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Stevan Dedijer
1911-2004

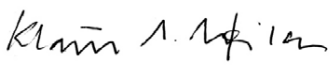
The width and scope of intelligence studies in business

If the last issue of JISIB was a special issue where the discipline was reflecting on itself, then this issues shows some of the width and scope of the field. The conceptual article by Nienaber and Sewdass presents a relatively new concept of workforce intelligence, and links it to competitive advantage by way of predictive analytics. The article by Solberg Søilen is an attempt to lay out a broad scientific agenda for the area of intelligence studies in business. Empirical findings come from a survey, but in the discussion the author argues for why the study should define itself as much broader than what the survey data implies, breaking out of the current dominating scientific paradigm. The article by Fourati-Jamoussi and Niamba is an updated evaluation of business intelligence tools, a frequently reoccurring topic. However, this time it is not a simple evaluation of existing software, but an evaluation by users to help designers of business intelligence tools get the best efficiency out of a monitoring process. The article by Calof is an evaluation of government sponsored competitive intelligence for regional and sectoral economic development in Canada. The article concludes that it is possible to calculate positive economic impacts from these activities. Rodríguez Salvador and Hernandez de Menéndez come back to a field that has become a specialty for Rodríguez Salvador: scientific and industrial intelligence based on scientometric patent analysis. This time she looks at bio-additive manufacturing using advanced data mining software and interviews with experts.

As always, we would above all like to thank the authors for their contributions to this issue of JISIB.

On behalf of the Editorial Board,

Sincerely Yours,



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

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A reflection and integration of workforce conceptualisations and measurements for competitive advantage

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ABSTRACT Workforce management is important in organisational performance. However, executives lament that their workforce management efforts remain ineffective. This comes as no surprise, as workforce measurement poses a challenge for several reasons: the many different conceptualisations of the workforce, which developed in parallel, and flawed workforce analytics, hence inadequate workforce intelligence, are among the most significant. To have the right people available requires timely and accurate information and intelligence to make evidence-based decisions. In order to achieve this proper measurement is required, which forms part of the information system that ensures the availability of the right people, at the right place, at the right time. People measurement/metrics, is a neglected area of research, which is receiving increased attention. Though little, if any, attention is devoted to the link between people as dimension of competitive advantage and metrics to ensure the availability of the right people, at the right place at the right time. Our conceptual paper attends to this omission by reflecting on the different conceptualisations of 'workforce' by integrating the diverse and fragmented literature, which has not been done before, and linking it with workforce measurement. In so doing, we provide a more comprehensive understanding of 'workforce' and workforce measurement, ensuring alignment with organisational strategy to secure a competitive advantage and, thus, organisational performance. We also propose an integrated framework to measure and manage the workforce. It transpired that of the many tools available, predictive analytics emerged as the most effective means to measure and manage the workforce successfully. Our paper benefits both academics and practitioners as theoretical ambiguities and tensions are clarified while ensuring the availability of the requisite workforce.

KEYWORDS competitive advantage, organisational performance, predictive analytics, strategy, workforce, workforce analytics, workforce intelligence, workforce metrics

1. INTRODUCTION

Workforce management, in whatever guise it appears, has emerged as the answer to promote competitive advantage, ensuring sustainable organisational performance (Owen 1813; LePak and Snell 2002; Sirmon et al. 2011; Campbell et al. 2012; Vaiman et al. 2012; Ployhart et al. 2014; Teece 2014; Wright et al. 2014; Collings 2015). In brief, workforce management is generally seen to involve utilising people with the right sets of competence, across occupations and hierarchies, in a particular context, to ensure organisational performance (i.e. goal achievement) both now and in the future. These sets of competence comprise knowledge (tacit and/or explicit; declarative and/or

procedural), skills, abilities/capabilities, experience, attitudes/motivations and physical and emotional health. Although organisations recognise the importance of workforce management in sustaining organisational performance, their efforts remain ineffective (Ashton and Morton 2005; Lawler 2006; Beechler and Woodward 2009; Harris et al. 2010, 2011; Vaiman et al. 2012; Boudreau 2013; Dries 2013a,b; Winkler et al. 2013; Bersin et al. 2014; Gelens et al. 2014; Kinley and Ben-Hur 2014; Phillips and Phillips 2014; Collings 2015). A range of reasons is advanced for this state of affairs. On the one hand, it is argued that 'workforce,' especially in the talent guise, and 'organisational performance' lack conceptual clarity, influencing their measurement and consequently their management. This creates a dilemma for organisations when employing and deploying workers to ensure the organisation's performance. It stands to reason that we can only manage what we can measure, and we can do so only as well as the intelligence derived from the measurement. In addition, workforce management is compounded by challenges such as globalisation, skills shortages and the accompanying war for 'talent,' the mobility of workers, changing demographics and the recessionary lay-off of workers, all of which adversely affect access to workers and, thus, organisational performance (Axelrod et al. 2001; LePak and Snell 2002; Ashton and Morton 2005; Beechler and Woodward 2009; Farndale et al. 2010; Ployhart et al. 2011, 2014; Schuler et al. 2011; Sirmon et al. 2011; Vaiman et al. 2012; Thunnissen et al. 2013; Collings 2014, 2015; Teece 2014; Gallardo-Gallardo and Thunnissen 2016). On the other hand, it is argued that organisations do not use workforce analytics to derive intelligence based on proven measurement tools. This affects effective decision-making to ensure the availability of the required workforce when needed. Put differently, organisations generally do not use formal, relevant, business-focused metrics and intelligence to measure the impact of their workforce on goal achievement (i.e. organisational performance). And this is the case, despite the accessibility and demonstrated success of some measurement methods and tools (Bersin et al. 2014; Boudreau 2010, 2013; Collings 2015; Harris et al. 2010; Harris et al. 2011; Kinley and Ben-Hur 2014; Lawler 2006; Phillips and Phillips 2014; Vaiman et al. 2012; Winkler et al. 2013; Zula and Chermack 2007). It stands to reason that decisions regarding the workforce and their consequent impact on organisational performance are only as good as the intelligence/analytics yielded by the metrics used. We define 'analytics' as the information/intelligence that results from the systematic analysis of the data or statistics collected by the instrument(s) chosen to measure a specific workforce aspect to be managed.

To capitalise on the promise of workforce management, researchers call for further research (Boudreau 2013; Collings 2015; Dries 2013a; Gelens et al. 2014; LePak and Snell 2002; Vaiman et al. 2012) towards a finer-grained examination (Ployhart et al. 2011) of unresolved issues in the literature (Wright et al. 2014), while drawing on and (better) integrating various related literatures (Thunnissen et al. 2013; Vaiman et al. 2012) to more fully understand (Collings 2015; Thunnissen et al. 2013) and making a lasting contribution to workforce management and measurement (Thunissen et al. 2013; Vaiman et al. 2012) theory and practice.

This paper aims to respond to the above calls and contributes to the debate on this important issue by integrating significant sources from the diverse and large body of management literature on the different workforce guises, specifically (strategic) human capital (resources), talent management; strategic human resource (HR) management; strategy, particularly the resource-based view; engagement; and metrics, while providing top metrics that are used to make informed workforce decisions supporting strategy implementation, competitive advantage and, thus, sustainable organisational performance. The workforce literature centres on people in the organisation and their (collective) contribution to sustainable organisational performance. Although progress has been made in this regard (Vaiman and Collings 2013) there is still room for improvement (Boudreau 2013; Davenport et al. 2010, Dries 2013a, Vaiman et al. 2012) because of the incomplete representation, which limits organisational performance. The need to integrate these literatures stems from both theory and practice. The theory indicates ambiguities and tensions (Collings 2014, 2015; Dries 2013a,b; Thunissen et al. 2013; Vaiman et al. 2012), while practice indicates that the required workforce is not available when needed, jeopardising the strategy implementation and,

consequently, competitive advantage and, ultimately, the sustainable organisational performance (Bersin et al. 2014; Collings 2015; Vaiman et al. 2012). A better integration of views across the literature in explaining phenomena is not uncommon and can, in certain cases, even be desirable (Mayer and Sparrowe 2013) as it will produce a more holistic understanding of workforce measurement and management, benefitting the practical application of the phenomenon and, ultimately, the competitiveness and sustainability of organisations. Thus our paper contributes to the body of knowledge, as it makes a synthesis that has not been made before and thus adds to knowledge (about workforce management and measurement) to support successful strategy execution, and thus organisational performance, in a way that has not previously been done (see Phillips and Pugh 2015, p. 26). Hence, our theoretical paper provides an overview of how to approach this topic strategically, culminating in a framework. The article begins by discussing people and their role in organisational performance. This is followed by a discussion of workforce analytics that can be used to ensure that organisations make sound decisions for unlocking the availability of the right 'workforce' when needed. The article concludes with a framework showing how metrics can be used to measure – and hence manage – the workforce to ensure organisational performance.

2. METHOD

The basis of this reflection was 86 texts, including peer-reviewed, full-text articles available in English, reporting on people contributing to organisational performance, whether conceptual or empirical in nature, and/or in combination with workforce metrics. These articles were gathered by merging our personal collections of texts on these topics with texts retrieved from a literature search from the Web of Science and EbscoHost limited to the period from 2000 – the year in which the first articles on the 'war for talent' appeared – to 2016. Search terms used were '(strategic) human capital (resources)'; 'strategic HR management'; 'talent management'; 'engagement'; 'strategic management'; and 'metrics, intelligence and analytics'. Only 17 of these texts specifically addressed workforce measurement in organisational performance, and only to a limited extent (see references).

3. PEOPLE AND THEIR ROLE IN ORGANISATIONS

The role of people in sustainable organisational performance has been recognised since the early management publications (see Owen 1813). People are acknowledged as the most valuable resource of organisations (Lewis and Heckman 2006) because of their potential to (collectively) drive organisational performance (Crook et al. 2011; Lockwood 2007; Ployhart and Moliterno 2011). Limited empirical evidence in this regard is available (Collings 2015; Guest 2011). Thus, people have been studied for a number of years from a variety of viewpoints, including (strategic) human capital (resources) (Becker 1962; Campbell et al. 2012; Ployhart et al. 2011; Ployhart et al. 2014; Wright et al. 2014), strategic HR management (Huselid 1995; LePak and Snell 2002), talent management (Collings 2015; Thunnissen et al. 2013; Vaiman et al. 2012), engagement (Cheese et al. 2008; Crook et al. 2011; Kahn 1990; Macey and Schneider 2008; Saks 2006) and strategic management (Barney 1991; Sirmon et al. 2011; Teece 2014). In short, these studies have explicitly or implicitly examined the availability of people with the required competence to execute organisational strategy successfully from an HR perspective or, to a limited extent, in combination with (business) strategy. These studies were largely developed in parallel and do not incorporate engagement and/or workforce measurement to enable management to make evidenced-based decisions on the availability of people with the required competence in support of its strategy execution.

Organisational performance stems from the competence people bring to the organisation, which should be aligned with the (common) purpose and goals of the organisation to support successful strategy implementation (Boxall 2013; Campbell et al. 2012; Collings 2014; Ployhart et al. 2011; Ployhart et al. 2014; Thunnissen et al. 2013; Wright et al. 2014). It should be noted that competence is not fixed or static and may change owing to changes in the workplace and/or environment (Bartlett and Ghoshal 2002; Campbell et al. 2012; Collings 2015; Lewis 2011; Lockwood 2007). It can therefore affect successful strategy implementation and, consequently, goal achievement, otherwise known as organisational performance. Moreover, competence by itself does not achieve organisational goals. The worker embodying

the competence must be 'available' to dispense the competence in pursuit of organisational goals (Wright and McMahan 2011). Availability depends on both the worker and the employer (see Blumberg and Pringle 1982; Boxall 2013) and needs elaboration as it entails more than the mere physical presence of the essential number of persons embodying the requisite competence.

Availability also means that the employee must be able and willing to expend the embodied competence in pursuit of organisational goals. This ability and willingness to act depends on a host of factors, including whether the person has the physical and mental health and the opportunity to dispense his/her competence. We interpret the drivers of engagement identified by Cheese et al. (2008) as the availability of people to act in pursuit of organisational goals, which we will briefly elaborate on. Opportunity may include being deployed in the correct position, which includes the physical, cognitive and emotional demands that the job makes on the worker, the sense of achievement that the job offers, the opportunity to learn or discover new things, and whether it is meaningful and leads to some form of satisfaction. Opportunity is furthermore influenced by whether the worker has been given the means to handle the job and whether his/her goals are achievable. Handling the job involves knowledge, skills, technology, accurate and timely available information, systems, processes, training, a favourable working environment, supportive managers and colleagues, work practices that reduce effort rather than adding to it, reasonable workloads and health. Furthermore, the worker must perceive that he/she is receiving fair financial compensation and is recognised for his/her contribution to organisational performance. In the main, being fairly compensated is a feeling of being equitably rewarded for his/her contribution and understanding how this is evaluated; he/she must thus experience the process as fair. Compensation that is reasonably market-related signals recognition. Moreover, the worker must experience a sense of community, that is, there should be a feeling of positive social interactions in the workplace. The work should be perceived as fulfilling, meaningful, enjoyable, fun and done in a supportive or collaborative environment, rather than a confrontational environment. In addition, the employee must perceive congruence, which consists of agreement between the individual and organisational values and alignment of expectations and values that have been met. Workers must also perceive an alignment between their career and life expectations and aspirations over both the short and the long term, including work–life balance. They must also perceive whether the organisation is investing in them and whether they can shape their own destiny. Based on these drivers of engagement, workers then choose to engage themselves (more or less) in pursuit of organisational goals via strategy implementation. The level of worker engagement is, in turn, influenced by, inter alia, the conceptualisation of the workforce, which is the key to strategy implementation.

4. WORKFORCE AND STRATEGY IMPLEMENTATION

Strategy is a 'potentially powerful tool to cope with change, but a somewhat elusive concept' (Ansoff and McDonnell 1990). Simply put, strategy is the tool management uses to achieve organisational goals and, in so doing, secure organisational performance (Andrews 1987; Ansoff 1988; Drucker 1954; Grant 2016; Nilsson and Ellström 2012; Ployhart et al. 2014; Porter 1985, 1998). It is common practice to express goal achievement in financial terms (Drucker 1954; Nag et al. 2007; Nilsson and Ellström 2012), the ultimate litmus test for long-term sustainability. This, however, may deflect attention from non-financial measures, whether employee, customer or social good (Andrews 1987; Boxall and Purcell 2011; Collings 2014). This observation resonates with the purpose of an organisation, namely to deliver products/services that are valued by its customers, provide employment and contribute to wealth creation (Drucker 1954; Teece 2014). Wealth creation is a broader concept than profit maximisation, involving more stakeholders than only shareholders. Moreover, profit maximisation does not necessarily equate with efficacy and, on its own, is not sufficient for organisational sustainability (Teece 2014). Additionally, there is more to employment than meets the eye. Because workers are not inanimate resources, they think about their work and how they contribute to goal achievement (Griseri 2013; Rothbard 2001; Wright and McMahan 2011). Thus, workers are not merely vessels embodying competence, but actively assess (cognitively and affectively) how they contribute to organisational performance in

discharging their duties (Fearon et al. 2013; Kahn 1990; Rothbard 2001). As such, workers 'do' strategy when discharging their duties in pursuit of organisational goals (Jarzabkowski and Spee 2009). Hence, workers and, in particular, their competence, in concert with other resources, are key in shaping a competitive advantage (Heinen and O'Neill 2004; Campbell et al. 2012; Collings 2014; Pease et al. 2014). Other resources include assets, systems, processes, information, firm attributes, technology and the like. The resource configuration enables the organisation to conceive and implement strategies that improve its efficacy (see Barney 1991; Cheese et al. 2008; LePak and Snell 2002; Ployhart et al. 2014; Teece 2014; Sirmon et al. 2011; Wright et al. 2014) in creating value for customers in the arenas where the organisation chooses to compete. According to Barney (1991), resources can be classified in three categories: (i) physical capital resources; (ii) human capital resources; and (iii) organisational capital resources, though not all of these have (the same) strategic relevance for the organisation. Yet all resources are required in differing degrees to compete successfully (LePak and Snell 2002; Ployhart et al. 2014; Sirmon et al. 2011; Teece 2014). The workforce must be prepared to expend their competence (available) (Wright and McMahan 2011), individually and/or especially collectively, to ensure a competitive advantage, as was discussed previously. Management plays an important role by creating an environment in which people will be available, as well as combining accessible resources to shape a competitive advantage (Campbell et al. 2012; LePak and Snell 2002; Ployhart and Moliterno 2011; Sirmon et al. 2011; Teece 2014).

5. COMPETITIVE ADVANTAGE

Competitive advantage, the hallmark of an effective strategy (Barney 1991; Campbell et al. Ployhart et al. 2014; Porter 1985; 1998), means the organisation does something better than the competition. It attracts customers based on value offered (Peteraf and Barney 2003; Porter 1985, 1998) by combining the resources at its disposal (Huselid 1995; Ployhart et al. 2014; Ployhart and Moliterno 2011; Sirmon et al. 2011; Teece 2014) to leverage their benefit for sustainable organisational performance. This description of competitive advantage shows that it is linked to the resource-based view of the firm. Barney (1991, pp.106-111) describes competitive advantage in terms of the characteristics of resources, namely valuable, rare, inimitable and non-substitutable:

> 'Resources can be valuable only to the degree that they enable an organisation to conceive of or implement strategies that improve its efficacy. Resources are rare when they are not abundantly available to competitors to implement a value-creating strategy. Valuable and rare resources can only create and sustain a competitive advantage if they cannot be obtained by competitors and thus are imperfectly inimitable. Non-substitutability means that there must be no strategically equivalent valuable resources that are themselves either not rare or inimitable.'

Thus, competitive advantage is deemed to be embedded in the organisation, and resources play a key role. Of all the resources, the workforce is the most important.

6. WORKFORCE MANAGEMENT AND CHALLENGES

Hence, for some authors, competitive advantage is achieved by a few key positions (Huselid 1995; Whelan and Carcary 2011) and/or top performers (Axelrod et al. 2001; Gelens et al. 2013; Vaiman et al. 2012) in the organisation creating an advantage over rivals. In some instances, authors refer to these performers as 'talent.' The debate about 'talent' covers the following, either as opposing positions or in some combination: whether it is subject (person) or object (competence); exclusive (a gifted few akin to top performers) or inclusive (all people but to differing degrees); unique (company-specific) or generic (applicable to a variety of contexts); and whether competence is innate (a predetermined and fixed capacity) or malleable (can be developed) (Becker 1962; Boudreau 2013; Campbell et al. 2012; Dries 2013a,b; Farndale et al. 2010; LePak and Snell 2002; Ployhart et al. 2011; Ployhart et al. 2014; Schuler et al. 2011; Tansley 2011; Teece 2014). Given the dynamic nature of relationships, the contribution of individuals to organisational performance is greater than merely aggregating individual actions (Boxall and Purcell 2011; Campbell et al. 2012; LePak and Snell 2002; Pfeffer 2001; Ployhart et al. 2011; Ployhart and Moliterno 2011; Pugh and Dietz

2008; Sirmon et al. 2011; Teece 2014; Wright and McMahan 2011). Hence, the notion that collaboration creates synergy emphasises that competitive advantage cannot be achieved by a position or person or competence acting on its own. Some combination is necessary, as shown by, inter alia, Boxall and Purcell (2011), Campbell et al. (2012), LePak and Snell (2002), Pfeffer (2001), Ployhart et al. (2011), Ployhart and Moliterno (2011), Pugh and Dietz (2008), Sirmon et al. (2011), Teece (2014) and Wright and McMahan (2011).

Thus the view taken on the workforce influences its management, which depends, inter alia, on its consequent measurement, including investing in the development of availability of a future workforce, in particular making decisions about the workers in pursuing organisational performance. Moreover, the decisions about having the right workforce available to shape competitive advantage are influenced by a myriad of factors, notably globalisation, global skills shortages, the mobility of skilled people and changing demographics, as mentioned earlier (Beechler and Woodward 2009; Farndale et al. 2010; Holtom et al. 2008; Nilsson and Elstrom 2012; Schuler et al. 2011; Vaiman et al. 2012). Of these factors influencing the availability of the right workforce, skills shortages, of which analytics, are the most important (Boudreau 2013; Harris et al. 2010; Harris et al. 2011; Kinley and Ben-Hur 2014; Lawler 2006; Phillips and Phillips 2014; Winkler et al. 2013). Moreover, workers can voluntarily relocate (Holtom et al. 2008), which is influenced by many factors and can be synthesised as 'inducements and contributions' (see March and Simon 1958; Holtom et al. 2008). The reasons most often advanced for voluntary turnover are improved career opportunities and enhanced work–life balance, suggesting that available workers are not properly utilised, thus affecting availability. To capitalise on the workforce and their contribution to competitive advantage, employers – and particularly line managers – should create an environment in which people feel motivated to expend their ability when given the opportunity to do so. Workforce metrics and, in particular, the intelligence gained from analytics play an important role in making sound decisions on the utilisation of workers and their competence, as well as developing competence (Boudreau 2010, 2013; Davenport et al. 2010; Harris et al. 2010; Harris et al. 2011; Kinley and Ben-Hur 2014; Phillips and Phillips 2014) to shape competitive advantage and, thus, organisational performance. Hence, in considering the workforce and their contribution to organisational performance, attention should be given to the purpose of the organisation and the goals it pursues; strategy, and specifically competitive advantage on which strategy is based; and particularly people – in terms of numbers required, the competence needed, occupations and hierarchies affected, other resources needed to assist the workforce to discharge their duties in pursuing organisational goals; and the configuration of the people and other resources needed to achieve organisational goals, which are influenced by the environment in which the firm operates. These considerations are relevant in introducing or changing workforce metrics to gauge the impact of the workforce on goal achievement (performance). As such, these considerations are variables forming the basis of the framework we propose, which is illustrated in Figure 1.

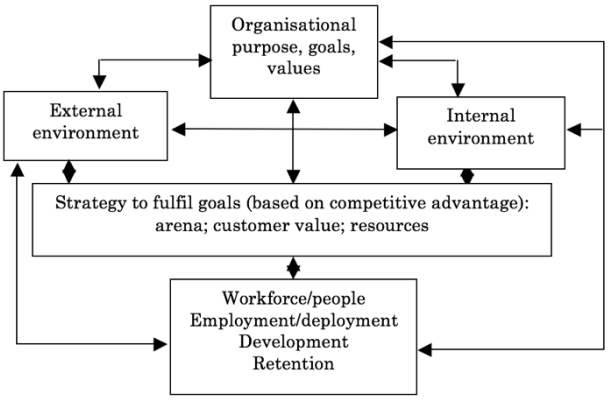

Figure 1 Workforce and their contribution to organisational performance.

Workforce metrics can be used to assess one or more of the components in Figure 1. Depending on the component to be measured, an appropriate metric/metrics must be selected to collect data that will yield the information and intelligence, on analysis, to make relevant decisions. Such decisions can then be assessed for their impact.

7. WORKFORCE ANALYTICS

While HR metrics, human capital metrics, talent analytics, HR scorecards and the HR information system (HRIS) are valuable for workforce management, it is suggested that there are differences in approaches (Khatri 2014, p.2). Human resource metrics and human capital metrics are qualitative in nature. Human resource metrics focus on the

efficacy of the role, purpose and accomplishments of the human resources function. Human capital metrics inherently focus on employees' expressing their skills, knowledge and ability, and attempt to explain employees' contribution to organisational performance. HR scorecards, on the other hand, assist managers to determine what the HR department's worth is and they attempt to aid in HR measurements. Hence, HR scorecards focus more on the strategic requirements of the organisation. There are various HRIS software programs for managing HR activities.

It has become important for organisations to examine the effects of their investment in their workforce on the returns that they gain from such investments (Zula and Chermack 2007) in terms of organisational performance. Hence, organisations need to re-examine their workforce planning processes regularly. This will ensure that they are aligned with the objectives and initiatives of the organisation and applied appropriately so that resources are allocated to support strategy execution and thus enhance the achievement of organisational goals. Regular re-examination can benefit organisations by providing evidence of their workforce configuration and can help them to measure and plan for the correct development, allocation and alignment of people so that the organisation can sustain a competitive advantage.

When workforce practices and processes are strategically managed, organisations can gain a competitive advantage by utilising their greatest assets, namely their people (Lawson and Hepp 2005). Zula and Chermack (2007) caution that when managing the workforce of the organisation, it is important to take note of the metrics adopted to determine if the endeavour is a success. The use of inaccurate or inappropriate metrics may result in incorrect measurements, or even in measuring the wrong thing, thus adversely affecting competitive advantage.

Typically, the metrics used to measure workforce practices include numbers and costs related to the hiring, training, time to deliver services, ratios of people to budgets and benchmarks (Fitz-enz 2009). Since these measurements focus mainly on those activities that cost the organisation money and do not provide much relevant information on the value-adding aspects of the people's performance in the organisation, they do not excite management. Pease et al. (2013) concur with this view and indicate that most data collected in organisations mainly focus on the past, including records of sales, expenses, productivity and past performance data that cannot be managed any longer or make a difference to the current situation in the organisations. Hence, it has been suggested that measurements are needed on leading-edge indicators such as leadership, engagement, readiness, culture and retention. Such information can provide management with clues about the future of the organisation. For instance, engagement surveys have become prominent tools, as reflected in the Bain & Co survey (see Rigby 2015). The latest and more advanced forms of metrics are leading indicators and intangible metrics that are able to predict what is more likely to happen to the workforce. These metrics offer a much higher level of analysis and can address issues that have an effect on the current organisational operations, instead of focusing on past events. This type of metrics is proving more beneficial to organisations and has been reported to attract the attention of management (Fitz-enz 2009). With the turbulence in the 21st century economic and business environments globally, most managers want to be forewarned about what is going to happen in the future so that they can make sound investment decisions regarding workforce measurement and management.

8. PREDICTIVE ANALYTICS

To deal with the challenges that contemporary workforce changes present in organisations, more powerful means of planning and deploying appropriate development and training of people will be needed. Predictive analytics is emerging as a game-changer in current business environments (Pease et al. 2014). Predictive analytics has been defined as the use of quantitative methods to extract insight from data and then using these insights to assist organisations to make informed decisions and to forecast and improve their final business performance (Pease et al. 2014). Khatri (2014) indicates that it is a valuable tool for employees' career planning and the organisation's strategic planning. Predictive analytics can also be used for assessing employees' training needs, as already discussed. With reference to the White Paper on predictive analytics, Dey and De (2015) state:

> 'Several organizations have proactively adopted predictive analytics for their business functions such as finance and risk, customer relationship management, marketing and sales, and manufacturing and it enables them to make informed decisions across a range of activities such as customer retention, sales forecasting, insurance pricing, campaign management, supply chain optimization, credit scoring, and market research.'

Furthermore, several new opportunities are offered by predictive analytics that are useful for all the core workforce processes, such as competence acquisition, attrition risk management, employee sentiment analysis and capacity planning.

Predictive analytics can be applied to workforce learning initiatives to improve the impact of the learning and development initiatives offered in the organisation, thereby shaping competence. It gives the organisation insight into the types of employees that can benefit from the learning initiatives and those that will receive very little or no benefit at all. In this way, employees can be selected that will benefit from the learning initiatives, increasing the impact of their performance in the organisation. Organisations can then provide for those employees who would otherwise gain little or no benefit from training, saving costs by investing in suitable learning initiatives that will affect all employees, improving their performance and ability to execute the organisation's strategy and achieving organisational goals, thereby sustaining organisational performance. It has also been suggested that the best workforce metric for an organisation is the long-term performance of the organisation, which is influenced by leadership and management.

Investing in people is not new. Organisations have anecdotally been using on-boarding, skills training and development programmes for a long time now (Pease et al. 2014). However, these initiatives have not been able to indicate exactly where and how they are of value and benefit to workers or the organisation. By applying predictive analytics to these learning investments, both the organisation and workers can benefit. The organisation benefits by reducing its expenditure on training for workers that will not benefit, while improving their performance. Furthermore, it can focus on improving other business metrics. Workers benefit because they attend training and development that can actually help them to improve their performance and that is worthwhile for their specific operations. In turn, appropriate training can contribute to their increased engagement and retention in the organisation (Pease et al. 2014). This is in line with the findings of Becker (1962), LePak and Snell (2002), Sirmon et al. (2011) and Teece (2014). Predictive analytics uses scientific data as evidence for planning, developing and deploying learning and development programmes for workers.

9. REASONS FOR USING PREDICTIVE ANALYTICS FOR WORKFORCE MANAGEMENT

We agree with Pfeffer (2009, cited in Fitz-enz 2009), who stated:

> 'if competitive success is achieved through people – if the workforce is indeed an increasingly important source of competitive advantage, then it is important to build a workforce that has the ability to achieve competitive success that cannot be readily duplicated by others'.

Pfeffer's statement resonates with the research of Barney (1991), Campbell et al. (2012), Collings (2014), LePak and Snell (2002), Ployhart et al. (2011), Ployhart et al. (2014), Sirmon et al. (2011), Vaiman et al. (2012) and Wright et al. (2014). According to a 2013 global study by the American Management Association and the Institute for Corporate Productivity (cited by Reilly 2014):

> '58 percent of business leaders indicated that they believe that analytics is a vital part of their organisation today, while 82 percent of business leaders indicated that they expect analytics to be a big part of their organisation in five years'.

Sullivan (2014) concurs with this and indicates that the traditional metrics used in workforce measurement have a very limited impact since they are backward-looking and focus on the past. Predictive analytics is regarded as offering higher value and quality for organisations, as it focuses on analysing past and current data. It looks for patterns and trends that can assist managers to predict possible future people problems, as well as emerging opportunities that they can capitalise

on. The Global Human Capital Trends Report (Bersin et al. 2014:117) also found that 78 percent of large organisations that have over 10 000 people in their employ realise that workforce, and specifically competence, analytics is 'urgent' and 'important.' Hence they have placed analytics as one of the top three most urgent trends for workforce management in the 21st century. The report also purports that organisations that make use of analytics successfully to manage their workforce are in a much better position to outperform their peers and competitors as far as the implementation of workforce configuration strategies is concerned. Workforce analytics, in particular, is able to provide a significant combination of workplace data and business data that can assist workforce managers to make more informed and appropriate decisions about their people for the sake of sustainability.

Sullivan (2014) indicates, inter alia, the following reasons why HR (and line) managers need to use predictive analytics for workforce management:

- It engenders a forward-looking mind-set and routinely making informed decisions based on evidence about what the future will hold for the organisation.
- It alerts managers well in advance to emergent problems and challenges so that they can prepare for their effects and minimise any damage.
- It allows managers to act strategically, ensuring that their HR plans are integrated into the organisation's strategic business plans.
- The root cause of problems can be easily identified with predictive analytics, allowing talent managers to devise appropriate solutions that solve the exact problems instead of alleviating the symptoms.
- Since predictive analytics is specifically designed to increase some form of execution to solve or enhance a situation, HR managers have a more positive attitude to accepting and reading the analysis. It also provides in-depth information, such as the estimated costs of future problems and their effects, as well as the cost to the organisation if no action is taken to improve the situation. It furthermore helps managers to prioritise problems that need immediate intervention in support of business priorities.
- Because predictive analytics is comprehensive, more integrated and usually available in an electronic form, it can provide answers to decision-makers' enquiries in a timely and consistent manner that other forms of workforce metrics usually lack.
- This form of analytics allows management to develop several scenarios or models for a specific problem situation, to pre-test the decision that they want to make, see its effects and, where possible, make adjustments before implementing it in the organisation.
- Predictive analytics allows the organisation to gain a far better workforce and competitive advantage, as compared to those competitors that do not implement predictive analytics to assist them in decision-making.

10. THE FUTURE OF PREDICTIVE ANALYTICS FOR WORKFORCE MANAGEMENT

To enable an organisation to leverage predictive analytics and obtain maximum benefits from the workforce data that it produces, it is essential to link these data sources to its strategic business outcomes, that is, it should be results-driven, as already pointed out.

Predictive analytics can be used in workforce management in the following areas, as identified by Dey and De (2015):

10.1 Employee profiling and segmentation

Predictive analytics can benefit workforce management by profiling and segmenting employees, helping managers to get a better understanding of their workforce and their contribution to organisational performance. Workforce data such as demographics, skills, educational background, experience and designation can be combined with information on roles and responsibilities to create segments that can be used to effectively deploy people. This is congruent with Boudreau (2010) and LePak and Snell (2002), who claim that the workforce will feel a higher degree of satisfaction in their jobs and their relationship with their employer will improve drastically if they are selected to attend relevant programmes that are going to benefit them the most, contributing to their availability to pursue organisational performance. This

analytic forms the basis of workforce planning and engagement surveys, to mention a few.

10.2 Employee attrition and loyalty analysis

Predictive models of attrition can be used to measure the attrition risk score of individual employees. In this way, the organisation can prevent the potential attrition of their workforce that forms part of its competitive configuration. Workforce demographic data, performance, compensation and benefits data, market data, rewards and recognition data, training data, behavioural data and workforce survey scores can be used for this analysis. This metric contributes to workforce planning, employee satisfaction and commitment measurements. This analytic will ensure that organisations have the required workforce available at all times.

10.3 Forecasting of workforce capacity and recruitment needs

Organisations are in a better position to optimise resource utilisation and sustain appropriate growth and margins when they are able to predict the requirements for workforce capacity and recruitment. Accurate forecasting enables managers to determine their future staffing requirements. Factors such as attrition risk scores, business growth forecast and pipelines, number of employees and competence in each department, productivity level and past performance of each employee can be incorporated to enrich the predictive models. Again, this analytic equips organisations to be in a better position to do workforce planning.

Table 1 Top five workforce management analytical tools.

Analytical tool	Purpose of the tool
Total cost of workforce	This tool is used on a macro level to measure the alignment of the workforce (e.g. competence, 'availability' and configuration) with the objectives of the business in support of strategy implementation and to make better strategic decisions in terms of workforce management. This tool can be used effectively in combination with workforce planning, in particular, because it also helps managers to link investments in the workforce to the organisation's results.
Management span of control	Management span of control is regarded as the best tool to measure cost and structure of management staff in an organisation. It is used to assist organisations to capitalise on productivity and efficiency and can evaluate the entire organisation or specific divisions or business units in relation to business results. This tool is useful because it connects well to workforce planning, as the objectives can be displayed on a real-time basis.
High-performer turnover rate	This tool helps the organisation to see how many employees providing a competitive edge it has lost over time; to some extent, this tool is predictive in that it also indicates the value of the loss of these employees over a period of time. It also provides clues as to how productive the workforce is, which can be linked to business results.
Career path ratio	This tool provides two important measures that reflect the mobility of employees, namely *total promotions* and *total transfers*. This measures career path mobility and any internal movement of employees. This metric can be used in combination with employee retention and performance metrics, they are also able to provide valuable links to critical workforce issues, particularly productivity and organisational performance.
Talent management index	This index helps an organisation to evaluate and analyse its talent management practices for recruiting, mobility, managing performance, training and development. The above metrics can all be linked to this metric in order to ensure that the organisation's workforce is properly measured and, thus, managed. This metric can therefore be regarded as an overarching or holistic tool to manage the workforce.

10.4 Appropriate recruitment profile selection

Attrition of employees in specific roles that entail high costs of hiring can lead to significant losses for the organisation. Dey and De (2015) indicate that 'by analysing the data for current employees, including performance and productivity indices, attrition details, and life-time value', the talent manager will be in a position to create the right profile for each potential employee. Moreover, a statistical relationship can be identified between employee value and profile variables such as education and experience. This will then assist managers to identify the most suitable profiles for their organisation. The organisation can then increase the quality, productivity and customer satisfaction scores, while at the same time reducing its recruitment cost and creating sustainable value for the organisation where the strategy can be achieved, thus feeding directly into workforce management.

10.5 Employee sentiment analysis

It has been suggested that 'employee sentiment analysis is more effective than annual employee surveys in getting honest, useful feedback'. Employee sentiment analysis involves the tracking, analysing and dissecting of key issues regarded as the most relevant to employee sentiments over time, or that can be related to a specific real-time issue. Managers then obtain a better understanding of how an HR initiative, policy, organisational change or event is being received by employees at that specific time. Internal data related to the respective HR initiatives or changes, together with data from external social media such as Facebook, Twitter and LinkedIn, can be used for this analysis, thereby providing the organisation with a clear understanding of the impact that various organisational factors have on productivity, business growth or other objectives. This directly promotes proper workforce management.

10.6 Employee fraud risk management

Predictive analytics can be used by organisations to identify employees who are at high risk of non-compliance with the organisation's security policy or other rules and regulations. The organisation can strengthen its internal fraud risk management by analysing the employee activity data and incident data, using statistical modelling techniques, and then creating a fraud risk score for employees so that appropriate proactive steps can be taken to protect the organisation's brand image and reputation and prevent possible financial losses. This metric demonstrates a link to workforce management.

It may be necessary for HR managers, in particular, as they drive workforce-related issues, to collaborate with other business units in their organisations that are already using predictive analytics to get a better understanding of how to use this measurement tool. The correct application of predictive analytics can transform workforce management from a reactive to a proactive process. It will provide accurate early warnings that can support strategy more comprehensively and help the organisation to sustain itself in the long term. Furthermore, the organisation will be in a better position to solve its business problems and reduce its costs, at the same time improving business performance, employee engagement and satisfaction. If this is accomplished, organisations will be able to prove that the 'generally acceptable idea that organisations can create a competitive advantage from their workforce and their management practices, as reported by Shrimali and Gidwani (2012)' is indeed a reality.

In sum, predictive analytics can give effect to the ideas proposed by Barney (1991), Becker (1962), Campbell et al. (2012), Cheese et al. (2008), Collings (2015), Huselid (1995), Becker and Huselid (2006), Kahn (1990), LePak and Snell (2002), Macey and Schneider (2008), Ployhart et al. (2011), Ployhart et al. (2014), Saks (2006), Sirmon et al. (2011), Teece (2014), Vaiman et al., (2012) and Wright et al. (2014). Moreover, this observation corroborates Boudreau's (2010) observation that HR metrics needs retooling. To assist practitioners in applying predictive analytics, we present the top five workforce analytical tools next.

11. TOP FIVE WORKFORCE MANAGEMENT ANALYTICAL TOOLS FOR THE 21ST CENTURY

Predictive analytics, workforce analytics or even 'people analytics', as it is more commonly referred to by HR managers, has been used extensively by organisations such as Humanyze, which assists managers to 'find surprising and unsuspecting connections and insights in data about what its most effective employees do differently' (Kane 2015). The CEO of Humanyze, Ben Waber, is of the

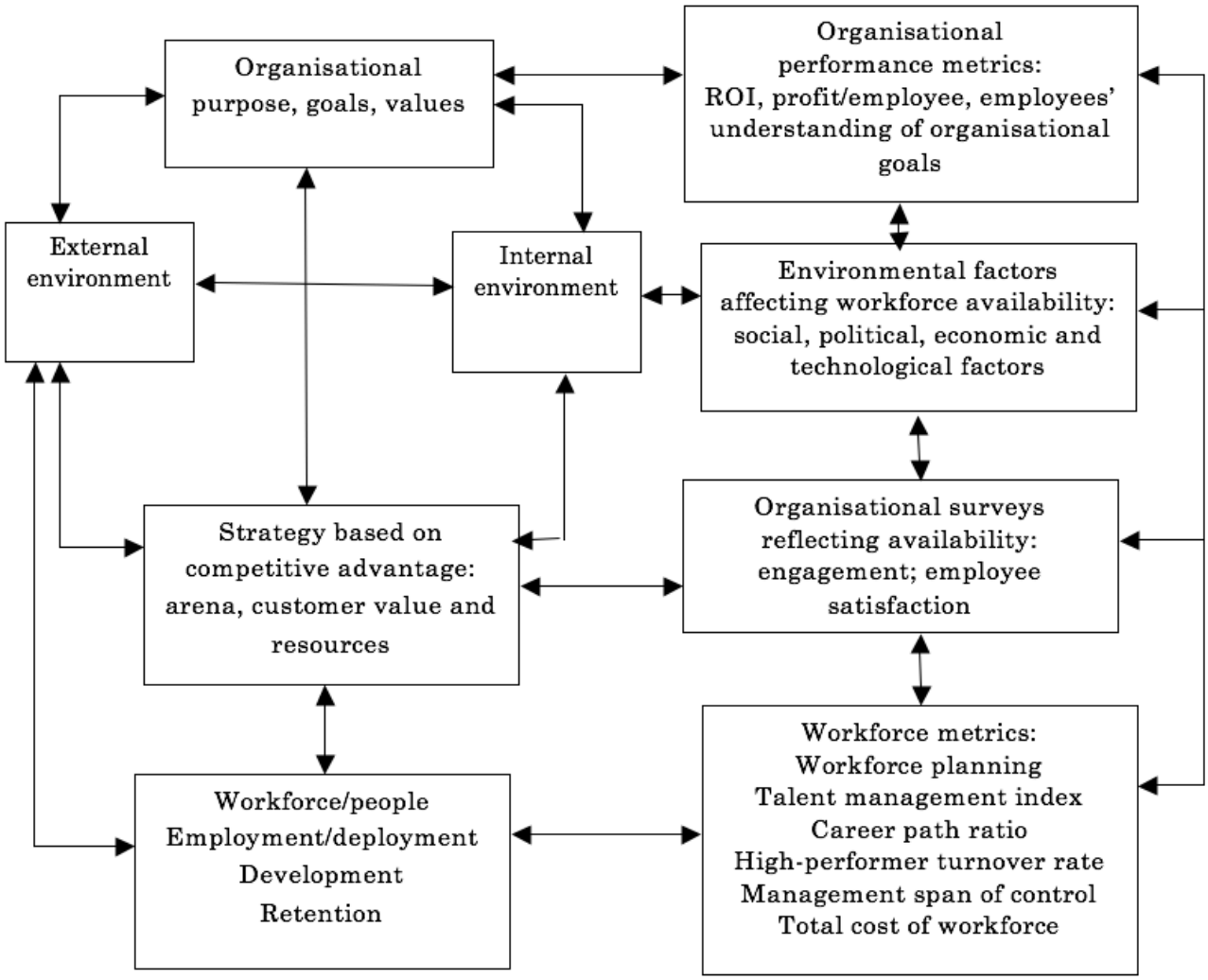

Figure 2 Integrated framework to measure and manage the workforce.

opinion that people analytics can assist managers to gain a better understanding of patterns that are usually hidden about why some employees are more successful at the jobs that they do than others. In this case, the analytics enable managers to read employees in the same way that they usually read statistics.

The SABA White Paper (2014) confirms that most of the world's advanced organisations use human capital metrics and analytical tools for managing their workforce. These tools provide managers with a more visual understanding of their workforce and enable evidence-based decision-making. The top five practical analytical tools for human capital and workforce management have been identified by SABA (2014) and are indicated in Table 1.

These tools can assist firms to identify and prioritise key questions about their workforce, especially the individuals who give them a competitive edge. These include identifying and quantifying the (strategic) competencies of people, who constitute the most important resource of the organisation, together with other resources, particularly information and technology, which enable the organisation to implement its strategy successfully. Moreover, these metrics can also show how the performance of the workforce, in concert, helps to enhance these capabilities, resulting in effective strategy implementation, as discussed in this article.

In summary, we provide an integrated workforce management framework in Figure 2.

12. CONCLUSIONS

For organisations to remain competitive, they should use workforce analytics effectively, particularly predictive analytics, derived from proven metrics suited to their context. These tools will allow the organisation to make informed decisions about workforce measurement and management and its availability in support of strategy

implementation, thus securing organisational sustainability. Organisations that are successful at leveraging this form of data-driven decision-making will most certainly position themselves to outsmart their competitors and sustain a competitive advantage. At the same time, they will sustain a higher return and value to all stakeholders and society at large, and they will be able to better position themselves for the challenging business world of today, as well as the business demands of the future.

13. THEORETICAL AND PRACTICAL IMPLICATIONS

This theoretical article demonstrates that investments in the workforce – whether employment, deployment or training and development – contribute to organisational performance. In this regard, an integrated approach should be followed, starting with a consideration of the purpose and goals of the organisation and the strategy employed to pursue those goals. More particularly, attention should be given to the competitive advantage on which strategy is based, particularly people, in terms of numbers required, the competence needed, and occupations and hierarchies affected. In addition, other resources needed to assist the workforce to successfully discharge their duties in pursuing organisational goals, as well as the configuration of the people and other resources needed to achieve organisational goals, should be considered. Moreover, the environment in which the organisation operates, which influences organisational performance, should be considered. It is imperative that managers (whether HR or line) focus on results rather than inputs to ensure the analytics are forward-looking rather than backward-looking and provide relevant workforce data per 'segment' (like the quadrants suggested by LePak and Snell 2002) – indicating future needs, including training and development per segment.

14. CONTRIBUTION

The suggested conceptual framework is theoretical and requires empirical testing. It serves as an outline for future research that can be used universally by researchers.

15. FUTURE RESEARCH

Given that limited empirical evidence is available on the use of predictive analytics in the workforce, we suggest a practical investigation of how organisations (i) conceptualise their workforce; (ii) what tools they use in measuring different aspect of the workforce, including their impact on organisational performance; and (iii) predict workforce performance.

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A research agenda for intelligence studies

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ABSTRACT This research paper defines the scope for a research agenda for competitive intelligence (CI), market intelligence and more generally for intelligence studies in business. Respondents in the survey defined the scope to include analysis, traditional phenomena or problems, new phenomena, trans- or cross disciplinary studies, methodological issue and industry specific studies. Respondents were also asked to come up with terms for a good definition of the study. We found that existing definitions of CI in use are overlapping with definitions of other more established fields of study, like decision sciences and marketing intelligence. Respondents agreed that it's practical to define the study in terms of understanding the external environment. In the discussion a parallel is made to the notion of surrounding world analysis and Stevan Dedijer's ideas about social intelligence. A broad discussion leads to a renewed interest for disciplines studied by the humanities as we show what has been lost in the development of the social sciences. Implications are shown and future studies suggested.

KEYWORDS business intelligence competitive intelligence, intelligence studies, market intelligence, research agenda

1. INTRODUCTION

1.1 A brief historical perspective

Deshpande and Webster (1989, p.1) remind us that "when Drucker (1954) first articulated the marketing concept, he noted that marketing was not really a separate management function but rather the whole business as seen from the customer's point of view." In much the same way today the disciplines studying information and intelligence have chosen a particular point of view of a particular department (marketing), of a particular technology or service (big data, business intelligence and data-as-a-Service, or DaaS) or from the question of competitive advantage (intelligence studies (IS), whether it's state or business) or strategy, which could be called the outside view. The problem is that there are many views or perspectives studying the same phenomenon, and to a large extent their respective adherents or researchers do not read each other's work or refuse to see the phenomenon from any perspective but their own. We have created a scientific landscape of compartmentalization and overlaps which has now mainly become a disadvantage to further understanding. Instead of tackling the methodical challenge, focusing on the notion of understanding as opposed to the promise of theory we instead end up feverishly hunting for the next management buzzword which only confirms the symptoms.

It wasn't always that way. The competitive advantage issue is an age old perspective going back in Europe to the foundations of the first city states (Venetia, Firenze) and before that in Asia to the foundations of nation states and empires (the Mauryan Empire, the state of Wu, the state of Qin), with contributions from men like Marco Polo, Machiavelli, Kautilya, Sun Zi and Han Fei Zi. The same question is asked again during the industrial revolution by Adam Smith and in modern times by Michael Porter (Solberg Søilen, 2012, p. 17). As a discipline intelligence studies

starts as state intelligence with men like R.V. Jones in Britain in 1939 and Sherman Kent in the USA, and as a function relevant for business with Stevan Dedijer in Sweden in the early 1970s (Solberg Søilen, 2012, p. 19).

On the macro level the discipline may be said to have a twin sister in the study of geopolitics where we look at the correlation between history, geography and the notion of power, which survives after the Second World War and pops up in the social sciences with the Frankfurter School, as critical theory. As applied to the world of international business we often talk of geoeconomics: both are theoretically anchored in evolutionary theory, not as neoclassical economics in the study of physics. The discipline coined geopolitik was developed by the Swedish political scientist Rudolf Kjellén (1864–1922), who was influenced by the German political geographer Friedrich Ratzel (1844–1904) who again was influenced by scholars like the Prussian geographer Carl Ritter (1779–1859), Alexander von Humboldt (the founder of modern geography) and the German historian Leopold von Ranke (1795–1886) (Solberg Søilen, 2012, p. 21).

Fast forwarding to today, the difference between information science in business, business- and market research and intelligence studies is mainly one of perspective, scope and dates and less about content and scientific method. Intelligence studies in business sees the organization much like an intelligence organization, an offspring of the study of state and military intelligence, searching for significant pieces of information that affect the business as a whole, not searching to see how selected experiences fit into oversimplified theoretical models. When Adam Smith wrote his famous book in 1776, this compartmentalization did not matter as political sciences then was an integrated part of economics and business studies in what is called political economy. Long before that, with Plato and Aristotle, it was all studied as philosophy, as opposed to the natural sciences. The compartmentalization of knowledge in the social sciences has since become an advancement to the body of knowledge about man as well as a hindrance as the method and logic continues to dominate at our universities, despite excellent scholarship in the 1970s and 1980s that shows that this is an intellectual impasse (see e.g. Hodgson, 1988). It's with theory as with great empires: their glow continues long after they have been surpassed (for example, England in the 19th century and the US in the 20th), an observation which itself fits into an evolutionary approach.

At the end, what decides the value of these different perspectives is to what extent they can show to be of relevance to practitioners. Academics must from time to time ask practitioners to what extent their work is being used and has positive effects for companies and for society at large. Drucker hardly wrote any articles for scientific journals, but he was always a favorite among practitioners, simply because his books were relevant. Thus it is real relevance that social science disciplines should strive for, not "academic impact," or the amount of articles or to what extent they are being cited by colleagues. The idea that basic research (as opposed to applied) is of great value in the social sciences is still to be proven even though it is true that the same method continues to do wonders for the natural sciences.

To know what to study researchers need to agree on what problems are of importance. The natural way to do this is to ask practitioners and academics alike what areas or problems they think deserves more attention based on unresolved problems they observe and are confronted with.

Solberg Søilen (2014) did a survey of what content readers of the *Journal of Intelligence Studies in Business* (JISIB) wanted to see. It said that readers are looking for more case study material. The survey also found that there is an even balance between those who think there is too much and too little technical content in the existing literature. Some readers also want articles in languages other than English. However, can these findings be used to draw general conclusion for the whole field of intelligence studies in business? We think not. Thus another more ambitious survey was planned to define a research agenda for the discipline as such, and thus identify the research gap.

1.2 An introduction to current literature

Wright and Calof (2006) study current CI practices among different cultures. The same authors did an evaluation of the study of the CI field two years later (Calof and Wright, 2008). Solberg Søilen (2013) presented an overview of articles on competitive intelligence in JCIM and CIR, two earlier CI

journals. Teo and King (1996) did an assessment of the integration of business planning with information systems, and Teo and Choo (2001) did an assessment of using the internet for CI. None of these articles tackled the question of defining a research agenda.

In more established business fields that also attract more research, similar projects to evaluate the field and lay out research agendas are more frequent. For example, Deshpande and Webster (1989) defined a research agenda for organizational culture and marketing. Guest (1997) did the same for human resource management (HRM). Closer to our own field, Varun Grover (2001) defined a research agenda for knowledge management (KM), Rumelt and Teece (1994) did the same for business strategy, Gibson et al. (2004) did this for business intelligence (BI) and Al-Mashari (2002) defined an agenda for enterprise resource planning (ERP) systems.

Intelligence studies can be divided into a private and a public side, or one related to business and the other to the affairs of the state. Research agendas in military and state intelligence have a longer history and have come further as a discipline. Landon-Murray (2013) presents a literature inventory and research agenda for intelligence studies. Marrin (2005) argue, much like Calof and Wright (2008), that in CI intelligence should continue to be done within the parameters of other disciplines. Landon-Murray (2013) argues that "Previously, students likely to pursue careers in the intelligence field completed liberal arts degrees—commonly political science and history at the undergraduate level and international relations at the graduate level" (p. 745) and that this corresponds to demand by practitioners: "Intelligence organizations like the Central Intelligence Agency (CIA) do not want graduates who have been educated to be 'intelligence specialists'" (p. 748). Dorondo (1960) argues that intelligence courses should teach broad concepts from a variety of academic disciplines (like economics, political science and sociology) and issues, with less focus on intelligence specializations. Meredith et al. (2012) argue for greater engagement between academia, BI vendors and BI customers, with an outline of a research agenda. Dhami et al. (2015) present a list of problems that deserve more attention. On the top they place methods for assessing and improving forecasting accuracy and examining communication of uncertainty using verbal and numerical probabilities. Andrew (1997) wants to see greater intelligence sharing with foreign agencies, which was also what happened later. A similar development is occurring with DaaS today for private organizations where organizations are starting to rent information instead of buying it.

We do not have to agree with all suggestions presented in these research agendas as much will depend on the industry we are in and on when the suggestions were made (many are quickly outdated). To be representative, surveys on research agendas try to gather data from a broad group of users and researchers. Others base their assessment on what has been done previously in scientific journals, thus what seems to be missing, or what authors themselves say are missing. We shall attempt to do both here in this paper.

1.3 Research on intelligence courses offered

There is a positive correlation between the number of researchers in an area, the number of courses and the amount of research produced, even though the causal relationship is less evident.

Again we will have to refer to research done for intelligence studies. According to Campbell (2011):

> "Between 1985 and 1999, the number of non-government higher education courses on intelligence increased from 54 to between 200 and 300" (p. 308),
>
> "By 2005 the number of unclassified courses offered within the military intelligence community had grown to 1 417, with National Security Agency (NSA) courses making up 46 percent of this number" (p. 309) and
>
> "The number of non-government courses in intelligence has now grown to over 840, with more than 100 civilian institutions providing some form of intelligence education" (p. 309).

There are no PhD programs in intelligence studies, except for at the American Military University, but it is possible to defend a thesis in intelligence related topics both within business studies and computer sciences in

many countries. See for example Solberg Søilen (2004).

In comparison, courses in CI and intelligence studies in business are probably far fewer even though no similar survey has been published. An unpublished survey from 2004 in Sweden shows that there were 23 courses in *omvärldsanalys* (which translates to "surrounding world analysis") at Swedish universities and colleges. However, most courses today are offered by business consultants, like the Strategic and Competitive Intelligence Professionals (SCIP) and the Institute for Competitive Intelligence (ICI).

1.4 Research questions

This article is a continuation of the article "A place for intelligence studies as a scientific discipline" (Solberg Søilen, 2015), where focus is on what the journal's readers want to see articles about. The article also shows what many CI practitioners *think* makes CI unique. The examples show that the content they list is not exclusive to CI. However, the article also suggests that there are problem areas within intelligence studies in business that are not covered by other studies and suggest that these be further investigated to build a research agenda for intelligence studies in business. The article suggests that the lack of scientific development in the field is related to how we chose to define it.

A working hypothesis is that CI is defined differently by different practitioners and that this is a part reason for the confusion. Thus in the survey we asked people to define CI and/or intelligence studies and react to an established definition. In the analysis a number of dimensions are identified in the form of working hypotheses where CI may be said to bridge a gap in relation to other fields of study related to method, perspective, technology, function and actor.

In this article we investigate the working hypotheses and identify a specific research agenda by way of a survey. Two research questions were formulated:

1. What research do practitioners think CI/IS should focus on? (In what areas would you like to see more research?)
2. What definition of CI/IS do practitioners think is better and why? (respondents get to react to an established definition)

Based on these questions three research questions were put in the survey:

1. In what areas would you like to see more research done within competitive intelligence and intelligence studies?
2. What definition of competitive intelligence and/or intelligence studies do you prefer? (How do you define it?)
3. What do you think about this definition:

"Intelligence studies deals with all the things which should be known in advance of initiating a course of action."

The definition was chosen to extract more information from respondents. The definition from the Clark Task Force of the Hoover Commission was chosen as it is well established, is wider than CI and is the result of a cooperative academic effort. Most other definitions of CI presented are suggested by individual academics or professionals.

2. METHOD

Data was gathered over LinkedIn and the JISIB mailing list. On LinkedIn we posted the survey (surveymonkey.com) at the SCIP members group with a population of ca. 22 000 registered users. The journal JISIB has ca. 800 registered users. The time period allowed for responses was three weeks. In total, 270 complete responses were gathered. Out of these respondents five deep interviews of 30 minutes each were carried out using Skype. These respondents were chosen randomly from different industries to avoid industry-specific interests. The following industries were represented: software, aeronautics, management consulting, pharmaceuticals and academia.

3. DATA

To include data of all responses directly in this paper was not possible due to limited space. Instead we publish every 10th answer, shown in Table 1. The analysis and statistics are done for the whole set. Some shortening of the text as well as language and grammar editing has been done for the original answers.

Table 1 A sample of data gathered from the survey. R indicates the response number, made up of every tenth answer from the survey. Q1 asks: In what areas would you like to see more research done within competitive intelligence and intelligence studies? Q2 asks: What definition of competitive intelligence and/or intelligence studies do you prefer? (How do you define it?) and Q3 asks: What do you think about this definition: "Intelligence studies deals with all the things which should be known in advance of initiating a course of action."

R	Q1	Q2	Q3
10	Motivations of employees	None	Sometimes we do not take actions, it is more to do with decisions
20	Foresight	The gathering, analysis and spread of information and knowledge created to support decisions and anticipation	It is about more than what is known, it is about understanding and anticipation
30	Risk management	All activities undertaken to secure and maintain responsiveness to client needs	All things cannot be known. There are many variables, unseen and unforeseen and observation biases that come into play.
40	Internet of things	None	None
50	Strategic conversation (cf. Kees van der Heijden)	Actionable knowledge	I miss the bit that you have to act all the time (where inaction is a type of action)
60	Cases with Quintuple Helix ⁎	Competitive intelligence must interact with three essential elements: (1) The competitive environment that issues weak signals, (2) The mass of information (big data) that includes weak signals and noise, 3) The decision maker that processes and translates the information	I don't agree with this definition
70	Veracity of sources ◊	The study of decision-making based on an understanding of the external competitive environment	Too broad
80	Competitive intelligence	CI is the process of monitoring the competitive environment	It is a general definition
90	Intelligence analysis toolsets used in military / government	Insights for strategic and tactical decision-making	The definition broadly covers the meaning
100	Industry strategy, energy and earth resources	Competitive intelligence concepts for strategy	Could cover the concepts
110	Science of education	The power of creating an opportunity	Agree
120	Decision making process and cognitive bias	Decision support tool	Too broad and diverse
130	International research, in "developing" markets. The application of marketing analysis techniques	The SCIP definition works	No, the decision may be to take no action. That is a decision - not a course of action.
140	Consumer products, case studies, stories about success and failure	None	Overly wordy
150	What is the value added of intelligence in business or economics?	CI assembles several practices, theories, models, techniques etc. Maybe an analogy can be in the wine sector, when talking about "assemblage"	The definition is related to Early Warning. I think this may a distinction from others disciplines. "Anticipation" is a key aspect and it needs to be taken into account
160	Broader, more external perspective	CI is knowledge and foreknowledge about the entire business environment that results in a decision/action	This definition is similar to mine
170	In the game area	Intelligence studies deals with all signals about things which should be known in advance before the organization initiates a course of action, which should alert the organization about an environmental change with a potential impact	The definition is good, but restrictive
180	Network/Platform strategy, applications of activity-based intelligence and other "discovery/data intelligence" methods in CI organizational design/agility and CI. CI approaches for Treverton's "mysteries" ∞ rather than existing approaches based on "puzzles" complexity and CI/strategy. More like Dr Rahul Basole is doing with computational enterprise analytics χ	The creation of decision advantage through external observation and sense-making	I don't think the definition is appropriate anymore. It is the product of a legacy of organizational structures, and intelligence targets & methodologies – which have shown to be ill-suited for 21st century problems. Furthermore, the definition presupposes the intel customer has the situational awareness and understanding to know when, if, and where they need to make decisions – they frequently don't.

190	Influence and soft power	To act as a catalyst to concentrate all the national and regional industries, universities and institutions to promote the development and defend the global interest of the nation and region	It seems to be speaking of the same point I made.
200	Measuring the value of CI, actual impact of CI as part of the decision making process	SCIP definition is fine. Intelligence to enhance business decision-making and organizational performance to create a competitive advantage.	Not good enough. Focus on understanding the external environment as a factor in the decision making process.
210	Information access and reuse of data. Knowledge about your customers, competitors, etc.	Intelligence assessment	Sounds good
220	CI in the relationship with organizational ambidexterity	CI helps the managers to understand the complexity of the competitive environment to make the right decisions.	It is too general
230	Applying data science to competitive intelligence	CI is an ethical and legal way of gathering actionable information	It is right
240	Data-driven competitive intelligence	I see CI as an information management discipline focused on supporting managerial decisions based on data about the market and the competitors. Intelligence studies is about how to design these information management processes.	Too broad
250	More industry specific	A tool that helps the anticipation of actions to mitigate failures & crises	Yes, this is a good definition
260	Health and security	A process of research, development and innovation for better intelligence	Yes I do agree
270	DaaS	A broad definition is better	Agree

⁎ The Triple Helix innovation model focuses on university-industry-government relations. The Quadruple Helix embeds the Triple Helix by adding the 'media-based and culture-based public' and 'civil society' as a fourth helix.
◊ Veracity is an open source distributed version control system primarily written by SourceGear LLC which integrates not only the artifacts placed under version control in the repository, but also associated data for features such as the integrated bug tracking system and agile "build management" tool.
∞ Gregory F Treveton is the author of Intelligence for an Age of Terror (2009). In the book Treveton explains: "In contrast to puzzles, no evidence can definitely solve mysteries because, typically, they are about people, not things" (p. 18). He suggests that we can normally "know" something based on recent history and perhaps some theory, which factors are important to monitor. This could be applicable, for example, in the case of Russia's inflation rate or whether Israel might strike Iran. For mysteries the product is the best forecast. Treveton also writes about a change from "need to know" to "need to share".
χ Rahul Basole is an Associate Professor and Director at the Georgia Institute of Technology. His research fuses system science and visualization to study technology strategy, innovation management, and transformation of complex enterprise systems.

4. ANALYSIS

The following can be said from the 270 responses and the five deep interviews: answers vary significantly. Respondents may have misunderstood the questions, maybe due to reading and answering too fast, which may be a problem with e-surveys and emails in general today. For example, respondents sometimes did not write definitions where this is asked for and are more interested in promoting their own ideas about CI in general. This information tells us instead how respondents think about CI, which can be useful, but is less useful for answering the specific research questions. It may also be that respondents think very differently about what CI is.

There was no difference in regards to these issues between those who answered on LinkedIn and those who answered by return email. The discrepancy was just as large between the two sources. A large part of respondents who give definition suggestions seem to have a poor understanding of what a definition is – and what is required of a definition - answering instead with what they see CI as being, how they work with CI or how they would like it to be. However, some careful conclusions can be made for each question.

4.1 Q1: In what areas would you like to see more research done within competitive intelligence and intelligence studies?

Data about what IS researchers should focus on can be divided into the following groups:

1. *analyses*, such as foresight, Cases with Quintuple Helix, Treverton's "mysteries,"
2. 2. *traditional phenomena or problems*, like HRM, risk management, soft power, measuring the value of CI, information access,
3. *new phenomena*, such as the internet of things, aaS solutions,

4. *trans- or cross-disciplinary studies*, such as intelligence analysis toolsets used in military / government, industry strategy, energy and earth resources (geoeconomics) and Applying Data Science to Competitive Intelligence,
5. *methodological issues* such as identifying and avoiding cognitive bias or publishing more cases,
6. *industry specifics* or focusing more on certain industries, such as consumer products, and health and security.

In summary, the most requested areas requested are: analyses, traditional phenomena or problems and trans- or cross-disciplinary studies.

4.2 Q2: What definition of competitive intelligence and/or intelligence studies do you prefer? (How do you define it?)

What elements are emphasized in the definition of CI and IS? The most recurring elements are about the individual steps in the intelligence cycle, responsiveness to client needs, actionable knowledge, signals from the competitive environment, relationships to big data, decision makers, strategy, seeing opportunities ("blue oceans"), knowledge and decision making with the entire business environment in mind.

The most recurring element in the answers is that it's *about supporting managerial decision and decision-making*. This occurs in 33% of the answers. The second most important element is that it's *based on an understanding of the external environment* present in 15% of answers. Third is that it's *about actionable knowledge/information* was included in 11% of answers. Other answers suggest that it's about following the CI cycle, following customer needs, working in a questions and answer format, a combination of detecting weak signals, applying big data and translating it to decision makers, that it's linked to strategy or that it's about putting it all together or acting as a catalyst.

The problem with the answers from the first question is that it's an area already covered by other established fields of study. There are several journals on decision-making, most of which are related to medicine and health. In SCOPUS there are 4291 articles, books and papers about decision-making in medicine and several journals on the topic, 2183 in decision sciences, 1897 in computer science, 1505 in psychology, 1477 in health professions, 1476 in nursing, 945 in business, 931 in dentistry, 852 in economics and 797 in mathematics.

The decision-making sciences have their own journals like the journal *Decision Sciences* and societies like the Decision Sciences Institute. Not only practitioners but even most academics pay little attention to these overlaps. Thus SCIP focuses on decision-making in their definitions and material, like when the organization says it "focuses on decision-making, to create competitive advantage". CI defined on Wikipedia also emphasizes decision-making.

The second most popular answer, that the study is about the understanding of the external environment, is a unique definition as that notion is not covered by other established scientific disciplines as far as I have been able to see. No other established research communities are looking at this phenomenon today it seems.

The third most popular answer, that it's about actionable knowledge/information, talks about an end product, or the end result of the intelligence process. As such, it is considered too narrow to build the basis for a scientific study. As a curiosity, only a few of the 270 respondents use the term preferred by Google in their new BI service, "actionable insights."

4.3 Q3: What do you think about this definition:

"Intelligence studies deals with all the things which should be known in advance of initiating a course of action."

For the third question we wanted to extract information from respondents by asking them to respond to an established definition. In total, 46% of respondents thought the definition by the Hoover commission can be used for intelligence studies and CI. A further 17% of respondents have objections toward the notion of "should be known" in the definition, as they argue that CI is largely about what you cannot know in advance. Another 17% think that the definition is too broad and 12.5% of respondents have objections to the use of the term 'action,' which they see as significantly different from the term 'decision,' which they prefer.

5. DISCUSSION

5.1 The problem of overlapping definitions

The definitions of CI, marketing intelligence and market intelligence are too close and overlapping to be separate disciplines. A comparison of definitions on Wikipedia illustrates this (italics added by author):

A. "Competitive intelligence is the action of defining, gathering, analyzing, and distributing intelligence about products, customers, competitors, and any aspect of the environment *needed to support executives and managers making strategic decisions* for an organization."
B. "Marketing intelligence (MI) is the everyday information relevant to a company's markets, gathered and analyzed specifically *for the purpose of accurate and confident decision-making* in determining market opportunity, market penetration strategy, and market development metrics. Marketing intelligence is necessary when entering a foreign market."
C. "Market intelligence is the information relevant to a company's markets, gathered and analyzed specifically *for the purpose of accurate and confident decision-making* in determining strategy in areas such as market opportunity, market penetration strategy, and market development."

Despite this, CI and marketing intelligence have developed into two separate professional and academic communities with their own groups of scholars, journal and conferences. Marketing intelligence has developed within the study of marketing, CI largely on the outside. Market intelligence has developed as a hybrid and a parallel to CI within marketing. For comparison we could also add strategic intelligence:

D. "Strategic intelligence (STRATINT) pertains both to the collection, processing, analysis, and dissemination of intelligence that is required for forming policy and military plans at the national and international level and to qualities that equip leaders to be effective strategists."

Strategic intelligence follows the elements of the intelligence cycle and is directed towards strategy. In the definition from Wikipedia it is used for state and military intelligence. However, the term is frequently used in business contexts, as a quick search in any of the scientific databases will show.

5.2 The relationship between fields of study and scientific journals

Any scientific field of study must be related to one or more scientific journals. If we start from the top, or from a broad perspective, all journal names with the term 'intelligence' in the most prestigious scientific database, Web of Science, are related to the study of psychology. In the database Scopus there are others. When we go down to the level of articles 73,381 in Scopus are on 'intelligence.' Of these, 66,448 are in computer science and 38,597 are in mathematics. Further down the list comes business with 1450 articles and there are 470 in decision sciences alone. Of these, most articles are published in *Marketing Intelligence and Planning* (Emerald) (756), *International Journal of Technology Intelligence and Planning* (Inderscience) (224), *International Journal of Business Intelligence and Data Mining* (Inderscience) (200) and the *Journal of Intelligence Studies in Business* (Halmstad University) (46).

Past and present journals that are outside of the two major databases or non peer-reviewed include the journal *Business Intelligence* (from 07/01/2003, 6 months), *Competitive Intelligence Review* (From 1998 to 2001 in Wiley-Blackwell Journals, Frontfile Content), *International Journal of Intelligence and Counterintelligence*, and *GfK Marketing Intelligence Review*. The *Journal of Competitive Intelligence and Management* (JCIM) cannot be accessed through university databases at present (property of SCIP).

The number of specific articles published about CI, marketing intelligence, market intelligence and strategic intelligence in each of these journals are listed in Table 2.

Table 2 Studies and corresponding scientific journals. The keywords list the fields of study by relevant terms. The first column lists first names of journals in the fields. The figures represent number of articles. At the end there is a summary of articles in each field and a division of classification it is listed as a paper in business, decision science or social sciences. Rank indicates the summation of articles.

	Key words					
Journal Name	***Competitive Intelligence***	***Market Intelligence***	***Marketing intelligence***	***Strategic intelligence***	***Sum***	***Rank***
Decision Support Systems	50	37	16	21	124	1
Journal of Intelligence Studies in Business	46	8	6	19	79	3
International Journal of Technology Management	39	13	3	18	73	4
Information and Management	23	4	7	16	50	6
Strategic Management Journal	22	4	5	13	44	8
Long Range Planning	20	10	5	25	60	5
Marketing Intelligence and Planning	10	34	42	12	98	2
Management Science	14	14	9	12	49	7
Industrial Marketing Management	8	13	13	6	40	9
Journal of Business Research	3	10	7	4	24	10
Eureopan Journal of Marketing	0	6	12	0	18	12
Journal of Strategic Studies	0	0	0	21	21	11
SCOPUS (total results)	9185	7473	2890	5633		
Business	1676	1507	776	1025		
Decision Sciences	876	517	213	507		
Social Sciences	711	592	206	808		

Decision Support Systems has the most articles published in CI, but then it has been listed in Web of Science since 1991. JISIB is number two, but published its first issue in 2011. *Marketing Intelligence and Planning* is not listed in WoS, but has been in Scopus since 1983. Thus based on the age and name of the journal it is no surprise that it is leading in articles on marketing intelligence and is number two in market intelligence, after *Decision Support Systems*. *Long Range Planning* has the most articles in strategic intelligence (business context) and has been listed in WoS since 1986. Considering that JISIB, with only four years of publications, is already the third most published journal in these fields we can conclude that the other journals, with far more issues and articles per year, publish a modest number of articles on the subjects of CI, market intelligence,

marketing intelligence and strategic intelligence.

Intelligence studies in business cannot define itself as yet another version of the same, but must be defined as different from other disciplines. In the survey we saw that respondents favored a focus on the external environment in the definition and that this term is not occupied by other studies or scientific journals. This is also the understanding of a much cited article by Chen et al. (2002): "Competitive Intelligence (CI) aims to monitor a firm's external environment for information relevant to its decision-making process" p. 1. A suggestion based on the data collected in our survey could be that:

E. Intelligence studies in business is about how companies study their external environment and how that contributes to their competitive advantage.

In an earlier article Gbosbal and Kim (1986) speak about "environmental intelligence" in the same way. Gilad (1989) makes the same distinction between CI, as scanning competitors and markets as opposed to environmental scanning, which is much broader, but also where it is more difficult to add value.

When we compare the literature, marketing intelligence is more about the micro perspective, what is going on in the company and the market. Only to a lesser degree does it study the macro factors that influence that market (macro-economic, political, judicial, environmental, scientific, technological, social, infrastructural factors). Intelligence studies, on the other hand, is just as much about the macro perspective, the factors that the company cannot influence but have a decisive effect on its operations. Simply put, it's about what goes on in the world and how that affects the company's competitive advantage.

It is also about the company perspective, not about the perspective of the state, which again separates it from [state or military] intelligence studies.

Respondents found the definition of The Clark Task Force of the Hoover Commission from 1953-55 to be good, but too broad. For the sake of order it's reaped here:

F. "Intelligence deals with all the things which should be known in advance of initiating a course of action."

In summary, definition E seems to be the best option when compared to the data gathered in the survey and from the deep interviews.

5.3 Setting a research agenda: the broader perspective

The suggestions by the respondents in the survey and the deep interviews gave us a list for a research agenda. In this paper, however, there must also be room for a broader discussion where less frequent answers are discussed.

The question of a research agenda is ultimately the question of how and where we as employees in companies may learn about the surrounding world that is relevant for the competitive advantage of the organization. Gilad (1989) suggests that the irrelevance of much environmental scanning can be solved by looking beyond obvious sources ("be entrepreneurial"), by harvesting the power of the entire company ("be economic") and by focusing on what specific users say they need ("be essential") (Idem).

Setting a research agenda is also a question of who can do the job. Does it have to be CI experts? Are we looking at some sort of super librarian for the web 2.0 age? CI has for a long time been of interest to the library sciences, even though librarians have their own journals and professional societies. Can't we give the whole job to a computer geek? After all business intelligence, big data and the internet of things are mainly studied by engineering types. Or, to take a diagonally opposite view, maybe the whole thing can be given to a good social science researcher or a wise man (as in the humanities). After all, for each question we ask about the world there is a set of answers and the scientific methods are the same, shared by all of the social sciences and some of the humanities. The ways we answer these questions gives birth not only to different research agendas but also decides the scientific home of the study.

For now, let's simply acknowledge that there will be different approaches and that some academic groups like BI are more successful scientifically than others. That is largely the result of being more relevant.

As for the question of how and where we may learn the most about keeping an organization competitive, there are numerous

possible answers, of which many have been suggested in terms of the topics in this survey. If we look to existing theory, much of the literature focus on different flows of information into organizations, starting with the article by Gbosbal and Kim (1986) focusing on trade publications, suppliers, bankers, consultants and customers. Another approach that continues to attract little or no attention in the scientific literature is travelling and reading, maybe in part because they are though to belong to the humanities, the study of history, geography and literature.

5.3.1 Travelling as a way to learn about the external environment

A good intelligence worker or analyst is a person who has travelled and seen a lot, is well-read and is part of an influential network of people, according to the formula: reading, watching and listening. We must read broadly and in order to watch and listen we need to travel. To identify the macro factors in the larger, international environment, we need to know what is going on in the world because things in the world affect us. This is the perspective of intelligence as surrounding world analysis, as defined by Stevan Dedijer, but also suggested by respondents in the survey. As such, it is very different from what students learn at university in the social sciences.

The intelligence expert should be able to solve the following problem given by a decision maker: "I need to make this decision, now tell me what I need to know to do it correctly." How do we study and train employees for this task? There are basically two questions; what is it that I need to know and how do I become good at it? The point made here is that the answer to these questions should also decide the research direction of the discipline. It is suggested here that we become good at CI also by travelling and seeing the world. Or, recalling the story of Drucker in the introduction, we are often better off reading books, instead of reading scientific articles, which tend to give a fragmented and overly theoretical (dogmatic) view on reality.

The notion of "learning by travelling" has been a method followed ever since Marco Polo went on his big journey and wrote a book about it, and Peter the Great went to the Netherlands to learn how to build ships. It was the tradition of the English aristocracy with the "Grand Tour" and it has been the method of big industrialists, like Ferdinand Porsche when he visited the US to learn about mass production at the Ford factory and when Robert Bosch went to work with Thomas Edison in New York. In Germany it was and to some extent still is the tradition that young apprentices organized in student unions (Burschenschaft) traveled (Wanderjahre) for some years before they set up their own shop, much like in Goethe's novel "Wilhelm Meisters Wanderjahre" (See also Steer, 2008). In much the same way, state intelligence organizations have thousands of people stationed in other countries and other departments, such as the foreign department, and make sure their employees travel the world on a regular basis if for nothing else than to keep up with current affairs. If this is a relevant direction in reality then it should be so in theory too. Still there is little research in this direction.

The problem is to a large extent that the neoclassical paradigm, which still dominates studies in business and economics, despite the fact that its usefulness has been refuted decades ago (see, for example, Hodgson, 1988). Neoclassic scholars consistently avoid topics covered by the humanities, which they see as less scientific just because they are less rigid simply because they belong to another domain of knowledge about human life.

In other words, the problem is to a large extent the way we define what is scientific for the study of man. Many will argue that intelligence as "wandering around the world" is more fitted as a study for the humanities. In comparison, Asian societies have been more inclined to see competitive questions from a broader and more practical perspective (Japan in 1960s and 1970s, China today) while Western societies, since the 1970s, have come to see travelling primarily as entertainment and personal enrichment (an end in itself).

My students have hardly heard about the twin cities of Chongqing and Chengdu as one of the great industrial hearts of the world, and they are ignorant about Wenzhou, where around 90% of global eyewear is made, Guangzhou, where around 70% of bags and suitcases for European and US mass markets are made, or any of the other 50 or so Chinese niche cities. Instead they know (much like consumers) about the brands themselves – not how they are made, or where or who the owners are. The business schools where they go continue to spread a curriculum void of historical parallels, detached from geography, with no real interest in questions of

ownership, but filled with oversimplified business models, common sense truisms and gossip about fast fortunes made (success stories).

The development of the social sciences after WWII lead to an extreme form of compartmentalization (specialization not being the major problem), of which intelligence studies has also been a victim to the point that it almost annihilated itself as a study with CI. This can also be explained by the study's false perception of itself, as the topic was driven forward by practitioners, more as a consultancy fashion and a fad then a scientific study. From a consultancy perspective one might say there is nothing wrong with this. As one term gets used up (does not sell) another is introduced, much like when CI consultants exchanged CI with market intelligence and today market intelligence with foresight, much without thinking about the difference in meanings. From a science perspective, however, this is troublesome.

5.3.2 Reading as a way to learn about the external environment

Maybe reading is just another way of travelling. Anyway, surfing the internet is not the same thing. It's an illusion to think that we have become smarter because of the increased amount of data *available* on the internet. Most new data added each day are YouTube videos (all those funny cats and dogs), our comments on Facebook and Twitter, information which is not even accurate or interesting, but appeals to our narcissistic and voyeuristic nature. I will keep this discussion for an upcoming article, dealing with DaaS and other aaS.

Reading is mostly a missed opportunity. Much valuable information and knowledge is only available in books (including e-books) but the knowledge they contain demands time for reading and reflection. We also need to read continuously because we forget continuously. Intelligence work is just as much about finding time to become knowledgeable. Instead our days are filled with disruptions and multitasking, which basically means doing many things poorly. Surfing and sifting through information and knowing where it is is not the same as knowing, much less remembering. For example the NSA knows it has data about future crimes and terrorist attacks, but it cannot extract it, so it does not matter. On the other hand, they have so much data that they can always find something that looks suspicious but isn't. Amazon.com has plenty of data about what I read but cannot tell me what book I want to read next.

Our open office landscapes and working environments are not made for reading. When we come home we have other (family) obligations. Trying to catch up with the world for 5-15 minutes before falling asleep by stacking books on the bedside table is not a solution. The best opportunity many of us have for reading is to do this while travelling: on planes, in cars (audio), in airports and on trains. Others try to catch up during summer vacation, but it is mostly a romantic image. Disruptions are also the nature of vacations. Thus instead of reading we have skimming. Instead of knowing we have know-about. Instead of building our own opinion we follow those of others who somehow seem to us to know more. We follow management fads like "blue oceans," co-creation, innovation or CSR, simply because it seems a good idea at the time and critical thinking somehow takes too long. Of course, most people are too busy being entertained to read anything at all. All of this is no critical of any individual or mankind, simply a reminder of our cognitive limits.

There are basically two ways to learn, through our own personal experience and those of others. What we read, watch or listen to depends on what we want to know, for example what industry we are studying, but we can still say something in general about types of sources, their relevance to the questions we face and the degree of trust we can place in their answers. Table 3 summarizes these sources of information and how we interpret them.

The problem with types of sources is often a tradeoff between trust and relevance. It's easy and quick to see what is relevant, but it takes time to write it and to make it trustworthy. By the time the product (book) is ready many will have forgotten and moved on to the next big thing. Instead we need to learn to wait for the book. Popular sources know what we want to know but cannot deliver the answers. Their headlines become unfulfilled promises. Scientific sources are often too narrow to be relevant, focusing on some narrow correlation.

Still, we can give some general advice for reading to break with some of our worst biases: try to read in different languages (to get different perspectives), rotate your sources, for example every year (for example,

Table 3 Media sources and trust.

Source type	***Example***	***Type***	***Trust***	***Relevance***
Scientific books	Springer-Verlag	Reading	Very high	Medium
Popular books	Bantam publishers	Reading	High	High
Scientific articles	*Journal of Marketing*	Reading	Very high	Medium
Popular articles (including newspapers articles)	The Economist	Reading	High	Medium
Reports, white papers	EIU: country reports	Reading	High	High
Social media messages	Twitter	Reading/watching	Low	Low
Video and TV programs	YouTube or CNN	Watching	Low	Low
Radio programs	BBC World News	Listening	Medium	Medium
Podcasts	Local radio stations	Listening	Low	Low

exchange the Economist with der Spiegel). Break your own search patterns, letting chance chose for you. For example buy books at bookshops where you are more likely to find books you did not know of before.

Moreover, good intelligence is about the network of people you have access to. Informed and resourceful people tend to find each other at the best at places like the World Economic Forum. LinkedIn is a pseudo version of a good network, more suited for marketing purposes. Being informed is a question of who we chose to listen to, but also who we have access to. Besides books, the most important source for intelligence in business is industry reports and country reports, more so than even scientific articles.

5.3.3 Industry and country reports as a way to learn about the external environment

The longer we have been in a business, the more we know about it (even though there is always a risk that we become blind to solutions because we get stuck in habits). Industry experts frequently claim they require no help from CI experts as they do not know the business. This is a dilemma; the CI expert comes with a toolbox but frequently doesn't know the material he is set to work with. It's impossible to be an expert on all industries, simply because there are so many and they are so different. At the same time, their numbers are finite and there is some consensus about their classification.

The Harvard Business School (HBS) site lists around 50 different industries on its website, the Economist Intelligence Unit (EIU) site lists about 100 "subjects" (Table 4). Together they give us an idea about the scope of what we need to know for the competitive advantage of companies. The HBS list consists of: accommodation, accounting, advertising, aerospace, agriculture and agribusiness, air transportation, apparel and accessories, auto, banking, beauty and cosmetics, biotechnology, chemical , communications, computer, construction, consulting, consumer products, education, electronics, employment, energy, entertainment and recreation, fashion, financial services, food and beverage, health, information, information technology, insurance, journalism and news, legal services, manufacturing, media and broadcasting, medical devices and supplies, motion pictures and video, music, pharmaceutical, public administration, public relations, publishing, real estate, retail, service, sports, technology, telecommunications, tourism and transportation.

Out of fifty-two industries, twenty-four can be classified as production (46%). They represent 41.8% of the papers available on the HBS site. This is of importance for the competitive advantage of nations, which builds largely on our ability to export, a lesson often forgotten (Solberg Søilen, 2012b).

Some industries are underrepresented in the number of studies: these include the insurance industry, travel, accommodation (hotels), tourism and medical devices. Some divisions are also misleading, like the separation between IT (1) and technology (126). The aerospace industry has few studies, but it's also an industry with few actors. Some areas may be said to be overrepresented in terms of the number of reports or information available about them: these include publishing (48), health (106) and financial services (180). The amount of papers says nothing about the quality of information.

For the "subjects" listed by EIU, I have divided them into industries, analyses, studies and topics in Table 4. The reason for this mix of categories by EIU has to do with the kind of knowledge customers ask for and the specialties of EIU employees.

Topics are open to larger changes over time, industries less so. As indicated by respondents

Table 4 EIU subjects.

No.	Industry	Analysis	Discipline/Study	Topic
1	Automotive	Benchmarking	Economics	Business environment
2	Banking	Company analysis	Innovation	Capital flows
3	Education	Competitiveness	International relations	Productivity Sovereign credit/risk
4	Energy	Corporate strategy	SMEs and entrepreneurship	Cities
5	Financial services	Country data	Geopolitics	Mercosur
6	Food security	Country risk	Econometrics	Commercial research and advisory
7	Healthcare	Credit risk	Labour	Consumer goods
8	Investment	Demographics	Macroeconomics	Cost of living
9	Islamic finance	Risk	Monetary policy	Livability
10	Cross border finance and investment	Forecasting and policy analysis	Migration	Currency
11	Debt markets	Predictive modelling Regulatory impact	China	Data services
12	Oil	Global trends	Climate change	Infrastructure
13	Retail	Indices	Democracy	Global economy
14		Market entry	Emerging markets	Development
15		Operational risk	EU integration	Gender
16			Foreign direct investment Politics	Economy
17			Public policy	Foreign policy
18			Research	Employment Environment
19			Scenario analysis	Evidence-based solutions
20			Security	

in this survey there is a demand for research papers in specific industries. Our lists show the scope for such studies. We could also have listed country reports, which besides industry reports are the major focus of EIU, but these are obvious for everyone with an elementary course on geography.

6. CONCLUSIONS AND IMPLICATIONS

In this paper we identify a research agenda for CI and intelligence studies in business. According to respondents, practitioners and academics should focus on *analyses*, such as foresight, cases with Quintuple Helix, Treverton's "mysteries", *traditional phenomena or problems*, such as HRM, risk management, soft power, measuring the value of CI, information access, *new phenomena*, like the internet of things, aaS solutions, *trans- or cross-disciplinary studies*, such as intelligence analysis toolsets used in military or government, industry strategy, energy and earth resources (geoeconomics), applying data science to competitive intelligence, *methodological issues* such as identifying and avoiding cognitive bias or publishing more cases and *industry specifics*, or focusing more on certain industries, like consumer products, and health and security.

Respondents think that CI should be defined around *supporting managerial decisions and decision-making* but in this article we show that this is associated with certain methodological problems, as the area identified is already covered by other scientific groups and journals. The result is a considerable overlap. Respondents' second suggestion is that the definition should be around the *understanding of the external environment*. This is a better definition from the point of view of defining a unique research agenda. It also corresponds with the understanding of intelligence as *surrounding world analysis* and the broader definition of social intelligence as defined by Stevan Dedijer.

In the discussion we try to show how the development towards compartmentalization in the social sciences has been to a disadvantage to the development of CI and intelligence studies in business as disciplines. We show how notions like reading and travelling have always been the way companies have learned about the surrounding world and suggest reasons for why this lesson has been forgotten.

The implication of this research helps to form some consensus around what kind of problems are interesting for researchers to take on for intelligence studies in business. There are suggestions in the discussion of this paper that indicate that it would be of interest to see a compilation of courses offered in CI and its equivalents around the world. It would also be interesting to see how the tradition of traveling-as-learning continues in companies today. Furthermore, it is of interest to better understand how companies succeed with intelligence within specific industries or subject areas.

The future of intelligence studies in business continues to lie primarily with its symbiosis with new technology. A generation ago it was the development of software, business intelligence, but it is now with Cloud solutions, DaaS and other members of the aaS family. Managerial aspects cannot be developed independently. Zhiqiang et al. (2012) show how CI can be integrated in BI, but more and broader research in this direction is required.

BI may represent tremendous business opportunities in dollar terms, but these systems and software are by themselves nothing but empty shells. They do not become valuable before we fill them with good intelligence. Intelligence systems are primarily about content, not technology. Intelligence studies in business are about how we build that content for the surrounding world of any private organization.

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An evaluation of business intelligence tools: a cluster analysis of users' perceptions

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ABSTRACT The purpose of this paper is to discuss and evaluate the use of business intelligence (BI) tools by professionals and students to help designers of these tools get the most efficiency out of a monitoring process. This paper explores the business and competitive intelligence literature. BI is considered to be a new area in information systems, so literature research was conducted in the area of management information systems (MIS) with two evaluation models: task-technology fit and technology acceptance to evaluate BI tools. A questionnaire was sent to users of business intelligence tools addressed to French companies in different trades and engineering students and the most pertinent replies were examined. The responses were analyzed using the statistical software SPAD. Results showed a typology from the various profiles of users of this technology using the method of classification. We note different perceptions between professional and student users (the clients). Although this study remains focused on individual perspective, it requires more examination of the organizational impact of the use of BI tools. The identification of the different user profiles was done by using a cluster analysis. For the designers of BI tools these results highlight the importance of user perception, suggesting designers take into account the perception of all user types. As these tools develop, more and more companies will be looking for skills for monitoring and management of strategic information.

KEYWORDS business intelligence, cluster analysis, TAM model, TTF model, user perception

1. INTRODUCTION

In recent years, the emergence of information technology and knowledge has improved the completeness of data collecting in order to ensure a better ability to classify information and knowledge through the use of artificial intelligence.

Business intelligence (BI) now has better tools able to identify the interests of users and facilitate the analysis and dissemination of information and knowledge. BI is considered to be a separate and scientific discipline dominated by engineers and programmers (Solberg Soilen, 2015). Adamala and Cidrin (2011) attempted to analyze what the factors are that influence BI. Sabanovic and Solberg Soilen (2012) defined BI as:

> "an analytic application, […], that enables a wide range of users to access, analyze and act on integrated information in the context of the business processes and tasks that they manage in a given domain…"

These authors showed that there is a positive correlation between company size and usage of BI systems. They used and developed a purchase and employment layer (PET) model of BI implementation to identify companies' understandings, expectations and needs in terms of BI systems. Nyblom et al. (2012)

proposed a model for evaluating the performance of BI software systems by using five criteria: efficiency, user friendliness, satisfaction, price and adaptability. Their results showed that the choice of system used is related to the individuals' experience. Amara et al. (2012) developed and tested a Solberg Søilen Amara Vriens (SSAV) model for the evaluation of BI software to facilitate the user's selection tool.

By generating more relevant information, these tools seem likely to influence the process of decision making in the company. Despite this important role of business intelligence, little research has addressed the interaction between the monitoring tools and their users.

This article addresses the issue of the identification of business intelligence tools and the evaluation of professional and student perception by putting this technology in the business intelligence process.

The management of information and knowledge poses three major challenges related to three basic needs: the analysis of structured and unstructured data, the measurement of the user perception on monitoring tools and the identification of user categories.

From these three challenges, our approach seeks to answer two key research questions:

1. How can we make the choice between different monitoring tools to collect, to process and to disseminate information?
2. What are the characteristics of the use of monitoring tools?

In the second section, we define the concepts of "competitive intelligence", "business intelligence", "strategic intelligence" and "BI or monitoring tools". In the third section, we propose the approach of our study and the research method. In the fourth section, we present our results on the monitoring tools developed within the higher education institution and the companies surveyed and classification of users of this technology in their perception. Conclusions are drawn in the sixth section.

2. CONCEPTUAL BACKGROUND

Historically, a business company is listening to its changing environment (customers, suppliers, competitors, government and web) to identify indicators that have an influence on its present and future activity. Over time, some companies have integrated this process into their organization by seeking information about their environments. This process has become an autonomous research field. Aguilar (1967) pioneered research on strategic intelligence and he defined this concept as the gathering of external information on events and trends of the environment. He showed support for the identification and understanding of the threats and opportunities of strategic processes.

Thus, during the last fifty years, researchers have in turn spoken of organizational intelligence (Wilenski, 1967; Choo, 1998), business intelligence (Gilad and Gilad, 1988) and intelligence of business (Lesca and Chokron, 2000) before the more recent appearance of the "competitive intelligence" and "business intelligence" concepts.

Competitive intelligence is regarded as a specialized branch of business intelligence. Solberg Soilen (2015) proposed the classification of intelligence studies to help us to place different forms of intelligence and to show how they related to each other. The first concept aims to collect and analyze data on specific and generic competitive environments, while the second focuses on the current competitors and can analyze areas such as potential acquisitions-mergers and evaluate specific country risks (Lesca and Caron Fasan, 2006). In the case of competitive intelligence, Herring (1998) defines this process as a number of separate activities; it is a continuous cycle which includes the following levels:

Level 1: Human Collaboration

- Planning and management: working with decision makers to discover and identify their needs in an intelligent way.

Level 2: Content Sharing

- Data collection: conducted in a legal and ethical manner (using general search agents, meta-search engines, personalized web crawlers).
- Data analysis: data interpretation and compilation of relevant data (text mining, platforms of monitoring).
- Dissemination of information: presentation to decision makers of what was analyzed (Kahaner, 1998; Ruach & Santi, 2001).

- Return: effectively taking into account the response of decision makers and their needs presented intelligently and continuously.

Level 3: Platforms standby and software

- The technological infrastructure for automating tasks. These tools increase the exhaustivity of the collection to ensure a better ability to rank and prioritize information (processing and analysis).

The purpose of these applications is to provide everyone with the information enabling them to manage their business and thus achieve their objectives and optimize performance. Besides the organizational revolution induced by the implementation of these tools, business intelligence has a considerable impact on the technological infrastructure of the company.

First, the success of business intelligence is based on the ability to compile and analyze all available information. The volume of data to be processed can be considerable. For example, billions of lines published every day on supermarket receipts are valuable masses of information, but so are big data extracted and processed from operational systems.

One specificity of business intelligence tools is their remoteness and independence from operational systems. These are tools that affect the strategic level of the organization. This separation is to avoid penalizing operational systems asking them to ensure heavy processing (sorting, extraction, computing). It also helps protect operational data by authorizing a posteriori analysis. It is therefore necessary to extract information from massive operational systems to inject into specific tools for "data warehousing" into multidimensional databases. The frequency of these extractions should be adapted to the analytical (daily, weekly, monthly) needs. Finally, these extractions should allow the creation of a series of historical periods that can be shorter or longer as needed. These volumes should be protected not only because of their size but because of the sensitivity and confidentiality of any information they contain.

Since the end of 1990s, business intelligence has evolved in its definition according to the phases covered (Lesca 2001; Ruach and Santi, 2001) and according to the tasks assigned. Anticipative and collective strategic intelligence (VAS-IC, or Veille Anticipative Stratégique- Intelligence Collective; Lesca H, 2003) is the collective and proactive tool by which members of the organization perceive, process, choose and use relevant information about their external environment and the changes that occur therein. The use of VAS-IC aims to help and create business opportunities, to innovate, to adapt to the changing environment, to increase responsiveness at the right time to avoid strategic surprises and to reduce risks and uncertainty. Its main feature is to help the building of a proactive vision for decisions in the short, medium or long term. The objective is to act quickly at the right time and the lowest cost.

The business intelligence process was to find, interpret and transform relevant information useful to the action of decision-makers (Blanco, 1998). Ten researchers have contributed to the definition of strategic intelligence (including Thietart, 1981; Morin, 1985; Marmuse, 1992; Walls et al 1992; Lesca, 2000,2001,2003). Whatever the terminology used, all these notions express the fact that the strategic intelligence process is a voluntary process by which the company tracks, assimilates and disseminates information from the external environment for its use for action. It is also a process in which actors interact on a voluntary basis, according to objective, with information systems. Thus, we move from process of information to its use and from use to the action.

Theoretically, monitoring tools are used and integrated into the business intelligence process.

For a long time, business intelligence was confined in the upper echelons of business leaders. Providing dashboards to some officials, the business intelligence tools were used to control and manage. Democratization of these tools will facilitate common dissemination of information traditionally limited to the leaders to all levels of the company, making business intelligence an ideal tool for performance management (Sakys and Butleris, 2011; Adamala and Cidrin, 2011). The articles published in the Journal of Intelligence Studies in Business since 2011 focus on developing and testing models to evaluate BI systems and software. Following these studies, new problems have emerged including differentiating BI vendors (Solberg Soilen and Hasslinger, 2012) and classifying BI software based on their functionalities and performance (Amara et al. 2012; Nyblom et al. 2012; Abzaltynova and Williams, 2013).

3. METHODOLOGY

3.1 Data collection

The study concentrated on a certain number of variables stemming from the literature in information systems, which join the problem of the evaluation of the BI tools used within the framework of the process of strategic intelligence. A questionnaire was built and tested by two specialists in the field of the conception of BI tools (Lesca and Caron-Fasan, 2006; Grublješič and Jaklič, 2014). Through this study, we tried to show the use of the watch tools and their applications. The survey was built with the aim of operationalizing the variables of the theoretical model as well as profiling the users who answer this survey. It was designed and diffused to 200 professionals. Only 78 responses were usable for clustering of user's monitoring tools (these respondents were from six sectors: 1) consulting/engineering; 2) commercial enterprises; 3) IT; 4) electric and electronics; 5) financial enterprise; and 6) industry). This survey was also diffused by mail to 80 engineering students at LaSalle Beauvais Institute (sector 7) of which 56 responded.

3.2 Logic of the study

To evaluate and compare the user profiles, the selected criteria were taken from the theoretical fusion of two models: Technology / Task Fit (Goodhue and Thompson, 1995) and the Technology Acceptance (Davis, 1989; Venkatesh et al., 2003) as part of the literature on the evaluation of information systems:

Variable I: The dimension "task characteristics" was explained by:

a. Complexity of the task
b. Interdependence between the tasks

Variable II: The dimension "technology characteristics" was measured by:

a. BI tools used
b. Functionalities of BI tools: were the capacities of the system to help individuals or group determined by the type of system used (Benbasat and Nault, 1990; Wierenga and Van Bruggen, 2000). The tasks presented in the questionnaire were: search information, store, process and extract a large quantity of information, resolve the semantic and syntactic problems.

Variable III: The dimension "task/technology fit" aims to evaluate the user perception towards the used system. It is defined by the degree of correspondence between the functional needs relative to the task and the technical features offered by the information technology. It was explained by five criteria:

a. Data quality: measured the correspondence between needs and the available data, it also measured the exactness of these available data by using BI tools and the quality of data at a level of detail suitable for the tasks.
b. Localization of data: measured the ease of determining the availability and the exact sense of data (the existence in due course and under the deliberate size of public information).
c. Authorization of access: measured the accessibility of data (ease of connection and ease of extraction of public information).
d. Data compatibility: between the various sources of data.
e. Relevance of the system: making sure that BI tools did not raise unexpected problems or difficulty of use.

Variable IV: The dimension "intensity of BI tool use" was explained by:

The intensity or frequency of use: it was a subjective appreciation of the increase or the decrease of the degree of use. The intensity depended on the integration of the BI system (Grublješič and Jaklič, 2014) and on the strategy adopted by the company.

Variable V: The dimension of the acceptance of BI technology: Inspired by the "Technology Acceptance Model" of Davis (1989), this dimension was explained by:

a. Ease of use of the BI tools (Davis, 1989): measured the degree of faith of a user in the effort to supply in order to use the system. To measure the ease of use, we referred to the measuring instrument of Davis (1989) which consists of six items,

proven valid and reliable by Doll and Torkzadeh (1998).

b. Perceived utility of the BI tools: this element was not directly measurable. This notion came from microeconomic analysis: it was the measure of the use value of hardware or software for a user. It measured at the same time the impact of BI tools on productivity and quality. The perceived utility was defined by the degree of improvement of the performances expected from the use of the system (Davis, 1989).
c. Satisfaction of the BI tools user: this was the degree of continuity of use by the individual. It was a positive faith of the individual perception which showed the value of BI tools. This variable was considered as a dimension of success of BI tools (Sedden, 1997). It could influence the intention, but it was also a consequence of the use (Delone and McLean, 2003) of the utility and the ease of use perceived.
d. Intention of BI tool's use: the manager can accept a system but decides when he uses it or plans to use it in the process of decision-making. The intention of a user to use a system adopted by the organization as well as its satisfaction by this use depended on the utility and on the ease of use perceived from the system.

4. RESULTS AND DISCUSSION

Descriptive statistics have been used in order to show population characteristics. We have used SPSS.19 to treat data. In total, 60.4% of respondents were male and 39.6% were female. Furthermore, 17.2% of respondents were 23 years or less, 30.6% were between the ages of 23-26 years, 24.6% were between the ages of 27-35 years and 27.6% were 36 years or older. Finally, our sample of users was composed of 58.2% students and 41.8% professionals (Table 1).

According to Table 2, about 36% of respondents used general tools such as search engines and other free tools (such as Google search, Google alert and Netvibes), while 45% used specialized tools like databases of patents or sector studies (such as Espacenet, Patenscope and Xerfi), and a final 19.4% used platforms to monitor the competitive environment and social networks (such as Cognos, Business Objects, SAS, Sindup and Digimind).

Around 29% of respondents didn't frequently use monitoring tools, 44.8% used them sometimes or often and 26.1% always used them.

Table 1 Demographic profile of respondents (n = 134). Char = characteristic.

Char.	**Descriptor**	**Distribution (percentage)**
Gender	Male	60.4
	Female	39.6
Age	< 23 years	17.2
	23-26 years	30.6
	27-35 years	24.6
	> 36 years	27.6
Occupation	Student	58.2
	Employed	41.8

Table 2 Tool usage and characteristics. Char = characteristic.

Char.	**Descriptor**	**Distribution (percentage)**
Tool	General tools	35.8
	Specialized tools	44.8
	Platforms	19.4
Frequency of use	Never	8.2
	Rarely	20.9
	Sometimes	15.7
	Often	29.1
	Always	26.1

4.1 Result 1: Link between technology and tasks (Appendix A. Cluster analysis 1)

A cluster analysis was applied to the data using the SPAD software. The aim was to classify the respondents in groups in order to know their characteristics.

Three main groups were identified: the first group contained 52 persons, the second one 35 persons and the third one 47 persons.

The first group was composed of the persons who agreed with the fact that it is easy to find the location of data using key words. They also agreed with the link between the tasks and the work. According to the quality of the data, these people agreed that the data were up to date and facilitated their job. They disagreed

with the fact that they can't obtain the data useful for their job. The technological tool (Sindup) was very useful for their job and no problems were encountered with its use. These people were mostly from the sector of consulting and engineering (sector number1).

The second group was composed of the persons who agreed with the fact that they were involved in tasks which deal with problems. They found it difficult to deal with the data sources. Moreover, it was difficult to have the authorization to get the data, which were not always updated. For these people, it was not easy to find the location of the data through key words.

In the third group, people also found that it was difficult to have the authorization to get the data but they didn't agree that the tasks in which they were involved dealt with problems, particularly with data sources. These people were students of LaSalle Beauvais (sector number 7)

4.2 Result 2: Individual perception of tools (Appendix B. Cluster analysis 2)

In this second phase of the analysis, two distinct groups: the first was composed of individuals from the IT sector while those of the second group were mostly students.

Individuals in group 1, 83 in number, were satisfied or very satisfied with the Sindup tool (information gathering, user interface, information processing) and more generally of monitoring tools. The functions of tools were generally well received (research and information extraction, processing and storage).

Individuals in group 2, numbering 51, were instead indifferent or even disagreed with the usefulness of monitoring tools including the Sindup tool. They had a poorer perception of their duties and were unhappy. This was explained by the fact that this group of students used a new intelligence platform for the first time. User satisfaction was gained through experience and frequency of use.

5. CONCLUSION

The business intelligence process was to find, interpret and transform relevant information useful to the action of decision-makers. We presented the BI software systems that were studied by many authors that emphasized a different set of factors divided into three perspectives: organization, process and technology. We focused our article on the technology perspective and the evaluation of BI tools by proposing a cluster analysis of users' perception and a classification of these tools used (general, specialized tools and platforms). Technology-Task Fit and Technology Adoption models have been applicable to specific information systems, we adapted these models to BI tools, and this is a main theoretical finding.

Regarding the managerial implication, the first Technology-Task Fit model showed three groups in those who used business intelligence tools, ranging from source identification to the dissemination of information. Based on the innovation adoption model (Rogers, 2003), we can see that the profile of the first group of users can be part of an advanced monitoring unit. The second and third groups of users were latecomers in adopting this technology. Finding the monitoring tools not flexible, this implies the dissatisfaction with the quality of service offered by this technology may be due to limited use.

Two opposite groups were identified in the second Technology Adoption Model, the first group is aware of the perceived usefulness of these monitoring tools and the second is not satisfied as completely as the first users of a platform (Sindup) as part of a monitoring project. The difficulty lies in the appropriation of this tool by students and its adaptation to the selected BI project.

Regarding the users' perceptions towards the BI tools, we suggested more attention from BI software vendors that should be integrated in their differentiation strategy with many key success factors.

Finally, we conclude that a BI tool implementation in a company is accompanied by organizational changes, which are sometimes cultural, where the financial impact (price) wasn't negligible. This would explain, in part, why this technology is mostly used in large companies.

For future research, we will adapt our survey to our student population to evaluate their perception of BI tools as part of their project, we will integrate a learning variable in our model that can play the crucial role in the success of a BI project. We will try to study the correlation relationships between the variables of the proposed model.

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7. APPENDIX

7.1 Appendix A. Link between technology and tasks

Characterization by continuous variables of partition classes.
Class 1/3 (Weight = 52.00; Size = 52)

Characteristic variables	Average in the class	Overall average	Standard deviation in the class	General standard deviation	Test statistic's value	p-value
CT2	5,404	4,619	1,114	1,578	4,566	0,000
LD1	4,731	4,007	1,456	1,591	4,176	0,000
QD3	5,019	4,433	1,263	1,341	4,017	0,000
LD2	4,750	4,194	1,207	1,352	3,776	0,000
CT4	5,673	5,142	1,051	1,311	3,722	0,000
CT3	5,423	4,910	1,276	1,453	3,240	0,001
CT1	5,038	4,493	1,427	1,554	3,227	0,001
QD2	5,154	4,701	1,406	1,506	2,758	0,003
QD4	3,462	4,007	1,365	1,427	-3,513	0,000
CS3	4,096	4,672	1,348	1,455	-3,633	0,000
QD1	2,769	3,440	1,325	1,586	-3,886	0,000
PO1	3,500	4,201	1,563	1,629	-3,955	0,000
PO2	2,923	3,866	1,439	1,549	-5,588	0,000
AD1	2,000	3,187	1,109	1,754	-6,212	0,000
AD2	2,327	3,590	1,383	1,821	-6,367	0,000

Legend of variables :
CT : Characteristics of task
LD: Localization of data
QD: Quality of data
CS : Compatibility of data sources
PO : Relevance of system
AD : Accessibility of data

Class 2/3 (Weight = 35.00; Size = 35)

Characteristic variables	Average in the class	Overall average	Standard deviation in the class	General standard deviation	Test statistic's value	p-value
CS3	5,914	4,672	0,732	1,455	5,858	0,000
CS2	5,800	4,672	1,141	1,530	5,058	0,000
AD2	4,886	3,590	1,526	1,821	4,880	0,000
AD1	4,229	3,187	1,692	1,754	4,073	0,000
QD4	4,829	4,007	1,424	1,427	3,945	0,000
PO1	5,086	4,201	1,273	1,629	3,722	0,000
PO2	4,686	3,866	1,190	1,549	3,630	0,000
CS1	5,114	4,269	1,545	1,631	3,556	0,000
QD1	4,200	3,440	1,653	1,586	3,285	0,001
CT2	5,286	4,619	1,161	1,578	2,896	0,002
CT1	5,143	4,493	1,150	1,554	2,870	0,002
CT3	5,486	4,910	1,180	1,453	2,715	0,003
CT4	5,543	5,142	1,024	1,311	2,098	0,018
LD1	3,486	4,007	1,680	1,591	-2,249	0,012
QD2	4,114	4,701	1,563	1,506	-2,673	0,004
LD2	3,457	4,194	1,273	1,352	-3,737	0,000

Class 3/3 (Weight = 47.00; Size = 47)

Characteristic variables	Average in the class	Overall average	Standard deviation in the class	General standard deviation	Test statistic's value	p-value
AD1	3,723	3,187	1,620	1,754	2,594	0,005
PO2	4,298	3,866	1,351	1,549	2,365	0,009
AD2	4,021	3,590	1,550	1,821	2,009	0,022
LD1	3,596	4,007	1,347	1,591	-2,194	0,014
QD3	4,064	4,433	1,060	1,341	-2,333	0,010
CS1	3,702	4,269	1,398	1,631	-2,945	0,002
CS2	3,957	4,672	1,254	1,530	-3,958	0,000
CT4	4,255	5,142	1,296	1,311	-5,732	0,000
CT3	3,915	4,910	1,285	1,453	-5,808	0,000
CT1	3,404	4,493	1,347	1,554	-5,937	0,000
CT2	3,255	4,619	1,360	1,578	-7,328	0,000

7.2 Appendix B. Individual perception of tools

Characterization by continuous variables of partition classes.
Class 1/2 (Weight = 83.00; Size = 83)

Characteristic variables	Average in the class	Overall average	Standard deviation in the class	General standard deviation	Test statistic's value	p-value
SAT3	5,265	4,567	0,958	1,330	7,722	0,000
EOU6	5,301	4,590	0,954	1,383	7,569	0,000
UP5	5,578	4,851	1,066	1,453	7,366	0,000
UP1	5,747	5,045	0,890	1,424	7,255	0,000
SAT5	5,566	4,955	0,839	1,286	6,989	0,000
UP2	5,843	5,201	0,975	1,359	6,948	0,000
UP6	5,855	5,164	1,054	1,467	6,932	0,000
UP3	5,602	4,918	1,075	1,461	6,892	0,000
UP4	5,639	5,022	1,025	1,368	6,624	0,000
SAT1	5,482	4,836	1,123	1,452	6,548	0,000
EOU5	5,229	4,627	1,112	1,359	6,520	0,000
EOU2	4,988	4,381	1,047	1,381	6,470	0,000
EOU3	5,518	4,948	0,923	1,301	6,452	0,000
EOU4	5,651	5,090	0,911	1,318	6,261	0,000
SAT2	5,060	4,493	1,206	1,342	6,222	0,000
SAT4	5,699	5,149	1,179	1,438	5,623	0,000
EOU1	5,458	4,978	1,112	1,390	5,083	0,000
Fonc3	5,313	4,910	1,119	1,296	4,574	0,000
Fonc2	5,651	5,216	1,265	1,498	4,264	0,000
Fonc1	4,807	4,410	1,954	1,921	3,039	0,001

Legend of variables :
EOU : Ease of use
Fonc : Functionalities of BI tools
UP : Perceived utility
SAT : Satisfaction of BI tools

Class 2/2 (Weight = 51.00; Size = 51)

Characteristic variables	Average in the class	Overall average	Standard deviation in the class	General standard deviation	Test statistic's value	p-value
Fonc1	3,765	4,410	1,676	1,921	-3,039	0,001
Fonc2	4,510	5,216	1,576	1,498	-4,264	0,000
Fonc3	4,255	4,910	1,296	1,296	-4,574	0,000
EOU1	4,196	4,978	1,442	1,390	-5,083	0,000
SAT4	4,255	5,149	1,370	1,438	-5,623	0,000
SAT2	3,569	4,493	0,995	1,342	-6,222	0,000
EOU4	4,176	5,090	1,368	1,318	-6,261	0,000
EOU3	4,020	4,948	1,291	1,301	-6,452	0,000
EOU2	3,392	4,381	1,285	1,381	-6,470	0,000
EOU5	3,647	4,627	1,135	1,359	-6,519	0,000
SAT1	3,784	4,836	1,303	1,452	-6,548	0,000
UP4	4,020	5,022	1,260	1,368	-6,624	0,000
UP3	3,804	4,918	1,314	1,461	-6,892	0,000
UP6	4,039	5,164	1,343	1,467	-6,932	0,000
UP2	4,157	5,201	1,243	1,359	-6,948	0,000
SAT5	3,961	4,955	1,267	1,286	-6,989	0,000
UP1	3,902	5,045	1,390	1,424	-7,255	0,000
UP5	3,667	4,851	1,199	1,453	-7,365	0,000
EOU6	3,431	4,590	1,176	1,383	-7,569	0,000
SAT3	3,431	4,567	1,034	1,330	-7,722	0,000

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Government sponsored competitive intelligence for regional and sectoral economic development: Canadian experiences

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ABSTRACT Can competitive intelligence (CI) be used to assist in regional and sectoral economic development? This article looks at intelligence initiatives (largely around training) sponsored by various government departments and agencies in Canada and their link to regional and sectoral economic development. The article provides examples of the kind of intelligence initiatives that have been used in Canada to support regional and sectoral (industrial) economic development. The article proposes a method for categorizing these regional and sectoral intelligence programs and suggests methods for assessing the impact of these programs on regional and sectoral economic development. The Canadian programs are divided into three broad categories 1) Government programs aimed at enhancing their own ability to develop competitive intelligence 2) Programs that are sponsored by the government for industry and others to develop competitive intelligence and 3) Programs sponsored by the government to help communities develop competitive intelligence for local economic development. Positive economic impacts were identified using program review documents, government officer reports and anecdotal evidence from program participant surveys. However, while the evidence does support positive impact a more comprehensive approach to evaluating these impacts should be considered in the future.

KEYWORDS competitive intelligence, economic development, economic intelligence, program impact, program review

1. INTRODUCTION AND OVERVIEW

Making better decisions based on a proper understanding of the competitive environment (present and future) is at the heart of competitive intelligence (CI). Competitive intelligence assists organizations in developing a proactive approach that identifies and responds to changes in the competitive environmental, helping organizations (companies, governments, universities, associations and others) thrive in turbulent times. This need for understanding the external environment and its impact on success has been echoed in the regional economic development planning literature. External environmental changes (the focus of CI):

> "have brought new opportunities to regional industries while simultaneously exposing them to increased competition both domestically and internationally" (Stinson 2006, p. 4).

It has also been identified as critical in designing economic policy and programs (Calof et al., 2015).

The objective of this paper is to look at how government competitive intelligence initiatives have been used in Canada to enhance economic development at both the regional and sectoral

level. The intent of presenting both programs and evidence of program impacts is to stimulate a global discussion on how regional and sectoral economic development can be enhanced through government competitive intelligence activities. It is hoped that researchers from other countries that read this article will be encouraged to develop similar articles and provide additional program examples that can be shared amongst the competitive intelligence and government program communities.

Governments in Canada both at the Federal and Provincial level have been involved in competitive intelligence initiatives largely since the mid 1990s. In this article, several of these programs will be described and discussed. This article uses, as its base for discussing these initiatives, a comprehensive review of competitive intelligence in Canada (Calof and Brouard, 2004) and programs that the author of this article has extensive knowledge about either through active involvement in them (e.g. training programs delivered by the author, organizational systems created by the author etc.) or because the author reviewed and/or studied them for academic purposes (for example, the National Research Council's competitive intelligence unit study as reported in Calof, 2014). While this could lead to possible biases in terms of the comprehensiveness of programs reviewed for this article, nevertheless in depth knowledge of the programs and the government officers responsible for the programs are required to properly analyze and classify them.

Over one hundred government programs and intelligence initiatives are examined in this article. These are divided into three broad categories that are discussed in more detail in Section 3 (including the rationale behind these categories):

1. Government programs aimed at enhancing their own ability to develop competitive intelligence. This includes training initiatives (e.g. sending government officers for competitive intelligence training) and creating intelligence units.
2. Programs that are sponsored by government for industry and others to develop competitive intelligence. This category includes providing or sponsoring training in competitive intelligence for Canadian companies (and associations) and joint intelligence projects (both government and industry working together to develop competitive intelligence).
3. Programs sponsored by the government to help communities develop competitive intelligence or local economic development. This category involves programs sponsored by the government aimed at assisting small communities in developing competitive intelligence capabilities for local economic development

Programs and initiatives in these three categories are then examined for evidence of economic impact at the regional and/or sectoral (industry) level.

2. GOVERNMENT INVOLVEMENT IN COMPETITIVE INTELLIGENCE

Government involvement in competitive intelligence has been studies and written about for many years. Dedijer (1994) wrote about the French government's involvement in competitive intelligence. Much has been written about the French involvement in CI including the use of and development of CI for government economic policy purposes, French government CI assistance to companies and associations, as well as joint intelligence assistance involving chambers of commerce, industry association and companies (Dedijer 1994, Horne and Parks, 2004, Bisson, 2014). Similarly, Calof and Brouard (2004) looked at Canadian Federal and Provincial involvement in Canadian competitive intelligence and Julyeta et al. (2014) looked at examples of government involvement in competitive intelligence in Indonesia.

These and other authors have looked at the importance of these activities as a stimulus to regional and sectoral economic development. For example, Julyeta et al. wrote ""It was then decided to used Competitive Intelligence not only to promote new economic and development conditions, but to move to local policy to promote in some key positions people which will have a Competitive Intelligence background and which will be able to facilitate a global move of the local stakeholders to new horizons." (2014, p. 38). Bisson (2014, p. 10), in looking at the work of Guesnier (2004), Momagri (2012) and Massmann and Quonniam (2010), wrote:

> "[these authors have] pointed out the correlation between territorial governance and economic performance, and in this way CI activities should lead to better territorial economic results. A lack of information, for example, on price or technology lowers the price of farmers' yields."

Calof and Brouard (2004) looked at the Canadian experience with competitive intelligence between 1989 and 2004. In their research, they looked at competitive intelligence growth in terms of academic development (courses and research), corporate activity, associations, consulting and government activities. The authors noted that there had been significant development in the 1990s in terms of government involvement in competitive intelligence. For example, in the mid 1990s the Department of Foreign Affairs developed an intelligence program for producing competitive intelligence for Canadian companies and departmental officials. Agriculture Canada established market intelligence within their Market and Industry Services Branch for providing policy advice within the department. Industry Canada brought in a competitive intelligence training program to enhance their officers' skills. The National Research Council established a technical intelligence unit in their organization to provide technical intelligence to departmental officers for decision making and policy development. Provincially, Alberta Economic Development brought in competitive intelligence training for their officers and also made it available to their industry clients. Alberta also set up a joint market intelligence committee, which had representation from various federal and provincial economic departments. In Saskatchewan, STEP (Saskatchewan Trade and Export Program) developed an intelligence department and established market intelligence as one of their offerings to Saskatchewan business. In Nova Scotia, Nova Scotia Business Inc. also brought in competitive intelligence training and established market intelligence as a product offered to Nova Scotia Business. In Quebec, each Quebec ministry had an officer responsible for competitive intelligence. This officer reported to a central government business intelligence committee.

It is within this context of significant growth in government led competitive intelligence activity that this article is set. This article looks to provide readers with information on government competitive intelligence initiatives in Canada, in particular those geared towards regional and/or sectoral economic development and their economic impact. There are three caveats on the programs discussed in this article:

1. This article does not cover all Canadian programs that use intelligence for regional or sectoral economic development. It is not truly comprehensive. It includes only ones that the author has been involved with, either through studying them, running them or advising the organization in charge of them. This limitation is made to ensure that the author has sufficient information to discuss, assess and properly classify the programs.
2. Although this article covers programs between 1993 and 2015, the majority of the programs discussed occurred before 2006. This arose as from 2006-2015 significant budget cutting arose both at the federal and provincial levels, making the funding of the programs discussed in this article difficult.
3. This article only looks at competitive intelligence programs and initiatives associated with economic departments. It does not look at programs associated with national security and national intelligence agencies (for example Canadian Security and Intelligence Service – CSIS, Communications Security Establishment – CSE).

3. CANADIAN GOVERNMENT ACTIVITIES IN COMPETITIVE INTELLIGENCE

One of the contributions of this article is that it attempts to develop a classification scheme for government competitive intelligence initiatives. In reviewing past articles on government involvement in competitive intelligence (described in Section 2) the author notes that programs and initiatives tend to fall into one of two broad categories: 1) Programs designed to help the government develop competitive intelligence (for example development of in-house intelligence units, training in competitive intelligence for government officers). The intent of these programs is to ensure that the department has the ability to develop competitive intelligence

that can be used either to assist companies or help the department make decisions. 2) Programs designed to help companies develop their own competitive intelligence. The author notes several of the articles listed above written about the government providing competitive intelligence resources and training to local companies so that they can develop their own competitive intelligence (Calof and Brouard, 2004 and Dedijier 1994 in particular write extensively about this).

In spite of the limitations listed above, there have been a plethora of programs developed in Canada that are focused on developing intelligence to assist in both regional and sectoral (industry) economic development. These were reviewed for the writing of this article and examined to determine their focus (departmental intelligence development vs corporate intelligence development). In looking at the mandate of the programs, reviewing reports about them (where available) and talking to those familiar with the program, further enhancements to the classification scheme mentioned above were made. Table 1 provides a list of those departments and agencies and the type of programs they have had. This list is compiled from the authors' direct experience either in developing and delivering the program or knowledge of the program through academic research. As such it is not a comprehensive list but can be seen as a convenience sample that is being used to examine the ability to categorize and later assess programs. The programs listed are divided into the following categories:

3.1 Government programs aimed at enhancing their own ability to develop competitive intelligence

This category covers competitive intelligence training that the government (federal or provincial) had customized to their organizations' needs to help their personnel develop intelligence skills. Some are of the classic introduction to competitive intelligence variety, while others allow participants to run an intelligence application (project) as part of the training. The general intent of the training is to enable the government officers to develop or enhance their understanding of what competitive intelligence is and work on key intelligence skills such as planning intelligence projects, collecting information for intelligence, analysis and communication to assist in their job and either contribute to sectoral or regional economic development by using these skills to provide Canadian organizations with intelligence that will make them more competitive or use the skills to develop policy and programs that will enhance the economic performance of the region or sector.

a) *Personal/department*: Training geared around helping officers learn how to use intelligence to assist the department/agency. The agencies/departments mentioned in Table 1 have specific sectoral or regional development responsibilities. As a result, the focus for the training/skills development was on using these skills to help develop appropriate industry policy. Examples of this include Industry Canada receiving intelligence training to help in the development of sectoral assistance programs. NRCan (National Resources Canada) had a module on intelligence to help in selecting the appropriate research and development programs to focus on for industrial development. Agriculture Canada had a project related to intelligence training that was focused on identifying sectors of the agriculture industry for further development in a 2020 exercise.
b) *Helping others*: Several government departments have used intelligence training to assist in developing skills that would enable them to better provide intelligence to Canadian companies. Examples include the Department of Foreign Affairs, which had provided intelligence training to most trade officers since 1993 to help them better serve Canadian exporters. Nova Scotia Business Inc. and STEP (Saskatchewan Trade and Export Partnership) have taken extensive skills training in intelligence as both these organizations have the provision of intelligence to local companies as part of their mandate.

The two categories (personal/department and helping others) are not mutually exclusive. For example, the National Research Council established a technical intelligence unit that helped the department develop industrial policy, helped officers make recommendations on technology investments and also helped Canadian technology companies directly. Also, although training is mentioned above, it is not

the only element of the programs: STEP and the NRC (mentioned above) have established infrastructure that includes specific intelligence units while NSBI (Nova Scotia Business Inc.) included it within their mandate and developed materials around it.

Table 1 Canadian Federal and Provincial Government Department and Agencies Competitive Intelligence Programs by Program Category. X indicates that the program was run/sponsored by the department or agency identified. The programs and departments/agencies in this table are not a comprehensive list of all programs in competitive intelligence run in Canada, but they are the ones that the author of this paper is familiar with either through research done on Canadian intelligence programs (with Francois Brouard) or through involvement either in running the program or evaluating it for the department/agency. The programs are also limited to those that were run by departments with economic related mandates. This table is used to demonstrate the breadth of programs run in Canada and to provide a demonstration of the program categorization method proposed in this article.

Canadian Federal Government departments and agencies	*Enhancing their own (department's) ability to develop intelligence*		*Sponsored by the government for industry and others to develop intelligence*				*Programs to help communities develop intelligence*
	Personal/ department	Helping others	Intro. Skills	Joint projects	Company projects	Trade show intelligence	
Agriculture Canada	x	x				x	x
Atlantic Canada Opportunities Agency	x	x	x		x		
Canadian Food Inspection Agency	x	x					
Department of Foreign Affairs	x	x					
Environment Canada	x						
Export Development Corporation	x						
Industry Canada	x	x	x				
National Research Council	x	x	x				
Natural Resources Canada	x						
Office of the National Science Advisor			x				
The Alliance for Sector Councils			x	x			
Western Economic Diversification			x	x	x		x
Provincial Government departments and agencies							
Alberta Agriculture	x	x	x	x	x	x	
Alberta Economic Development	x	x	x	x	x	x	
Alberta Energy Research			x				
Alberta Innovation and Science			x		x		
Alberta Treasury Board and Finance					x		
Manitoba Agriculture, Food and Rural Development			x				
Ministry of Economic Development and Trade Ontario	x		x				
Newfoundland Advanced Technologies Industries			x		x		
Nova Scotia Agriculture						x	
Nova Scotia Business Inc.	x	x	x		x	x	
Ontario Cultural Heritage			x				
Saskatchewan Advanced Technology			x				
Saskatchewan Trade & Export Partnership			x				

3.2 Programs that are sponsored by the government for industry and others to develop competitive intelligence.

Federal and provincial governments throughout Canada have sponsored a myriad of programs across Canada designed to help Canadian organizations develop and enhance their competitive intelligence skills. Some of these have been geographically focused (offered in one or more regions to help develop and enhance the local economy) and some have been sectorally focused, providing training and intelligence assistance to companies in multiple regions but in a specific sector (for example training for agriculture companies or training for technology companies). While sponsored programs have been given to a broad number of sectors, the two most frequent sectors for sponsored programs have been agriculture and technology. In work that the author has done with other governments the same two sectors have also been the most frequent focus for sponsored intelligence programs.

a) *Introduction to CI/skills development*: These types of programs introduce participants to the concept of competitive intelligence and the skills and organizational requirements to develop intelligence. These programs have ranged from one-hour keynote addresses as part of major government events (for example the Manitoba Department of Agriculture and Rural Development program and Ontario Economic Development had intelligence keynote talks as part of industry events) or as long as two day introductions to competitive intelligence programs such as some of those sponsored by Alberta Economic Development.
b) *Joint government and industry projects*: Joint projects bring industry, association and government together to work together on intelligence project with results being shared amongst all participants. An example of this is Alberta Agriculture, Food and Rural development, which sponsored an intelligence program that brought together industry, association and government participants. The joint project was to develop intelligence on opportunities for the Alberta beef industry in Japan. The program involved providing a basic introduction to intelligence (two-day program involving introduction to intelligence, how to collect information, planning for intelligence and analysis) to all participants who were then put in project teams (each team had industry, association and government representation) with each team developing intelligence on the Japanese imported beef market. The final intelligence product (the combination of each of the team's intelligence reports) was then shared with all participants.
c) *Company projects*: Company projects are similar to the introduction to CI/Skills development training but also involve participants developing and running an intelligence application on behalf of their organization as part of the training. These programs start with one to two days training and then participants go back to their organization, develop an intelligence plan (which is discussed with the program trainer) and then have weekly mentoring sessions with the trainer as they work on their intelligence project. At the end of the program (normally one month) all participants gather again with the trainer to discuss their experiences. For some of these project sessions, participants have both the trainer and a government officer helping them on the project. An example of this type of program is the Atlantic Canada Opportunities Agency (ACOA) sponsored program that was focused sectorally on technology companies on the East Coast of Canada. ACOA and the trainer provide the training and project support to companies in Halifax (Nova Scotia), St. John's (Newfoundland) and Fredericton (New Brunswick).
d) *Trade-show intelligence*: A cooperative trade show intelligence approach was developed which combined small and medium sized companies, appropriate associations, federal and/or provincial government officers in a training program focused on a specific trade show. All participants were given trade show intelligence training. The training involved two days of training both on

competitive intelligence and trade show intelligence. For the training, specific materials from the trade show they were attending were included in the training material. For example, in training for the bio-technology trade show, participants were given a list of exhibitors that were going to the show, a list of all seminars, workshops, presentations and also social events. As part of the training program, participants were asked to develop trade show intelligence plans for the trade show that all program participants were going to (for example Foodex in Japan, Fancy Food Show in San Francisco, Bio in Washington) and to send the plan to the program trainer. The trainer then provided feedback and additional guidance to participants. Government and association participants helped the companies execute their projects as well as running their own applications and the consultant/trainer also assisted. The approach was run at several trade shows and helped companies identify opportunities, assess markets, helped associations identify better ways to serve their members and government officers identify better programs and policies. One of the trade show programs from a technology trade show was written up in Calof and Fox, 2003 and provides details on the organization of the program. Several provincial and federal departments and agencies have sponsored trade show intelligence programs across a broad number of sectors. These include Nova Scotia Business Inc., Agriculture Canada, Alberta Economic Development, Western Economic Diversification and Alberta Agriculture. Trade show intelligence is an example of a program that can be regionally and sectorally focused. It is sectorally on the specific event and regionally in terms the regional authority sponsoring the training.

3.3 Programs sponsored by the government to help communities develop competitive intelligence for local economic development

This was a program developed to help small communities harness the knowledge within communities to develop their own economic development plan using intelligence. In the program, community leaders, local business owners, government officials and others were brought together in a facilitated program, taught about competitive intelligence and were then put in groups to develop the intelligence needed to support their region's competitive advantage. All of this was then used to develop a regional economic development plan designed by the program participants and then presented to the community at large. The program involved multiple training sessions and intelligence projects and was done over an extended period (nine months). The program was designed to help small communities develop a long term economic development plan based on identifying their competitive advantage(s) and the intelligence required to exploit it. Local community media have written extensively about the success of the program in their region (see Dalman 2005 for an example of the program in Humboldt, Saskatchewan). A more detailed description of the program can be found in Calof et al. (2010).

4. COMPETITIVE INTELLIGENCE PROGRAM IMPACT ON REGIONAL AND SECTORAL ECONOMIC DEVELOPMENT

Section 3 provided a method to categorize government competitive intelligence programs. Given that the programs mentioned above are designed to lead to regional or sectoral economic development, this section looks at documents generated by the program that would indicate that they had some sort of economic impact.

4.1 Community economic development programs

One of the community economic development programs (in Humboldt, Saskatchewan) was subjected to a full program review within a year of the program delivery. The purpose of the program was to transfer both skills that could be used to develop an economic development plan for the community that would lead to economic development and also

intelligence skills that could be used to help program participants in their organizations. The program review, done by Impact Research Consulting Ltd (Kehring 2006) asked several questions about knowledge gained and economic development. Amongst the question asked:

> "Do you think that the process of creating the Action Humboldt Economic Development Plan has produced positive gains in community capacity building knowledge and skills (including facilitation, competitive business intelligence, and networking)?"

A total of 95.2% of program participants responded yes to the program reviewer.

> "Do you think the creation of the Action Humboldt Economic Development Plan has contributed in positive, tangible ways to the economic development of the region?"

A total of 90% of program participants responded yes to this question.

> "Were you able to increase your business or professional opportunities as a direct result of your involvement with the Action Humboldt Economic Development Plan?"

A total of 60% of program participants responded yes to this question

Participants were asked to list specific benefits attributable to the program. Those identified by participants included: New residents moving to the region, new businesses starting up, increased employment opportunities, employee retention and the development of regional partnerships.

The program review concluded with the following statement "The potential for economic development has been enhanced in the Humboldt region due to the creation and the implementation of the Economic Development Plan. There have been direct and significant results in the region due to the initiative." (Kehring 2006, p. 23)

Collectively, the answers to the evaluation questions coupled with the evaluators overall conclusions and analysis provide support for positive regional economic benefits arising from the Humboldt community intelligence program that was sponsored by the government. Unfortunately, this was the only community economic development program that was evaluated. There were other community economic development programs but no evaluations were done, therefore this section can only conclude that for the one program reviewed, a positive economic impact was found at the regional (local) level.

4.2 Sponsored programs for industry

Despite the large number of sponsored programs for industry in Canada there has not been a formal program review according to the organizations contacted for this article. Accordingly, the link between these sponsored programs and regional and sectoral economic development is based more on the post-training reports provided by the sponsoring organizations and the anecdotal evidence in these reports in the form of participant comments gathered as part of the program assessment.

One report written up in Alberta and published in Alberta Treasury Board and Finance documents (2006) assessed the project intelligence program success using their organization's metrics for the program. The article noted that 88% of the companies that attended the competitive intelligence course did undertake an intelligence project (a measure of success for this government agency). Comments in the report included:

> "One company noted that the process was valuable…. A second company confirmed that they had sought out additional information leading up to a conference and it had prepared them to more effectively discuss their needs with others that could provide them with information. A third noted that they had completed a process that led them to refocus their marketing efforts in a slightly different direction.
>
> "All indicated that they found the process valuable. One company indicated that they would like three additional members of the team to take the training with another company saying 'I was able to gain considerable information/intelligence…as a result of the training' … Finally, one company reported that the training session 'led to discussion across divisions on how [company name] could advance its CI infrastructure.'" (p. 86)

In the case of one of the joint programs (in which government, industry and associations worked jointly on a specific intelligence

application) a post program review had industry participants estimate the value to them (industry) as being in the six figure range. Once again this provides support for economic value at both a regional (provincial) and sectoral level.

In terms of anecdotal evidence from officer reports on the program and participant evaluations, here are a few examples mainly from the trade show intelligence programs. They are from a review of an intelligence program event given on the East Coast of Canada. For the Houston Offshore Trade Show the following comments were included in the officers' report "The training, mentoring and support at the trade show enabled me to do three months of work in four days in Houston". The same review also looked at participant comments from another East Coast program focused on the plastics industry for the National Plastics Exhibition trade show (NPE). The following quotes were in the report "I was able to use CI techniques to optimize my info gathering exercise. A 'focused approach' was, I believe, the key to a productive two days… The show was huge and would have been overwhelming if not for the CI preparations."

A report on a trade show intelligence program that focused on SIAL (a food show in Paris) included the following quotes from program participants:

> "I really enjoyed it. The process made me think carefully about what I was trying to find and what decisions needed to be made."
>
> "It was valuable as a planning tool because nobody realized how big the Paris SIAL was."
>
> "This is something that can be a value to nearly everybody. It should be required of those that go to large trade shows. It is applicable to both governments and the private sector….The training allowed me to do much more at Paris Sial (food trade show) than I could have done under normal circumstances. The process yielded more and *better* information."

Finally, a report out of Alberta after a trade show intelligence program for BIO (bio-technology trade show) included the following comments from the association that had jointly sponsored the training with the government "We all benefited from this process a lot…We will do this again." "The process assisted our companies and the association itself in acquiring more reliable information in less time. It is something that we will use again and recommend to our members."

As a final measure of program impact, some of the government officers that were in charge of the programs (public servants) noted that the program had been the recipient of various recognition awards. These awards include department based awards (referred to as Minister's Awards) as well as provincial awards (referred to as Premier's Awards).

Readers are cautioned that while the results indicate positive economic impacts of these economic or sectoral intelligence programs, with the exception of the program review on the community economic development program and the valuation exercise for the joint intelligence exercise, all other results are either from officer reports or are anecdotal. There is no way to tell whether the comments in the reports and articles about the project intelligence and trade show intelligence are reflective of the majority of program participants and not just biased towards those that were most satisfied. Nevertheless, the following can be concluded:

1. For the small community economic development program, a positive regional economic development impact was shown through the program evaluation results provided in this article.
2. For the joint intelligence project in Alberta (beef industry) a positive economic impact both sectorally (beef) and regionally (Alberta) was indicated according to the reviewers' estimation of the value of the intelligence produced. For #1 and #2 these are a matter of public record from government conducted program reviews.
3. For all other sectoral and regional programs presented in this article that had anecdotal comments (and there were many) they (those that provided the anecdotal examples) indicated that they had received some sort of economic benefit.

5. CONCULSIONS AND AREAS FOR FUTURE RESEARCH

This article has sought to classify government competitive intelligence programs and

initiatives used in Canada and also examine the impact of these programs on economic development. Three broad categories were identified along with several subcategories in each:

1. Government programs aimed at enhancing their own ability to develop competitive intelligence
2. Programs that are sponsored by the government for industry and others to develop competitive intelligence and
3. Programs sponsored by the government to help communities develop competitive intelligence for local economic development.

This article has sought to provide examples of intelligence programs and initiatives under each one of these categories. It is hoped that future research will look at other intelligence related regional and sectoral economic development programs to help develop a more comprehensive list and description of the kind of intelligence programs that have been used around the world to assist in sectoral and regional economic development. It is hoped that in the future, the categorization method described in this article will be improved by others applying it to programs in their countries. As well it is hoped that this kind of research will result in the development of a comprehensive list of the kinds of competitive intelligence initiatives that have been used around the world. This article only reports on Canadian initiatives.

Finally, this article has attempted to link these programs to regional and/or sectoral economic development. Economic impact was examined using program review documents but only in the case of one community economic development program. Other initiative had to be reviewed using government officer reports and anecdotal evidence from participant satisfaction surveys. However, while the evidence does support a positive impact a more comprehensive approach to reviewing these impacts should be considered in the future. Which intelligence programs and initiatives provide the best sectoral and regional economic development impact cannot be answered based on the way these programs were reviewed and this should be addressed in future studies.

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Major advances in ophthalmology: emergence of bio-additive manufacturing

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ABSTRACT Important efforts to discover new ways to combat illnesses are being carried out worldwide. In this sense, bio-additive manufacturing is an innovative technology that will revolutionize the health industry, as it provides the possibility to develop three-dimensional bio devices, such as body tissues and even organs. This research explores the most novel inventions of bio-additive manufacturing in ophthalmology. The main aim is to support the decision making of the research community and the organizations involved in this industry. The major advances, organizations, research focuses and main countries involved in the ophthalmology field were identified. To accomplish this, a scientometric patent analysis was carried out using advanced data mining software and consultations with experts. Insights show a global research trend toward the development of lenses, followed by prosthesis and implants. Bio-additive manufacturing is now in a nascent S-curve phase; however, important advances are being carried out.

KEYWORDS 3D bioprinting, 3D printing, additive manufacturing, bio-additive manufacturing, biomedical devices, bioprinting, health, ophthalmic devices, ophthalmology, sientometrics, patent analysis

1. INTRODUCTION

Additive manufacturing, also known as 3D printing and rapid prototyping, is an innovative technology that enables the development of products in an additive way by fusing or depositing materials in layers to produce a three-dimensional physical object (Delgado, Ciurana, and Rodríguez 2012). The first technique was developed by Charles Hull in the early 1980s (Schubert, van Langeveld, and Donoso 2014). Since then, the industry has grown, and as a consequence, the number of patents has increased (Rodríguez et al. 2014).

High value products can be developed with this technology, including artwork, automotive parts, architectural models, dental bridges, jewellery and ductwork for mobile hospitals. Versatility is one of the core advantages that 3D printing offers (Conner et al. 2014). In addition, it allows for customized designs (Euromonitor 2013) and product manufacturing with complex geometries and superior quality (Campbell et al. 2011). A wide range of sectors could benefit from this technology, particularly the health industry, which presently needs to develop more innovative processes to face global changes in sustainability. Worldwide markets demand high quality services and products at affordable prices (Kivisaari et al. 2013). Bio-additive manufacturing applications are growing rapidly and are expected to revolutionize the entire industry (Schubert, van Langeveld, and Donoso 2014) with tools that facilitate education, surgical planning and organ transplantation research (Huang and Zhang 2014).

The purpose of this research was to identify the main organizations, their research focus, the major advances and the main countries involved in bio-additive manufacturing applied to ophthalmology. For this aim, a scientometric patent analysis was developed. The insights obtained could be useful to key players in the healthcare industry, particularly those who focus on researching emerging technologies to enhance innovative applications in ophthalmology.

This paper is organized as follows. First, a review of additive manufacturing applied to health care is presented. Second, current applications of this technology in the ophthalmology field are explored. Third, an overview of the scientometric patent analysis is provided. Fourth, the methodology applied is explained. Lastly, the results are analyzed, and the conclusions are presented.

2. LITERATURE REVIEW

2.1 Additive manufacturing: applications in the health care industry

Additive manufacturing has been used for decades, mainly in the manufacturing industry to produce prototypes (Schubert, van Langeveld, and Donoso 2014). A wider adoption of this innovative technology is expected in the next two to five years due to its rapid diffusion into other industries. Currently, its application has been extended to accessories, assembly parts and medical devices, including prosthesis (Wohlers Associates 2013), eye glasses and implants (Schubert, van Langeveld, and Donoso 2014). As an example of its applications in health care, this technology is used to produce customized dental braces. The dental impression is converted into an stereolithography (STL) file, and then the braces are printed to fit the patient's anatomy (Conner et al. 2014). 3D printing offers valuable solutions for bone implant production. Novel materials, such as Cobalt–chromium–molybdenum alloy, can be used with this technology, allowing for the integration of a prosthetic component with a surrounding bone, which increases surgery success (Stenlund et al. 2015). Bio-additive manufacturing will play a determinant role in the health sector, considering the growing interest in developing breakthrough products that could change people's lives, resulting in its global use (Basiliere and Shanler 2015).

The use of bio-additive manufacturing in the health industry began with the production of medical devices that could repair, replace or control body functions. Currently, it also includes the development of pre-surgery planning tools, surgical cutting templates (Burton and Shanler 2014) and custom-made products, providing patients and doctors with significant benefits that range from reduced time invested in surgery, to expedited patient recovery, to a higher likelihood of successful interventions. Additive manufacturing also provides the possibility of printing tissue and organs directly, and it has enabled researchers to develop heart valves and cartilage tissue, among other body components. As the technology advances, the probability of developing functional tissues and organs using additive manufacturing will increase. In 20 years, it is expected that this technology will also offer the possibility of developing organs, such as eyes, hearts, livers and kidneys (Ventola 2014).

2.2 Bio-additive manufacturing in ophthalmology

The potential uses of bio-additive manufacturing in ophthalmology are promising. Complex three-dimensional models for ophthalmologists' training are expected to be developed in the near future, enhancing the learning experience. Moreover, advanced models of a patient's eye anatomy could be reproduced and as a result, surgeons would be able to practice before an intervention, increasing precision and success (Huang and Zhang 2014). Although more research is needed, there are significant advances in this area. Along these lines, a 3D hollow eye model was fabricated almost 10 years ago using a rapid prototyping machine in which the purpose was to test a novel cleaner for healing complications in retinal diseases treatments. The inner walls of the model were coated with 5% bovine serum albumin to mimic the surface properties of the human retina (Chan et al. 2015). Important research has also been carried out for developing ophthalmological surgical instruments. For example, an ophthalmic speculum and a customized spatula have been developed using bio-additive manufacturing technology. They are currently undergoing prototype testing and a computer aided design (CAD) development stage, respectively (Lupeanu et al. 2014).

By means of bio-additive manufacturing, the development of a printed cornea is a real

possibility. For example, a research group from Massey University and Auckland University have discovered how to print cornea replacements using collagen (Mechatronics and Robotics Research Group of Massey University 2015). This development is in the proof of concept stage.

Although the use of bio-additive manufacturing in ophthalmology is still limited, there is a significant potential for the development of ocular tissues, such as conjunctiva, sclera and corneas. Also, the printing of artificial lenses, glaucoma valves and a variety of medical implants developed in customized processes will be a reality in the future (Huang and Zhang 2014). Moreover, the use of additive manufacturing in the development of flexible optical lenses for smartphones has been reported as well (Sung et al. 2015). With additional research, this progress allows for the possibility of producing high-quality ophthalmic lenses for human use. Ophthalmology is expected to be an important industry for future developments and innovations in bio-additive manufacturing (Huang and Zhang 2014).

2.3 Scientometric patent analysis

Important studies have applied quantitative methods of analysis to evaluate scientific and technological literature production in the health domain. They have shown how research trends could improve the management and establishment of new strategies. One example is the investigation developed by Zhang et al. (2013), who analyzed research papers on health management with the purpose of identifying the current status of collaborative activities and research topics in the field. Their main objective was to develop insights for policy makers to allocate health research funds in a more precise manner; however, when analyzing technologies, patents emerge as an important source for developing valuable insights, in addition to scientific production.

Patents are highly valuable mechanisms for protecting innovations. They provide important competitive advantages, such as the invention right of for twenty years (Weenen et al. 2013). In addition, patents are considered good indicators of the technological innovation process (Hidalgo-Nuchera, Iglesias-Pradas, and Hernández-García 2009; Rodríguez and Tello 2012 utilization). In fact, they are frequently seen as a level of R&D activities and are widely used to determine research trends as well as development profiles (Tsuji 2012). Moreover, 90% of all available technological information can be found in patent publications (Blackman 1995). They represent an accessible, reliable, updated and standardized source of information (de Souza Antunes et al. 2012). Most importantly, they provide a way to envisage technology trajectories and to identify ongoing developments of organizations (companies, government agencies, centers, universities, etc.) (Rodríguez et al. 2014). Patents are used frequently as an indicator of technology research; its statistical analysis offers valuable insights (Huang and Yang 2013), as is the case for scientometrics applications, which involves the statistical analysis of technological literature.

Since the 1980s, extensive literature regarding patent analysis has been produced, causing a large growth in the early 2000s (Ranaei et al. 2014). However, for additive manufacturing technology, there is still scarce patent analysis research. Previous studies (Rodríguez et al. 2014; UK Intellectual Property Office Patent Informatics Team 2013; Gridlogics Technologies 2014; Tsuji 2014) have focused on determining patent activity from a general perspective rather than in regards to a specific sector or application. In this research, a scientometric patent analysis on additive manufacturing applied in the ophthalmology field was developed.

3. METHOD

A scientometric patent analysis was developed during this study. The research began with a broad analysis of the field and included the application of Patseer software and consultation with experts. Patseer is a global patent database and research platform with integrated analytic tools covering more than 92 million records from the main authorities worldwide (Sinha and Pandurangi 2015). Patents were retrieved from 19 patent authorities. The time period covered in this research depended on the authority coverage, which ranged from 1782 to 2015 (April 29).

The “title” and “abstract” fields as well as the following queries were considered: (3D print* OR additive manufactur* OR bioprint* OR rapid prototyp* OR rapid manufactur*) AND (eye* OR ophthalm*).

Table 1 Research focuses and recent inventions of organizations, ordered by family patents. Family patent refers to the same patent application or the publication of a single invention protected by different authorities by a common owner.

Family Patent No.	Patent Publication Number	Application Date	Invention Description	Organization
RESEARCH FOCUS: LENSES				
1	WO2015014381A1 (Single patent)	July 31, 2013	A method for ophthalmic lens using additive manufacturing. It includes constituting voxels of one or more compositions, wherein manufacturing a three-dimensional at least one of the compositions comprises one or more pre-polymers or polymers.	Essilor International SA (France)
2	WO2015014380A1 (Single patent)	July 31, 2013	A method using additive manufacturing technologies and processes to manufacture a three-dimensional ophthalmic lens with a high management level of the homogeneity during the construction.	Essilor International SA (France)
3	FR3006622A1 Family patent: WO2014195654A1	June 7, 2013	A process for manufacturing an ophthalmic lens having at least one optical function. It comprises the step of additively manufacturing an intermediate optical element.	Essilor International SA (France)
4	FR3006623A1 Family patent: WO2014195653A1	June 7, 2013	A process for manufacturing an ophthalmic lens having at least one optical function characterized by comprising a step of additively manufacturing the ophthalmic lens.	Essilor International SA (France)
5	FR3008196A1 (Single patent)	July 8, 2013	A method for manufacturing an ophthalmic lens having at least one optical function, comprising the step of providing a starting optical system of the lens with a basic optical function and the step of additively manufacturing an additional optical element of the lens.	Essilor International SA (France)
6	CA2884801A1 Family patent: WO2014049284A1	Sept 26, 2013	A method for manufacturing an ophthalmic lens comprising a marking step for producing permanent technical marks. It comprises a step of additive manufacturing of a body and first and second surfaces.	Essilor International SA (France)
7	FR2985214B1 Family patent: WO2013098511A1	Dec 29, 2011	A template for an ophthalmic lens produced by additive rapid prototyping.	Essilor International SA (France)
8	CN102854639A (Single patent)	Sept 21, 2012	A manufacturing process of photosensitive resin eyeglasses. With the adoption of the manufacturing process, optometry prescription data can be directly input into rapid prototyping equipment in a factory or eyeglass store.	Jiangsu Wanxin Optical Co. Ltd. (China)
RESEARCH FOCUS: PROSTHESIS				
9	CN104091506A (Single patent)	July 24, 2014	The invention discloses a novel three-dimensional simulation eye. According to the novel three-dimensional simulation eye, the 3D printing technology is adopted.	Liu Qinghuai (Individual) (China)
10	GB2504665A Family patent: GB201211903D0	July 4, 2012	A method of manufacturing an artificial eye is presented. A digital image of an iris may be acquired and transferred to a substrate either by 3D printing or a transfer material, such as a dye sublimation film.	Manchester Metropolitan University (UK)
11	GB2487055A (Single patent)	Jan 5, 2011	A method of manufacturing an artificial eye is presented. In one embodiment, the image of the iris is CAD modelled, and the substrate may be formed as an inherent part of the transfer step by a 3D printer using silica powder and then bound using cyanoacrylate.	Fripp Design Ltd. (UK)
RESEARCH FOCUS: IMPLANTS				
12	DE102012011311A1 (Single patent)	June 10, 2012	The invention relates to an intraocular lens that has a front side at which light occurs and a back side at which the light emerges. The lens is manufactured by an injection molding process, rapid prototyping or laser sintering.	Becker Hartwig (Individual) (Germany)

4. RESULTS AND DISCUSSION

Additive manufacturing applications in ophthalmology are in a nascent stage; only 33 patents were initially identified. A data cleaning process known as standardization (Randall et al. 2013) was conducted manually to remove irrelevant information and to homogenize organizations' names. After this process, a total of 17 patents were analyzed. This information was organized and categorized, resulting in 12 family patents (the same patent application or the publication of a single invention protected by different authorities by a common owner), which are shown in Table 1.

The results obtained show that the main research focus of Bio 3D printing in ophthalmology is on the development of ophthalmic lenses. Essilor International SA has 7 families in this area. For example, this company patented the process development of ophthalmic lenses and its intermediate or additional elements. Incremental innovations of root patents have been developed through the application of additive manufacturing technology. Additionally, Jiangsu Wanxin Optical Co. Ltd. has patented an invention for producing photosensitive resin eyeglasses.

Prosthesis advances emerge as the second main research focus, which include 3 families. Liu Qinghuai (individual), Manchester Metropolitan University and Fripp Design Ltd. have patented the development of artificial eyes.

The third research focus is on implants. Becker Hartwig (individual) patented the creation of an intraocular lens.

Figure 1 shows that the top country in patenting these innovations is France (FR: 5 families), followed by the United Kingdom (GB: 2 families), China (CN: 2 families) and Germany (DE: 1 family). In addition, 2 families were first filed to be protected in all European Union countries at the same time (EP: 2 families).

The identification and analysis of the inventions presented show the first efforts devoted to the application of bio-additive manufacturing in the field of ophthalmology. Industry and academy are attempting to identify superior solutions to manage eye illnesses. This technology is in a nascent stage; however, the results show promising advances. Bio-additive manufacturing provides the possibility to develop breakthrough innovations to improve patients' conditions.

5. CONCLUSIONS

Valuable insights were obtained through the scientometric patent analysis developed. The application of bio-additive manufacturing in the field of ophthalmology is still in its infancy. The majority of inventions found correspond to products developed to be used outside the human body, which represents the lowest risk for patients. This fact could be related to the novelty of the technology.

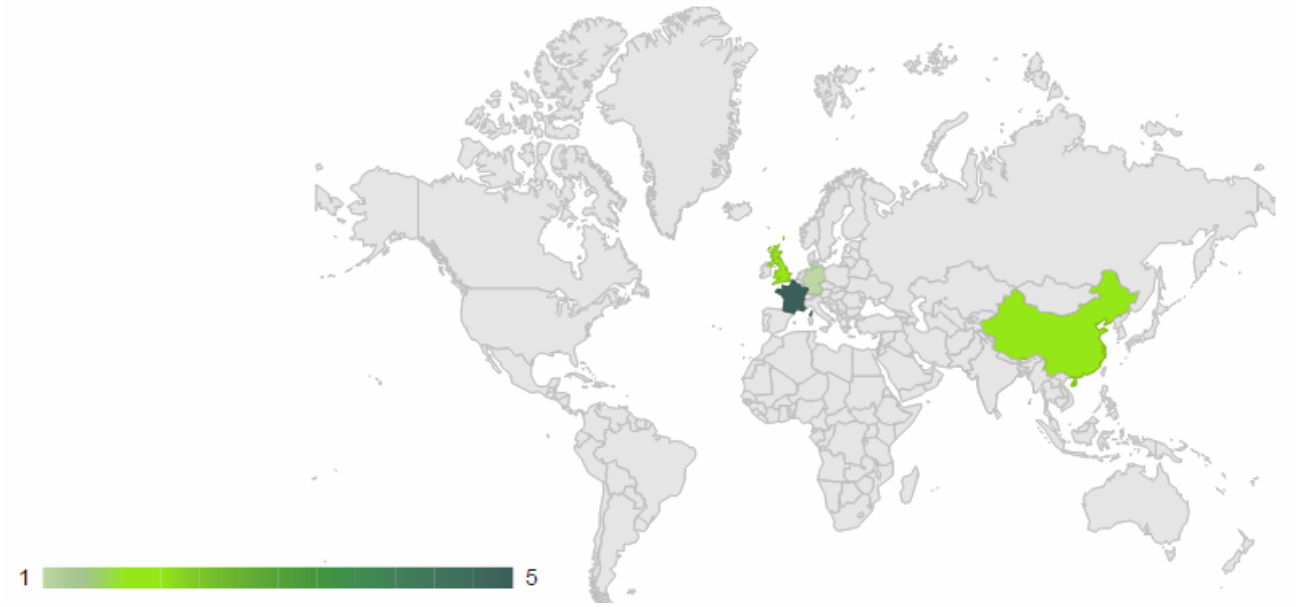

Figure 1 Top countries for the development of ophthalmic inventions, determined by family patents.

The findings of this study show that the main research focus is on the development of lenses due primarily to the invention activity of Essilor International SA. The second focus is related to the development of prosthesis, such as artificial eyes. In this sense, bio 3D additive manufacturing technology is mainly used to simplify the manufacturing processes and to create additional realism in the devices. Only one invention belongs to the research focus group of implants, and this corresponds to the development of an intraocular lens.

Regarding the top country of protection, France occupies the leader position, particularly as a consequence of the patent activity of one company (Essilor International SA). The results of this research offer valuable knowledge on emerging technologies and breakthrough innovations in ophthalmology.

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