support systems based on computer applications offer the necessary tools and the right infrastructure so businesses can process the data, extract relevant information and

come to appropriate conclusions and therefore make better business decisions. Until a few years ago, the acquisition of BI systems by SMEs was considered difficult. Also, business owners did not consider it useful to obtain such a system. But over time, the evolution of technology and the continuous increase in competition, led to BI systems becoming a necessary tool for facing businesses' competitors and helping SMEs to evolve. However, SMEs have different needs compared to larger companies. This is the main reason BI vendors design and create software that is affordable, convenient and effective so as to meet the needs of smaller companies and organizations. Such technology is called cloud computing, and it is easy to use, economical and provides many features. Some of the advantages of using decision support information systems are the conversion of data into useful information in order to draw useful conclusions, the understanding of key elements in a company (e.g., customers, suppliers, or resources) and the use of a common code of understanding between different departments, the company's profit growth and the creation of a competitive advantage.

It is understood that BI is an essential part in the development of SMEs. Businesses will be able to make better business decisions and compete more effectively by choosing an appropriate system from a wide variety of programs based on the programs' weaknesses and challenges. Of course, the results from the use of the systems are not initially visible, but are perceived gradually. Businesses initially make slow but steady movements to become familiar with system tools. Then they take into account the system outputs that lead to decisions. Finally, once the companies are familiar with the system, all decisions are made by it. Once one knows the challenges and obstacles that may arise they will be in a position where they are prepared to face any obstacle presented to reach a satisfactory result through the application of BI.

8. REFERENCES

Agostino, A., Solberg Søilen, K., & Gerritsen, B. (2013). Cloud solution in Business Intelligence for SMEs -vendor and costumer perspectives. *Journal of Intelligence Studies in Business, 3*, 5-28.

Atre, S. (2003). *The Top 10 Critical Challenges for Business Intelligence Success*. Atre Group Inc.

Bernstein, J. H. (2009). The Data-Information-Knowledge-Wisdom Hierarchy and its Antithesis. In *Proceedings of the 2009 North American Symposium on Knowledge Organization*, 68-75.

Bryman, A., & Bell, E. (2011). *Business Research methods*. Third Edition. Oxford University Press Inc.

Cheng, C.H. (1997). Evaluating Naval Tactical Missile Systems by Fuzzy AHP Based on The Grade Value of Membership Function. *European Journal of Operational Research, 96*(2), 343-350. DOI: 10.1016/s0377-2217(96)00026-4

Fowler, J.F. (2001). *Survey Research Methods*. Third Edition. Sage Publications.

Frion, P., & Yzquierdo-Hombrecher, J. (2009). How to implement competitive intelligence in smes?. In *Proceedings of the Third VISIO Conference*, 162-173.

Godse, M., & Mulik, S. (2009). An approach for selecting software-as-a-service (SaaS) product. In Cloud Computing, 2009. CLOUD'09. IEEE International Conference on, 155-158

Henning B, & Kemper, H.G. (2010). Business intelligence in the cloud?. In *Proceedings of the PACIS 2010*, 1528–1539.

Hidayanto, A.N., Kristianto, R., & Shihab, M.R. (2012). *Business intelligence implementation readiness: A framework development and its application to small medium enterprises (SMEs)*. In *3rd International Research Symposium in Service Management (IRSSM)*.

Kaiser, H.F., & Rice, J. (1974). Little Jiffy, Mark IV. *Educational and Psychological Measurement, 34*(1), 111–117.

Nenzhelele, T. (2014). Competitive Intelligence Location in Small and Medium-Sized Enterprises. *Mediterranean Journal of Social Sciences, 5*(23), 608-615.

Nenzhelele, T., & Pellissier, R. (2014). Competitive Intelligence Implementation Challenges of Small and Medium-Sized Enterprises. *Mediterranean Journal of Social Sciences, 5*(16), 92-99.

Scholz, P., Schieder, C., Kurze, C., Gluchowski, P., & Bohringer, M. (2010). Benefits and Challenges of Business Intelligence Adoption in Small and Medium-Sized Enterprises. In *Proceedings of the 18th European Conference on Information Systems*.

Sheshasaayee, A., & Swetha, M.T. (2015). The Challenges of Business Intelligence in Cloud Computing. *Indian Journal Of Science And Technology, 8*(36).

Taylor, B. W. (2005). *Introduction to Management Science*. 8th Ed. Prentice Hall.

Thompson, B., & Daniel, L.G. (1996). Factor analytic evidence for the construct validity of scores: A historical overview and some guidelines. *Educational and Psychological Measurement, 56*(2), 197–208.

Toms, M.L., Cummings-Hill, M.A., Curry, D.G., & Cone, S.M. (2001). Using cluster analysis for deriving menu structures for automotive mobile multimedia applications. In *SAE Technical Paper Series 2001-01-0359*, Warrendale, PA.

Tutunea, M., & Rus, R. (2012). Business Intelligence Solutions for SME's. *Procedia Economics and Finance, 3*, 865-870.

Williams, S., & Williams, N. (2004). Assessing BI Readiness: The Key to BI ROI. *Business Intelligence Journal*, *9*(3), 15-23.

Yeoh, W., & Koronios, A. (2010). Critical Success Factor for Business Intelligence Systems. *Journal of Computer Information System, 50*(3), 23-32.

Journal of Intelligence Studies in Business
Vol. 7, No. 1 (2017) pp. 79-86
Open Access: Freely available at: https://ojs.hh.se/

A new model for identifying emerging technologies

Stephanie F. Hughes[a]

[a]*Department of Management, Haile/US Bank College of Business, Northern Kentucky University, Highland Heights, Kentucky, USA*

**Corresponding author: hughesst@nku.edu*

Received 1 January 2017; accepted 3 March 2017

ABSTRACT Today, the complexity of so many emerging technologies requires an understanding of adjacent technologies often originating from multiple industries. Technology sequence analysis has been used by organizations, governments and industries to help make sense of the many variables impacting the evolution of technologies. This technique relies heavily on the input of experts who can offer perspectives on the status of current technologies while also highlighting the potential opportunities in the future. However, the volume and speed at which scientific research is accelerating is making it nearly impossible for even the most knowledgeable expert to stay current with research in their own industries. Today however, the use of big data search tools can help identify emerging trends around disruptive technologies well before many of the experts have fully grasped the impact of these technologies. Despite the fear of many in the intelligence community that these tools will make their jobs obsolete, we expect that the value of the intelligence expert will increase given their unique knowledge of relevant data sources and how to connect the data in meaningful ways to derive value for the firm. We propose a new forecasting model that incorporates a combination of technology sequencing analysis and big data tools within the organization while also leveraging experts from across the open innovation spectrum. This new model, informed by current client engagements, has the potential to create significant competitive advantages for organizations as they benefit from expanded search breadth, search depth and search speed all while leveraging a range of internal and external experts to make sense of the rapidly changing technological landscape confronting their environment.

KEYWORDS Big data analytics, competitive intelligence, emerging technology, open innovation, technology sequence analysis

1. INTRODUCTION

Recent technological innovations such as unmanned aerial vehicles (UAVs) or driverless cars are hugely disruptive forces that have already, or soon will, dramatically alter the competitive landscape of markets from aerospace and the automotive industry to communication and defense. These innovations often involve technologies from multiple technological domains that can make a challenging environment for the experts tasked with staying on top of all the innovative activity. Long established market leaders can be quickly undermined by start-ups who understand the potential value of a technology long before most of the rest of the market is even aware of its existence. Clayton Christenson (2000) in his landmark book, *The Innovator's Dilemma*, coined the term "disruptive technologies" to describe innovations that create new markets by discovering new categories of customers. Disruption, per Christenson, can be achieved by harnessing new technologies, developing

new business models and/or exploiting old technologies in new ways.

To achieve the kind of disruptive innovation conceptualized by Christenson however, firms increasingly must look outside their own organizations and, often, outside their own industries to harness the innovative power of the crowd. These adjacent technologies are difficult for even the largest firms to uncover on their own. This innovation challenge is made even more difficult by the fact that so much innovative activity is taking place across the globe. Chesbrough (2003) coined the term "open innovation" to refer to firms that actively engage with outside organizations to enhance their own innovative capability. While firms have been doing this sort of thing for a long time, the focus on the positive impact of these activities on firm performance helped to jumpstart a broader acceptance across industries to utilize different types of external research partners such as universities, competitors, and government agencies, among others (Cohen and Levinthal, 1990; Parida, et. al., 2012). So, if firms want to take advantage of the wisdom of the crowd today, they must figure out how to become knowledgeable about all the activity occurring within their own industry, within adjacent industries and across the globe. They must also be able to identify and quantify the key researchers, associated organizations and the key technologies that would be most relevant to their own innovation processes. Finally, they must be able to accomplish this in an efficient, and relatively cost-effective manner.

Scenario analysis is one type of methodology that can help companies deal with the uncertainty of a future disruption. Bishop et al., (2007) suggested that "scenarios contain the stories of multiple futures" that are both creative and analytically feasible and help companies imagine a future world based on data and perspective grounded in the present. Scenario analysis techniques include a broad range of possible methodologies including expert judgment, event sequence analysis, backcasting, technology road-mapping, trend impact analysis, matrix analysis and technology emergent pathways among others (Bishop et al., 2007; Smith and Saritas, 2010). Smith and Saritas (2010) attempted to define the boundaries of these techniques a bit more specifically by suggesting that foresight analysis is a set of strategic tools that supports government and industry decisions by outlining multiple plausible futures over a 5 to 25 year horizon while highlighting emerging opportunities and threats along those various pathways. Each of these techniques is generally characterized in the following ways: provides a set of scenarios based primarily on expert judgment, sometimes, but not always, obtained through group engagement, mostly working from the present day set of events forward and rarely, involves the use of computers to assist the development process (Bishop et al., 2007). The utilization of external experts alone, or in a group, is rooted in the hope that they can provide a view of the future that is, ideally, not necessarily dependent on the company's present-day reality.

In the recent past, this type of analysis was mostly carried out by consulting organizations, working on behalf of big businesses, who accessed the expertise of Key Opinion Leaders (KOLs) to share their insight on where they believed the market was going and what was necessary to achieve this future state. There are three main problems with this approach. First, the focus of these efforts was often within single industries and lacked the perspective of an across-industry analysis which might uncover the adjacent technologies that are often so necessary to successful disruptive products coming to market today. For example, major camera manufacturers likely never thought about the possibility of a major technological change coming from *outside* their industry that smart phone-enabled photography would have on their market and thus, were unprepared for the seismic impact this technology had on their core business. Second, the use of consulting firms and KOLs to help make sense of the changing landscape of technology takes a long time to execute and produces a temporally-constrained view of what is happening with the technology. Finally, the length of time to recruit KOLs and execute an analysis of technologies from across industries can turn into an incredibly costly endeavor often outside the reach of most firms.

In this research, we propose the coupling of a big data analytics machine-learning capability with technology sequence analysis to offer an enhanced model for identifying emerging technologies. This approach can help firms deal with the huge challenge of initiating and managing disruptive innovation activities where success may depend on both the breadth and depth of the search as well as the convergence of varying maturation paths of different technologies. We also emphasize the importance of leveraging different kinds of

experts in this model including internal intelligence experts, data analytic experts and industry content experts as each of these groups plays a vital role in identifying, linking and contextualizing data to understand the evolution of specific technologies and their impact on the industry.

2. OPEN INNOVATION

A recent headline in a July, 2016 edition of Fortune magazine declared "Data is the New Oil" and projected that with only 20% of the world's data open and available, data will soon become its own currency (Vanian, 2016). Even as more governments make commitments to open their data to the public, an estimated 2.5 billion GBs of new data is created every single day (Schneider, 2016). In the United States, there are over 193,000 databases available to the public (Data.gov, 2016) and within the European Union, there are over 9,000 and counting (EU Open Data Portal, 2016). The Economics & Statistics Administration of the U.S Department of Commerce estimated that anywhere from $24-$221 billion is generated annually from using the data the government provides (USEAS, 2016).

The open innovation model is premised on the idea that invention and innovation do not have to take place in the same place where they are turned into products and commercialized (Inauen & Schenker-Wicki, 2012). Largely, as a result, of the huge investments in research and development (R&D) efforts, government and academic institutions tend to generate a lot of the inventions and innovations that eventually do get commercialized. In 2016 alone, the federal government was responsible for approximately $138 billion in R&D efforts while academia invested another $18 billion (Bernstein, 2016). Researchers have touted the benefits of open innovation to include the lower cost of R&D activities (Chesbrough, 2006), lower risk for the R&D efforts that can be shared by external partners (Herzog, 2008) and, better innovation performance (Hwang & Lee, 2010; Un et al., 2010).

Researchers further distinguished the nature of the flow of open innovation activities by focusing on inbound open innovation, which describes the one-way flow of external knowledge into a firm (Sisodiya, 2013); outbound open innovation where the knowledge flows out of an organization to external research partners (Powell, et. al., 1996) and coupled open innovation where knowledge flows are bi-directional and result in active collaboration between internal and external researchers and partners (Cheng & Huizingh, 2014; Gassmann & Enkel, 2004). Research has also confirmed the positive impact on firm performance by assessing the type of collaborating firm (e.g. customer, supplier, competitor, academic institution) involved in a firm's open innovation strategy (Tether & Tajar, 2008; Un, et. al., 2010; Wang et. al., 2015).

While it is conceivable to imagine that opening a firm's internal R&D efforts to outside knowledge would benefit from exposure to the diversity of thought and ideas, there appears to be a limit to the actual benefit due to the complexity and cost of establishing, maintaining and monitoring these external collaborative relationships. To understand that limit, Greco et. al., (2016) looked at the effect of search breadth (how broad the search process is), search depth (how intensive the interaction is between external collaborative partners) activities and the volume of bi-directional collaborative relationships the firm is engaged in and their impact on firm performance and found diminishing marginal returns. The researchers found that the broader the firm's search breadth and the higher the number of collaborative relationships, the more returns were diminished. The authors suggest that "a firm may be harmed by interacting with an excessive number of innovation channels, consequently reducing its effectiveness in bringing innovation ideas into implementation" (Greco et al., 2016). These results did not hold on the search depth metric as relationships that experience repeated interactions between the partners tended to be more robust in general and did not appear to evidence diminishing returns. So, it appears that a firm's open innovation activity could benefit from a more systematic and targeted approach to identifying technologies that will align with the organization's research efforts if it wants to accelerate the innovative output arising from its open innovation efforts.

3. TECHNOLOGY SEQUENCE ANALYSIS

Firms use technology sequence analysis to help them understand the extent, interdependence and likelihood of a wide range of emerging and adjacent technologies that are necessary to achieve a desired future state in their industry. Sequence analysis breaks down broad patterns of overall processes into sequences of activities or events that produce specific outcomes

constituting change (Isabella, 1990). So, the idea is to start with a future desired technology or product and work backwards by identifying the technologies or activities that must precede this future state. At each stage of the technology development process, there will be some assigned probability associated with their occurrence. Probabilities are assigned by accessing expert judgment, usually in the form of a panel of experts, who review the details of the required technologies to assess technological fit and estimated time to "market ready" status. Since we do not know exactly which event or events will occur, the probabilities assigned to later events will change as earlier events occur. This process produces a decision tree of nodes and branches with different outcomes listed along with assigned probabilities.

Van de Ven and Poole (1990) used sequence analysis to explain how and why innovations develop over time and which developmental paths lead to the success and failure of different kinds of innovations. Subsequent applications of sequence analysis looked at how organizational outcomes are influenced by changing the order of steps in a process (Pentland, 2003) or patterns of behavior (Adair & Brett, 2005) over some defined timeframe. Each of these efforts focused on process activities related to firm-level innovation.

Technology sequence analysis can also be used to assist in understanding how to accelerate product innovation. Abbott (1990) looked at whether and when certain events occur in the product development process as indicators of successful results. Salvato (2009) used sequence analysis to uncover the way capabilities are developed through everyday activities involved in the new product development processes and found organizations that track innovative activity occurring at all levels of the organization and, sometimes, outside its boundaries are generally more successful at renewing their core capabilities. Perks, et al., (2012) adopted sequence analysis to track the process of co-creation in the incremental development of a radical new service. Using sequence analysis on an experiential simulation dataset, Thatchenkery, et al., (2012) found that firms' R&D performance and performance in new markets increased significantly when firms engage in a consistent time-paced competitive sequence whose sequences follow regular (i.e. continuous or periodic) patterns and whose sequences do not conform to what their competitors perform well. Perks and Roberts (2013) utilized technology sequence analysis to investigate the series of micro activities, involved in product innovation, which are carried out by individuals within and outside the organization that create change over a longer time frame. Each of these applications of technology sequence analysis focuses on understanding the steps or processes involved in the innovation process, at a firm level, that can lead to more successful product outcomes.

There has been little publicized use of technology sequence analysis at the industry or country level, likely due to the inability of researchers to accurately access and categorize research being done outside the boundaries of individual firms. However, the ability to incorporate a big data research capability that leverages significant search depth and search breadth into this process makes technology sequencing at an industry or country level a more realistic possibility. Incorporating experts from outside the firm, across industries and from the furthest reaches of the globe is now possible due to the power of big data analytics, which can combine millions of records, aggregate search terms and, through the utilization of various machine-learning algorithms, identify the most relevant research and the companies and researchers most responsible for producing it.

4. EXPERT JUDGMENT

Expert judgment is one of the most common forms of scenario analysis and is used often to support many other forms of forecasting. Typically, expert judgment is accessed through panels convened for reviewing research or technology developed internally by organizations. The value of expert panels is that diverse ideas and alternatives can be examined especially by tapping into those outside the industry mainstream including "canaries", iconoclasts and idea provocateurs (Smith and Saritas, 2011). While not inexpensive, the cost of empaneling experts from academia and government entities is far cheaper than hiring these people on as employees of the organization and the perspective that is offered is often free from organizational bias.

Functionally, expert opinion supports a wide range of firm activities from strategy and competitive intelligence through to research and development. Competitive intelligence (CI) involves the collection of internal and external information to help companies predict the next

moves of their competitors, customers, and government entities (Gilad, 1996). In the CI field, industry experts are a critical source of perspective and information used to inform a firm's tactical and strategic activities. Internal CI professionals are tasked with helping the company make sense of these activities and must be knowledgeable about where to find the most relevant data to answer the company's most urgent intelligence needs. In many ways, these individuals act as translational experts for the organization by helping to frame research requests from internal constituents and then identifying the appropriate external data sources and experts to address these requests. Most CI units will outsource their data collection efforts, including hiring or interviewing experts, to third-party research firms. These groups maintain lists of industry experts that they rely on for key insight into what is happening in the industry. A key limitation of this approach is that often the networks are not deep enough in their bench capacity, broad enough in their industry perspective or refreshed frequently enough with new perspectives to provide the kind of insight and foresight that can give an organization confidence about the magnitude of the changes that might lay ahead or how to respond to them.

5. PROPOSED NEW TECHNOLOGY SEQUENCE MODEL WITH BIG DATA CAPABILITY

The proposed new model follows closely the suggestions of several researchers to augment existing forecasting models to include utilizing big data analytic capabilities in the process (Kajikawa et al., 2010; Vaseashta, 2014; Park et al., 2016). In utilizing computer-assisted citation network analysis across a broad range of energy-related publications, Kajikawa and his colleagues were able to efficiently build a technology roadmap for energy research that was incredibly effective at highlighting emerging areas of technology such as fuel cell and solar cell technology, despite the huge proliferation of readily available science-related content. Vaseashta (2014) combined three different methodologies, including technology foresight analysis, trend analysis and automated data analytics to demonstrate the potential of a new model for surveillance of emerging trends in science, technology and intelligence environments. Park et al., (2016) used patent data as a source and, in employing various statistical measures, were able to map out where the market for 3D printing was in its technological evolution and where it might be heading into the future.

As previously highlighted, most forecasting techniques rely heavily on expert feedback. However, as the proliferation of data continues to grow and the speed at which this data is produced accelerates, constructing a future technology roadmap based strictly on expert feedback is quickly becoming an obsolete approach. The fact that so much of this data production is also occurring globally makes

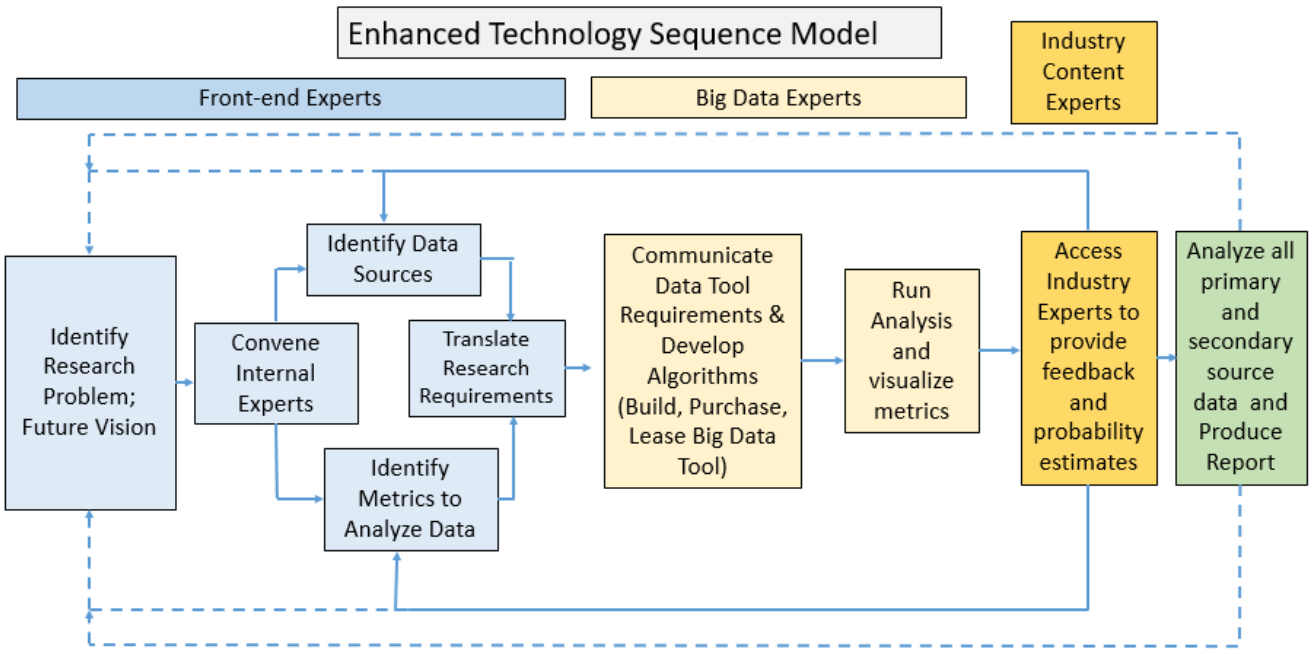


Figure 1 Enhanced technology sequence model.

expert-focused forecasting models even more of a concern as the ability to capture, process and analyze huge troves of global data becomes almost impossible to achieve without the assistance of some powerful data analytic platform. The very real possibility of missing a significant technological milestone can become an unfortunate reality if the company's network of experts does not stay up on the latest developments in their field of expertise.

The model in Figure 1 goes beyond merely augmenting existing foresight techniques with big data capability. Instead it places a heavy emphasis on the role and timing of when to include different kinds of experts along with big data capability to help firms achieve significant differentiation in technological forecasting. We separate the role of experts in the process into "front-end translation experts" who are primarily company insiders such as strategists or CI professionals, "data scientists" who attempt to address the needs of the internal client by automating data capture and analysis using machine learning capabilities and "industry content experts" who generally come from outside the company and who provide a view of the industry or technology that is free of organizational bias.

The role of the front-end expert is highlighted in this expanded forecasting model as someone who takes the requirements of internal departmental units and makes sense of them by identifying the appropriate data sources, metrics and internal experts to incorporate into the process to produce a relevant and targeted analysis. By leveraging the potential of the open innovation philosophy, the role of the data scientist expert is to enhance the search breadth, search depth and search speed by focusing on connecting relevant data sources (either open or proprietary) and utilizing machine learning to find underlying patterns between technologies, people and organizations. These tools help to quantify experts' contributions to their scientific and technical disciplines and makes uncovering industry experts a much more scientific process. In this way, the role of the industry content expert can then be leveraged in a much more meaningful way because we can identify and quantify the expertise of researchers within and across technological disciplines by their specific areas of expertise. This opens the potential for a much richer analysis of the technological landscape by broadening the firm's reach to those with very specific knowledge in technical domains and often from outside a single industry. These experts can provide insight and estimates of probabilities into the specific obstacles and opportunities around a broad range of core and adjacent technologies and help to develop a more sensitive and accurate technology sequence analysis.

Then recent emergence of many data analytic platforms provides organizations options for whether to "build", "buy" or "license" to get into the market. Obviously, the shortest path to implementation will be to license one of the many platform tools that are available today. The upside to licensing or leasing is the speed of implementation and lower upfront costs to participate. The downside is generally a lack of customization for both data sources and the algorithms that make sense of it all. The "buy" option provides some greater options for customization but with lower implementation speed than the license model and higher costs as well. Finally, the "build" option provides the greatest amount of flexibility around customization but costs significantly more than the other two options and takes far longer to implement.

6. CONCLUSIONS AND FUTURE RESEARCH

Traditional forecasting methods which rely heavily on expert guidance must begin to incorporate big data analytic capabilities in their process or risk soon becoming obsolete. This paper reinforces the important role of several different kinds of experts in technology forecasts but emphasizes the importance of adding big data tools to the process primarily because of the need in all industries to be "globally data aware" (Kostoff & Schaller, 2001), which is impossible to do today with the volume and speed of production of digital data.

The choice of whether to build, buy or lease a big data analytic platform will be heavily dependent on the long-term vision of the organization with respect to the choice of data sources. If an organization possesses data that they believe provides a true leading view of the market, they may want to exercise greater control over that data and opt for a custom-built platform tool. If they are unsure what data they want or need or are just getting started, they may want to consider leasing a tool early on. As they gain experience and better appreciation of the value of leveraging connected data, the buy or build approach becomes the more valuable option. One caveat to this choice is the fact that currently there is

a dearth of data scientists and visualization professionals so if a firm lacks the resources to attract and retain these type of professionals, they may face limited options regardless of interest or need.

CI professionals who embrace the utilization of big data tools into their CI processes should find increased relevance and power within their organizations as they become crucial to the organization's ability to leverage the power of these new tools. The role of the "translational expert" who can take the research problems and, by leveraging data and speed, generate advantages for the organization over its competitors becomes exponentially more valuable to the organization. CI professionals should seek out training and seminars to learn as much as they can about big data tools and the various business models associated with the utilization of these tools so they can begin to identify opportunities inside their organization where these tools may provide value. Finally, CI professionals should begin to create a reference library for the automated data that the company currently produces, especially anything that highlights the behavior of its customers or market that can potentially be combined with external data to drive new and unique insights. The fact that CI professionals have responsibility for maintaining competitive and market intelligence oversight for entire product lines, divisions or for the firm makes them uniquely positioned to appreciate the research and data needs of their internal customers and able better translate these needs to the data analytic experts.

The new battlefield of the future for strategy and CI professionals will be to identify the appropriate mix of datasets and algorithms that create a truly predictive big data intelligence tool. As more and more data become available to mine, it is the company's knowledge of how to combine internal and external datasets utilizing proprietary algorithms and their access to industry experts that will become the new competitive advantage for the next generation of global market leaders.

7. REFERENCES

Abbott, A. (1990). A primer on sequence methods. *Organization Science*, (4), 375-392.

Adair, W.L. & Brett, J.M. (2005). The negotiation dance: Time, culture, and behavioral sequences in negotiation, *Organization Science*, 16(1), 33-51.

Bernstein, E. (December, 2016). The Global R&D Funding Forecast, *R&D Magazine*, Winter, 1-36.

Bishop, P., Hines, A., & Collins, T. (2007). The current state of scenario development: An overview of techniques. *Foresight*, (1). 5-25.

Cheng, C.C. & Huizingh, E.K. (2014). When is open innovation beneficial? The role of strategic orientation. *Journal of Product Innovation Management*, (6), 1235-1253.

Chesbrough, H., (2003). Open Innovation: The New Imperative for Creating and Profiting from Technology. Harvard Business School Press, Boston, MA.

Christenson, C. (2000). *The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business*, HarpersCollins Publisher. New York, New York.

Cohen, W.M. & Levinthal, D.A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, (1), 128-152.

European Union Open Data Portal. (2016). Retrieved from https://data.europa.eu/euodp/en/data/

Gassmann, O., & Enkel, E. (2004). Towards a theory of open innovation: Three core process archetypes. *Proceeding of R&D Management Conference*, Lisbon, Portugal, July.

Gilad, B. (1996). *Early warning: Using Competitive Intelligence to Anticipate Market Shifts, Control Risk, and Create Powerful Strategies,* AMACOM, New York, NY.

Greco, M., Grimaldi, M., & Cricelli, L. (2016). An analysis of the open innovation effect on firm performance. *European Management Journal*, 34, 501-516.

Herzog, P. (2008). *Open and Closed Innovation. Different Cultures for Different Strategies*. Gabler, Wiesbaden.

Hwang, J. & Lee, Y. (2010). External Knowledge search, innovative performance and productivity in the Korean ICT sector. *Telecommunications Policy*, 34 (10), 562-571.

Inauen, M. & Schenker-Wicki, A. (2012). Fostering radical innovations with open innovation. *European Journal of Innovation Management*, 15 (2), 212-231.

Kajikawa, Y., Takeda, Y., & Matsushima, K. (2010). Computer-assisted roadmapping: A

case study in energy research. *Foresight*, (2). 4-15.

Kostoff, R.N., & Schaller, R.R. (2001). Science and technology Roadmaps, *IEEE Transactions on Engineering Management*, 48, 132-43.

Perks, H. & Roberts, D. (2013). A Review of Longitudinal Research in the Product Innovation Field, with Discussion of Utility and Conduct of Sequence Analysis. *Journal of Product Innovation Management*, Nov. 2013, 30 (6), 1099-1111

Parida, V., Westerberg, M., & Frishammar, J., (2012). Inbound open innovation activities in high-tech SMEs: the impact on innovation performance. *Journal of Small Business Management*, 50 (2), 283–309

Pentland, B. T. (2003). Sequential variety in work processes. *Organization Sciences*, 14 (5). 528-540.

Perks, H., Gruber, T., & Edvardsson, B. (2012). Co-creation in radical service innovation: A systematic analysis of micro-level processes. *Journal of Product Innovation Management*, 29, 935-951.

Perks, H. & Roberts, D. (2013). A review of longitudinal research in the product innovation field, with discussion of utility and conduct of sequence analysis. *Journal of Product Innovation Management*, 30 (6), 1099-1111.

Park, A., Kim, J., Lee, H., Jang, D., & Jum, S. (2016). Methodology of technological evolution for three-dimensional printing. *Industrial Management & Data Systems*, 116 (1), 122-146.

Powell, W.W., Koput, K., Smith-Doerr, L., (1996). Interorganizational collaboration and the locus of innovation: networks of learning in biotechnology. *Administrative Science Quarterly*, 41(1), 116–145.

Salvato, C. (2009). Capabilities unveiled: The role of ordinary activities in the evolution of product development processes. *Organization Science*, 20(2). 384-409.

Schneider, C. (2016, May 25). The biggest data challenges that you might not even know you have, *IBM Blog*, Retrieved from https://www.ibm.com/blogs/watson/2016/05/biggest-data-challenges-might-not-even-know/

Sisodiya, S.R., Johnson, J.L., Grégoire, Y., (2013). Inbound open innovation for enhanced performance: enables and opportunities. *Industrial Marketing Management*. 42(5), 836–849.

Smith, J.E. & Saritas, O. (2010). Science and technology foresight baker's dozen: A pocket primer of comparative and combined foresight methods. *Foresight*, 13(2), 79-96.

Tether, B. S., & Tajar, A. (2008). Beyond industry university links: sourcing knowledge for innovation from consultants, private research organizations and the public science-base. *Research Policy*, 37(6), 1079-1095.

Thatchenkery, S. M., Katila, R. & Chen, E. L. (2012). Sequences of competitive moves and effects on firm performance. *Academy of Management Annual Meeting Proceedings*. 2012, p1-1

U.S. Federal Government (2016). Retrieved from https://www.data.gov/

U.S. Economic & Statistics Administration. (2016). Retrieved from http://www.esa.doc.gov/reports/fostering-innovation-creating-jobs-driving-better-decisions-value-government-data

Un, C. A., Cuervo-Cazurra, A., & Asakawa, K. (2010). R&D collaborations and product innovation. *Journal of Product Innovation Management*, 27(5), 673-689.

Van de Ven, A., & Poole, S. (1990). Methods for studying innovation development in Minnesota Innovation Research Program. *Organization Science*, 1 (3), 313-335.

Vanian, J. (2016, July 15). Why Data Is The New Oil. *Fortune*, Retrieved from http://fortune.com/2016/07/11/data-oil-brainstorm-tech/

Vaseashta, A. (2014). Advanced sciences convergence based methods for surveillance of emerging trends in science, technology and intelligence. *Foresight*, (1), 17-36.

Wang, C.H., Chang, C.H., & Shen, G.C. (2015). The effect of inbound open innovation on firm performance: Evidence from high-tech industry. *Technological Forecasting & Social Change*, 99, 222-230.