Real-time Operational Dashboards for Facilitating Transparency in Supply Chain Management: Some Considerations

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Keywords: Real-time Data, Intuitive Dashboard, Cognition, Supply Chain.

Abstract: The real-time sharing of data has created a unique opportunity to design software applications for the purpose of improving operations in a supply chain (SC) - both horizontally and vertically. As a result of these developments, dashboards have been designed to facilitate transparency - providing a better overview of a specific operation. In this paper, we outline our research to show that most of the operational dashboard designs are data driven but only a very few of them are designed from a user's perspective. Further, not many in their design process tap into the benefits of building a dashboard based on the principles of cognition. We argue that building dashboards based on how our brain is wired will result in enhancing the decision-making processes for a Supply Chain.

1 INTRODUCTION

For the past two decades, the introduction and use of the Internet and various software applications have radically changed the working environment and possibilities in a supply chain. This has resulted in a re-design of the supply chain to meet the various needs of different stakeholders. Information sharing platforms and real-time data connectedness have made it possible for the different members in a Supply Chain to capitalize on the information and its accuracy. However, in spite of real-time access to vast databases of information there is still room for improvement in creating better software applications and tools with the goal of increasing the transparency and user friendliness which will enable personnel to work more efficiently in the supply chain management (SCM) process (Chopra and Meindl, 2013). Today, the needed information is available but is not always extracted and displayed in a manner conducive to the user for a quick overview of resources available (Records and Shimbo, 2010). Of course, various limitations and restrictions dictate availability of storage of spare inventory for example on offshore oilrigs. Due to the very limited storage capacity on offshore rigs inventory planning and "warehousing" are critical factors. However, there is an opportunity to capitalize on the real-time data capabilities that IT can provide today. The movement of goods and delivery of services in the supply chain are a major part of the operational day-to-day tasks of an operations manager and his/her team. In the North Sea, the operations on a rig run 24 hours a day and 365 days a year. Currently, there is a huge potential to improve the supply chain in terms of inventory and logistics handling to become more transparent, efficient and sustainable by tapping into the potential of exploiting accessible real-time data and IT capabilities in order to create a more seamless and dynamic flow of information integrating the members in the supply chain. For example, in oil and gas drilling operations, an operational and customized dashboard can give the user a timely overview of real-time logistics. In this research, we focus on this aspect of dashboard and argue that there is a need for more research into this aspect of cognition as related to operational dashboards.

The rest of the paper is organized as follows. Section 2 presents the background literature, while research methodology is explained in Section 3. In Section 4, we present data collection process. Section 5 presents our analysis and findings. We conclude our research in Section 6.

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2 BACKGROUND LITERATURE

To date, many businesses face the challenge of having numerous information systems within their own company and their strategic supply chain partners share the same predicament, namely their internal systems are not integrated in such a manner that it gives them easy access to real-time data (Chopra and Meindl, 2013, Flynn et al., 2010). The potential for creating new real-time information platforms to ensure flow upstream and downstream in the supply chain, will result in a higher optimized visibility and accurate information. This will decrease the uncertainty and need for counter measures to mitigate slack due to inadequate and wrong information, resulting in less manpower and buffers in the SC, saving time, money and resources. Good cooperation through information-sharing platforms is a win-win for all parties involved. The purpose of the study is to research and potentially discover the gap between theory and practice in terms of the availability of a dashboard that is user-friendly. If the potential gap is found, use the findings for further research to build a model dashboard for operational purpose. Numerous dashboards are in use for logistics and SCM purposes in the oil and gas industry. The objective of this research is to examine potential gap of the utility of such dashboards, used for monitoring and retrieval of information.

The scope of the research will be limited to investigating the field of IT for dashboards that are already in use for logistics purposes via secondary data such as peer articles books and professional journals and databases, Google Scholar, and Google Grey Web. Principally, we shall use bibliometrics as our research methodology.

2.1 Supply Chain

The main objectives of supply chain management are to maintain a high level of customer satisfaction, minimize costs, and improve the flexibility of system controllers. It is important to understand the role that information availability plays in a supply chain. In this regard, it can be viewed as a flow. For example, Figure 1 shows the flow in a global environment, showing the demand flow, which results in forecasting for products and services, information flow and processes linked with these flows and financial resources. The customary business functions starting with marketing, sales, research and development, forecasting derived from sales expectations lead to the purchasing of raw materials, production and logistics utilized through information systems.

In Figure 1, supply chain levels can be interpreted in a historical context depicting the development on how the SCM has changed. Figure 1b shows a closed supply chain and it was handled by vendor took care of all aspects of the SC itself. However, further down the line the need for extended supply chain was more stakeholders were added on, but still in a closed SC. The ultimate supply chain (Figure 1c) structure represents the global supply chain scenario today. Being highly complex and challenging to manage for the partners involved. One of the advantages is that a third-party financial provider is involved and shares the risk. The organizational structure has an outside logistics (3PL) company that executes the logistics, serving the two companies and an external marketing company that provides information about the crucial customers. Figure 1c, represents the structure of how oil and gas companies manage the supply chain.

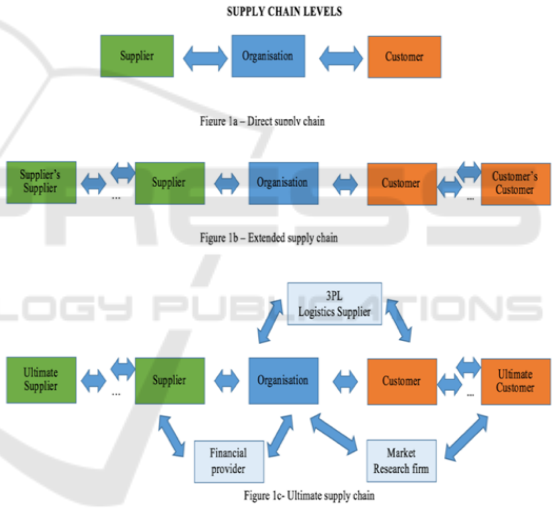

Figure 1: Supply chain in a globalized contest. [Adapted from Mentzer (2001, 5)].

2.2 Administration of Logistic Tasks

According to Stadtler (2015) "Inter-organizational collaboration is a necessity for an effective supply chain". Today, many companies still face the challenge of having several information systems within their own company, resulting in not having fully integrated real-time data information flow. This is due to systems having been developed over time and not always being adaptable to the new generation of technology and integration of in-house data. In addition, in an extended supply chain, partners in the company may also have their own variations and lack of data flow (Simchi-Levi et al., 2008). The rapid

development of new technologies creates an opportunity for supply chain strategies to change the process cycle in supply chain and become more integrated, resulting in increased interaction between the stakeholders. Information, facilitated through information platforms, is shared among the supply chain partners. This will result in higher transparency and reduce the uncertainty and bullwhip effect occurring in the supply chain (Kvie, 2015). According to Pereira (2009), the source of inefficiencies in a supply chain is information that is wrong, lacking or inaccurate. These scenarios represent a considerable challenge for supply chain management. Therefore, accurate and timely information is immensely important (Verissimo Pereira, 2009). To mitigate the challenge of lacking visibility in the supply chain, the typical countermeasure would be to have more staff and increased inventory, resulting in higher overall costs. Gartner analyst, Art Mesher, developed in the 1990s the concept of 3 Vs of supply chain: visibility, velocity and variability, and claims that a higher visibility throughout the supply chain will lead to velocity (higher speed in quantity) and will reduce the variability factors (Wilhjelm, 2013).

The importance of sharing information has increased significantly and can be considered as another set of dynamics and layer in SCM (Stadtler, 2015). However, one approach in optimizing the visibility of information can be to form a closer relationship with the transport companies and suppliers through information systems that are tailored to accommodate the needs of the members across the supply chain and share information (Frazelle, 2002). The information sharing in collaboration with partners and customers also faces challenges because of the high complexity of the supply chain integrations in global networks due to multiple layers of partners, and IT challenges due to the vast diversity of software and hardware (Stank et al., 2015).

2.3 Dashboard: Interactive Design

To date it seems that both academia and the industry have not sufficiently taken into consideration the user friendliness aspect of the dashboards they are developing (Sharp, 2006). Presthus and Canales (2015) found that dashboard design has mostly been data-driven. The dashboard should be designed based on cognitive psychology. However, it seems that few designers have focused on the visual perception and eye tracking that occurs when dashboards are viewed.

2.4 Human: Computer Interaction

The human–computer interaction model is a simplification of the process and stages of the interaction that will take place between the user and the machine/product. The purpose for such a model is to give the creators (designers) a better in-depth understanding of how the dynamics are in "dialogue" with "software" (human behavior), and to test the user friendliness and level of integration.

Prior to the design phase, it is important that the developers factor in human behavior, cognition, and emotions. The human perception/cognition refers to our everyday thought processes such as recollection, reflection, absorbing knowledge, daydreaming, seeing and observing, making decisions, reading and writing (Sharp, 2006). Some of the processes are more or less automatic and do not demand a lot of conscious thinking - they flow effortlessly through the human mind. Comparing and contrasting, making decisions, and doing tasks that require specific skills trigger creativity which leads to new ideas (Sharp, 2006).

2.5 The Design Process

The design process has the following dimensions:
Visceral Design: the visual physical appearance of the product and aesthetics such as colours and layout.
Behavioural Design: research has shown that the choice of correct aesthetics will influence the users' perception of usability and how the product "feels" while being used (Bonnardel et al., 2011).
Reflective Design: is the opinion that the user has of the product and whether the user felt positive or negative about the experience of using it (Bonnardel et al., 2011).

However, more factors need to be considered in the process of creating a dynamically good dashboard such as the graphic design and also the use of colours and the impact of these on the human emotions and aesthetics. According to the research of (Bonnardel et al. 2011), there is a direct correlation between the choice of colours and willingness to spend more time on the web page when navigating through the internet. The appeal, layout, aesthetics and colour determine within seconds whether the user will continue navigating the company's web pages (Bonnardel et al., 2011).

2.6 Cognition Processes Implemented in the Design of Dashboards

In the entire process in designing the intuitive dashboard should be including the cognition processes to optimize and capitalize on how the brain are wired. This will in return create a tool for the end user, which will be properly customized and perceived easy and logically deductive.

3 RESEARCH METHODOLOGY

The research objective was to search for written material about logistics dashboards designed for operational purposes that are user-friendly and built intuitively based on how the human brain is wired. In this research, we investigate whether there is a gap between academia and the business world in relation to the design and actual implementation of dashboards. Moreover, it is sought to use the findings for further research to build a dashboard model. The scope of the research will be limited to investigating the field of IT for dashboards that are already in use for logistics purposes via secondary data such as peer articles books and professional journals and databases, and Google Scholar. Hence, the methodology for the study will be bibliometric, which has the capability to canvas millions of records, through the use of database tools, such as Scopus and Web of Science.

Limitations of this Study

Due to the limitation of time and the size of the study, it can only be used as a suggestion to further develop potential improvements for real-time operational dashboards in logistics.

4 DATA COLLECTION

In addition to regular searches on the internet, we searched university catalogues, various books on supply chain management and dashboard design, peer-reviewed articles from academia and research institutions, white papers presented at conferences, newspapers and relevant industry journals. The choice of databases, fell on Web of Science and Scopus used by universities because of their size and global span. Scopus is the largest peer-review database in the world with 69 million records and Web of Science has over 90 million records (Wikipedia 2017). The “in text strings” should be identical for both databases to ensure validity and accuracy. “In text string” refers to the free text area where the researchers type in, for example, key words or phrases or topics. Using this secondary data bibliometrics was used to enumerate through the reports generated via the “in text string”. However, in the planned “in text string” for dashboard design, more keywords were added in the second search limited to “dashboard design” and only publications which contained those two keywords was to appear, the (..) will command the search to only show articles which have “dashboard design” in their content. In this context, drilldown is a term that indicates a deeper search of the gathered information, by prompting the search engine to go deeper into the information retrieved from Scopus and Web of Science.

After searching for the most appropriate keywords, bibliometrics analysis of “in text string” search yielded the following:

(1) “visualization” AND “dashboard” AND “real time”; all records were for 2006-2017. This generates a broad search for the keywords in the databases, and was also meant to exclude any irrelevant areas of research or industry. The time span was set to a decade with the purpose of investigating the research developments that have occurred in the field.

(2) “dashboard design”, all records are for the period 2006-2017. Further, in the analysis the following table structure has been used in the drill down in the data from the generated database report using the facilities of Web of Science and Scopus drill down possibilities. In both databases, you can “pick” new search words within the generated reports. Here after supply chain one level down (level 2) Logistic was tapped in and next level Oil and Gas (level 3). This structure has been followed through the research. When referring to findings this structure will be presented.

Table 1: Search “supply chain” in Scopus and Web of Science 2006-17.

Keyword “Supply Chain”				
Drilldown	**Data base Scopus**		**Database Web of Science**	
	Number of articles	Search words:	Number of articles	Search words:
Top of string	**85**		**37**	
Level 1	85	Supply chain: 3	37	Supply chain: 0
Level 2	3	Logistic: 2	37	Logistic: 0
Level 3	2	Oil and Gas: 1	37	Oil and Gas: 0

5 FINDINGS AND ANALYSIS

With regard to the number of articles in both databases using the search string "visualization" and "dashboard and "real time", very little has been written over the past decade on the topic of dashboards with only 37 articles retrieved from Web of Science and 85 articles in Scopus, spread over at 10-year period. (Process Model 1). This represents an average of only 11 publications per year. With regard to the research areas, science and engineering are predominantly the main contributors. Educational institutions appear with only four relevant articles in Web of Science. For the source of the publications, such as conferences, the result for Scopus is 69.1% and for Web of Science, 62%. With regard to peer reviews, the results indicate that articles from academia in Web of Science account for 39% and for Scopus, 28.6%. This shows evidence of the traditional gap between academic theory and business practice; in the research field, these are not aligned.

First Process Model

The search in Scopus on the string resulted in 85 matches and the same string in Web of Science yielded 37 hits (Process Model 1). Taking into consideration the huge number in these two of the databases, the results shows a low number of matches of the chosen search keywords, indicates that the information about development and research have not been published in the public media. So, further analysis was performed on the data available. The first step was to investigate the number of publications in both databases according to each year within the specified ten-year range.

Web of Science did not have any publications between 2006-2010 and in 2014, and Scopus for the same period showed no publications in 2006 and only five hits between 2007-2010. A mere total of five articles in both databases indicate that the area attracted little interest from researchers in academia and from the business world.

Despite the small amount of data retrieved from Web of Science. The generated data, shows a steady yearly increase in the number of publications, and a drop in 2017 although this is likely to increase by the end of the year. With regard to Scopus data depicted the last three years (2015-17) shows a significant surge in publications. An increase is seen in the number of articles (122 in total) in both databases. However, the results of the keyword search are low, given that they represent a decade of publications. The next step was to analyze the research areas/fields to which the articles derive from. In Web of Science, the retrieved results of 37 publications shows 17 publications from computer science, followed by engineering with 10 publications and educational research with 4 publications, representing the three major fields of contributors.

Scopus has 85 publications, contributed by: computer science with 48 (56 %) publications, followed by engineering with 37 (44%). In Web of Science, of the 37 publications, computer science accounted for 17 (46%) and engineering for 10 (27%). In both databases, the top two contributors are the fields of computer science and engineering. This may be explained by the fact that these two disciplines would be the ones involved with dashboards, real-time data and visualization.

Having established the research areas pertaining to the publications, the next question is: Where were the texts published? The analysis shows for 2006-2017, of the 85 articles from Scopus, 65.5 % were conference papers, 3.6 % were conference reviews, 2.4% were from books and 28.6% were from published articles. In the 37 articles sourced from Web of Science, 61% derive from conferences and 39% from published articles.

Analyzing the data shows that the majority of the research papers are (white paper level) from conferences (Web of Science 61% and Scopus 69.1%). Moreover, there is *prima facie* evidence of a classic gap between research and practice. In Scopus, only 28.6% are peer reviewed articles and in Web of Science, 39%. Academia is not following the development of dashboards, visualization and real-time. In addition, only 2.4% of the sources in the Scopus database are published books, and %0 in Web of Science. In industry, managers need solutions to help with everyday operational activities. Hence, there is a need to work towards solutions to fix current problems, or to propose better alternatives to increase business efficiency and decrease costs. The findings presented in tables pertaining to the in-text searches of Scopus and Web of Science using keywords "visualization", "data visualization", "real time data", "cognition", "eye tracking", "color", "supply chain or logistics", will be discussed below. Starting with "visualization" the search of a total (930+620) 1550 publications produced 350 hits (22.6%). This result is small when taking into consideration that the visualization process is an essential element of the dashboard design process. Further, in the search using keyword "real time data" (236+114) from the 350 drilldown source, the hits were 82 (23.5%) in total from visualization search and for a further keyword "cognition" (61+21) 82, the total hit was 11 publications.

With regard to real-time data and cognition, the data analysis shows that only a small percentage of 1550 articles factor in cognition in their research or

when designing or building dashboards. Further data collection on keyword data visualization (Table 3) produced a total hit of 287 (18.6%) from a total of 1550 publications, which is a low figure with regard to dashboard design process. Also, the data analysis showed (199+88) that for 287, for the keyword "real-time data", the result was 80 (28%) publications. In the last search for the keyword "cognition" there was a total of 11 (14%) publications. Based on the results, the conclusion drawn is that in research so far, the elements of visualization and cognition are not factored in to a large degree during the design and construction of dashboards. For the next keyword analysis "real-time data" from a total of 1550 publications, there were 233 (15%) hits. This indicates that 233 out of 1550 publications on dashboard designs () included real- time data.

A further level down from "real-time data" the keyword "supply chain" OR "logistics" produced 40 (11+23) (17%), and the last step used to check the presence of "oil and gas" produced only one publication. In the supply chain and logistics context, the research shows that at this point, only 17% of real-time data in this drilldown relates to the field. With regard to the search using the keyword "cognition" (Table 4), of 1550 publications, the total was (57+4) 61 publications (4%), indicating a very low representation of cognition concepts used in dashboard design. With regard to the next search using "supply chain or logistics" as the keywords, (57+4) 61, the results were, 11 articles, and further one level down "Oil and Gas" search produced four articles. The results of the cognition search show a very low level of published research in this area, considering that the data search covers over a decade of articles globally. The next step is related to the cognition process and how the brain processes information. Eye tracking is a visual cortex activity. The following results for the search using keyword "eye tracking" are: of 1550 publications, there were 34 articles (2%) on eye tracking; further drilldown from the eye tracking results for a "perception" search produced a total of 11 articles and further drilldown found six articles with the keyword "cognition". Part of the cognition process is also how the brain processes colors and color coding. Hence, the next keyword search was "color". The analysis shows: Out of 1550 publications, the search produced (43+11) 54 (3.5%). in the next search using the keyword "perception" yielded a total of 22 articles and the keyword "cognition" resulted in five articles.

The findings to date in the key word search regarding brain wiring show that only a small percentage of designers consider designing dashboards based upon the capability and limitations of the human brain and how it is wired. It is evident that there is a gap between academia (universities) and practitioners (businesses). When a theory or process coming from academia is deployed by an organization, quite often, it does not work. The theory practice gap between the management researcher and the practitioners is due to the fact that they are looking at a process or system from different perspectives. The practitioners are in an environment where theories are put into actual practice, and where the focus is to obtain knowledge that employees and management can utilize in their daily operations. Business researchers have a different perspective in that they are examining theories in the field, seeking to gain more knowledge from a more intellectual stance by posing critical questions. The methodological imperative is also different. For the researcher, everything is executed according to a strict methodology and scientific methods. For the practitioners, it is an ongoing process imbedded in their everyday business activity and their aim is to solve the challenges and problems they face and fix it.

On the topic of dashboards with only 37 articles retrieved from Web of Science and 85 articles in Scopus, spread over at 10-year period. This represents an average of only 11 publications per year. With regard to the research areas, science and engineering are predominantly the main contributors. Educational institutions appear with only four relevant articles in Web of Science. For the source of the publications, such as conferences, the result for Scopus is 69.1% and for Web of Science, 62%. With regard to peer reviews, the results indicate that articles from academia in Web of Science account for 39% and for Scopus, 28.6%. This shows evidence of the traditional gap between academic theory and business practice; in the research field, these are not aligned. The next step in the research process is to analyze the data generated by the search of Web of Science and Scopus, to find what has been published in the area of supply chain and logistics with regard to real-time dashboards. The purpose of the analysis is to determine and further mitigate the aforementioned gap between research and practical application. The following keywords, "supply chain", "visualization", "real time data", "dashboard" were used for the text search of relevant material in the *reports generated* from Scopus and Web of Science. (Process Model 1). Drilldown search in collected data reports from databases Scopus (85 hits) and Web of Science (37 hits), searching in text "visualization" "dashboard" and "real time".

As shown in Table 1, further drilldown using the keyword "supply chain" shows that out of 85 Scopus publications, only three were found in the area of supply chain and logistics, and two for oil and gas. The

same drilldown was performed in Web of Science, returning 0 for all categories. In both databases comprising a total of 122 hits, the three and one publications respectively are an extremely low number given that the data was collected for a one-decade time span. The next keywords to be used for the text search were "visualization", "real time data" and "cognition". The results from the drilldown show for the 85 Scopus publications, real-time data totals 77 and cognition, 9. In Web of Science, 37 (level 1) mention visualization, 33 consider real-time data (level 2), and cognition had only article (level 3).

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Table 2: Results of "Real-time data" search in Scopus and Web of Science 2006-2017.

Keyword "Real time data"				
Drilldown	**Data base Scopus**		**Database Web of Science**	
	Number of articles	Search words:	Number of articles	Search words:
Top of string	**85**		**37**	
Level 1	85	Real time data: 77	37	Real time data: 37
Level 2	77	Logistic: 4	37	Logistic: 0
Level 3	4	Oil and Gas: 0	37	Oil and Gas: 0

The findings of over 100 publications (77+33) (level 2) on real-time data, presented in Table 2 above, validate the *prima facie* evidence that the visualization element is a factor in real-time data research and processes. However, only 10% of the 100 publications show that the cognition theory, based on how the brain perceives patterns, has been applied when designing dashboards. Further investigation into "real-time data" in connection with logistics in the oil and gas industry in the visualization drilldown produced the following results. The results of the search using "real time data" as the keyword. In Scopus, 77 out of 85 (91%) considered 'real-time" data; four articles were the result of searching for "logistics", and "oil and gas" retrieved 0. In Web of Science the same drilldown shows 37 of 37 in the search for "real time data", "logistics" zero (0) and "oil and gas" zero (0).

Scopus analysis shows, 85 for the search of "dashboard", and further drilldown produced three (3.5%) for "supply chain" publications and zero (0) for "oil and gas". In Web of Science 37 publications contained the keyword "dashboard", but "supply chain" and "oil and gas" returned a result of zero. The same method was applied when searching for dashboards in relation to supply chain, logistics, and oil and gas. In Web of Science the top of string (37) list was applied in each search for "supply chain", "logistic" and "oil and gas" to support the claim that little has been done with regard to supply chain dashboards related to logistics in oil and gas.

Preliminary Summary

It can be observed from the above search results that the outcome of the in text string search of Scopus and Web of Science indicate a significant trend, viz. there has been an increase number of publications in searched topic from 2015-2017. Further, the research publications over the past decade have been mainly contributed by computer science (64), engineering (47). As *prima facie* evidence, a theoretical practice

gap has been found between academia and the business world since the research stemming from conferences accounts for a majority of 61% in Web of Science, and 69.1% in Scopus. Peer review publications in Scopus account for 28.6%, and 39% in Web of Science. Academia and the business world are not in sync.

We now recap the findings from the drilldown into respective data reports from Scopus and Web of Science, generated through in-text searches using keywords. Table1 shows the search results using the keyword "supply chain" for the period 2006-2017. In both databases, only three publications were found for this period. This indicates very low research activity in the field, for no apparent reason. Table 3 shows the search results using the keyword "visualization" for the period 2006-2017. The results indicate that the research field of visualization is a significant element in real-time data research, although 22 (26.84%) publications did not consider real-time data. The search results using the keyword "real-time data" for the period 2006-2017. The hit on real time data was high in the reports, returning114 out of a total search of 122. However, with regard to logistics, there were only four publications. The last keyword search in process model 1. The drilldown was for the keyword "dashboard" for the period 2006-2017. There was a 100% hit on the search in both data reports but, consistently, "supply chain" hits were very low at only three, and logistics a mere two.

Second Process Model

To assess the development in the research and performance of dashboard design over the past decade, in the analysis referring to publications, the results from 930 articles shows a noteworthy increase in the number of publications from 2012 to 2017, with a total of 682 (73.3%) publications, compared with only 248 (26.7%) publications for 2006-2011. In the analysis results of 620 articles shows the same trend: an increase from 2012-2017 to a total of 499 (80.4 %) publications, compared with 121 (19.6%) publications from 2006-2011.

Both databases show the same trend with regard to an increase in the number of publications from 2012-2017. Adding up the reports in the two databases, there have been 1181 publications in total over the last five years, compared with 369 publications for 2006-2011. These statistics indicate that the implementation of dashboards within the business world has increased and this trend is likely to continue in the future. The analysis of the data from the two databases shows the results of the search for written texts and the category to which each belongs.

Out of 930 publications found in the Scopus database, conference papers account for 507 publications, (i.e. 58.6%, comprised of conference papers and conference reviews) and 313 (33.7%) publications are articles. Thirty three (3.5%) publications were book chapters.

Further, it shows that out of 620 publications found in the Web of Science database, conference papers account for 317 publications (i.e. 51.2%), and 292 (47.7%) are articles. Six (1%) publications were book chapters.

The analysis of data acquired from Scopus. It confirms the theory- practice gap between, academia and conference (white paper level) is 24.9% comparing the findings, the same gap is only 3.5% which indicates only a small difference between academia and conference papers these results are evidence of prima facie. The large difference in results may be due to the different population of the database reports with 310 more hits on Scopus using the keyword in the text search. Having determined the categories of each text type, the, next step will be to analyze the research area segmentation.

Regarding the 930 publications the contributing fields can be summarized as follows: computer science (the largest) – 461 (49.6%); engineering - 318 (34%); medicine – 135 (14.5%); social science – 117 (12.6%); mathematics – 110 (11.9%); and business management – 97 (6%). Out of 930 publications, the largest research categories derive from computer science, 461 publications (49,6 %) is the area which has the most publications followed by engineering 318 publications (34%), Medicine 135 publication (14,5%) social science 117 publications (12,6%), Math 110 publications (11,9%) and business management 97 publications (6%). Further analysis of the data shows: computer science has 227 (36.6%) publications, engineering -181 publications (29.2%); educational research - 50 (8%), business economics - 48 (7.7%) are the business economics.

To summarize the findings so far, with regard to publications for 2006-2017, shows a much larger population than the search on "visualization" dashboard and real time which had 122 publications 85 in Scopus and 37 in Web of Science. In the new search of the databases, over 1550 publications were found, 930 in Scopus and 620 in Web of Science. The total number of publications found by the searches of the two databases was 1687.

With regard to the number of publications per year in both text searches, there was a substantial increase in publications in both Scopus and Web of Science. As discussed earlier, there was a significant increase in the number of publications from 2012 to 2017 with a total of 682 publications compared with 248 publications from 2006 to 2011. Further study shows the same

trend: 121 (19.6%) publications from 2006 to 2011, increasing to a total of 499 (80.4 %) for 2012 to 2017.

The majority of publications comprise conference papers and proceedings, followed by articles. Further analysis shows: (Scopus data analysis), the gap between academia and conference (white paper level) are 24.9%, in comparison with data from Web of Science the gap is 3.5% which indicates only a small difference between academia and conference paper level. It is difficult to know why there is such a large difference in the size of the gaps in Scopus and Web of Science. It may be due to the numbers of relevant articles in the databases. The next step was to identify the major contributors to the written documentation found in the databases. The results for both Scopus and Web of Science showed that the majority of contributors are from the field of computer science, followed by engineering.

The next step is to drilldown in the Scopus and Web of Science databases to search for texts containing "dashboard design". The procedure is identical to the drilldown process for "visualization", "dashboard" and "real time". The choice of drilldown key words for further data collection as mentioned before was carefully chosen, with the purpose of investigating the areas concerned with the design of dashboards. The keywords are the same as those discussed in the literature review chapter. The purpose is to analyze dashboard design in terms of visualization and, real-time time data, and to determine how many researchers and designers apply knowledge of cognition, eye tracking and color when designing dashboards. Using the keywords, the results of the drilldown were 930 publications for Scopus and 620 for Web of Science. Drilldown search in collected data reports from databases Scopus (930 hits) and Web of Science (620 hits), searching in text "dashboard design".

Out of 930 publications "visualization" appeared in 236 articles (level 1); further drilldown using the keyword "real time data" generated 61 (level 2) articles. When determining how many of the real-time data dashboards were based on "cognition", the result of the search was 10 articles (level 3). Of the 620 Web of Science publications, there were 114 articles for "visualization" (level 1), 21 articles for "real time data" (level 2), and further drilldown found 1 articles related to "cognition" (level 3). The next search was conducted using "data visualization" to determine how many of the 1550 publications contained the term. The results are given in the table below. For "real time data" (level 2), and further drilldown found 1 articles related to "cognition" (level 3). The next search was conducted using "data visualization" to determine how many of the 1550 publications contained the term. The results are given in the table below.

Table 3: Results of "Data Visualisation" search in Scopus and Web of Science 2006-2017.

Keyword "Data Visualization"				
Drilldown	**Data base Scopus**		**Database Web of Science**	
	Number of articles	Search words:	Number of articles	Search words:
Top of string	**930**		**620**	
Level 1	930	Data Visualization: 199	620	Data Visualization: 88
Level 2	199	Real time data : 61	88	Real time data: 19
Level 3	61	Cognition : 10	19	Cognition: 1

In Table 3 above, out of 930 publications in Scopus, the keyword "data visualization" yielded 199 (21.4%) articles (level 1), and further drilldown using the keyword "real time data" found 61 articles (level 2), and further drilldown showed a result of 10 for "cognition" (level 3). Out of 620 Web of Science publications the keyword "data visualization" retrieved 88 articles (level 1), and further drilldown using keyword "real time data" produced 19 articles (level 2) and for "cognition" one article (level 3). To ensure that the real-time data aspect was covered, another search using the keyword "real-time data" was generated, to search for publications in supply or logistics. The results of the data search in Scopus were: 160 articles using keyword "real-time data" (level 1), 11 publications for keyword 'supply chain" or "logistics" (level 2) and only one was found for "oil and gas" (level 3). The same drilldown was done in Web of Science. Out of 620 publications, the keyword "real- time data" had 73 hits (level 1); the keyword "supply chain" or "logistics" yielded 23 (level 2), and keyword "oil and gas" had 0 hits (level 3). In the next keyword drilldown with regard to cognition in both databases, the purpose is to check how many of the 1550 publications on dashboards, consider the cognition process in relation to dashboards and, further, specifically focus on supply chain or logistics in relation to the gas and oil industry. The results are given in the table below.

Table 4: Results of "Cognition" search in Scopus and Web of Science 2006-2017.

Keyword "Cognition"				
Drilldown	**Data base Scopus**		**Database Web of Science**	
	Number of articles	Search words:	Number of articles	Search words
Top of string	**930**		**620**	
Level 1	930	Cognition: 57	620	Cognition: 4
Level 2	57	Supply Chain or Logistic: 11	4	Supply Chain or Logistic:0
Level 3	11	Oil and Gas: 0	4	Oil and Gas: 0

For the "cognition" keyword drilldown, out of 930 publications in Scopus, 57 articles were found (level 1) and further drilldown using keyword "supply chain" or "logistics" found 11 articles (level 2), and for "oil and gas" there was a zero result (level 3). In Web of Science out of 620 publications, "cognition" yielded four articles (level 1), further drilldown produced no articles at levels 2 and 3. An additional step is the search for "eye tracking" which is part of the brain's cognition process. The results of the keyword search are discussed below. In the keyword search on color, the results are as follows, in Scopus 930, resulted in 43 articles (level 1), further drilldown on keyword "perception" 20 articles (level 2) and "cognition" 5 articles (level 3). Identical drilldown on keywords in 620 Web of Science publications resulted in 11 articles for "color" (level 1), "perception" had two articles (level 2) and "cognition" had zero (0) articles (level 3).

Table 5: Results of "Color" search in Scopus and Web of Science 2006-2017.

Keyword "Color" - drilldown				
Drilldown	**Database Scopus**		**Database Web of Science**	
	Number of articles	Search words:	Number of articles	Search words
Top of string	**930**		**620**	
Level 1	930	Color: 43	620	Color: 11
Level 2	43	Perception : 20	11	Perception: 2
Level 3	20	Cognition : 5	2	Cognition: 0

Keyword "Color" - drilldown				
Drilldown	**Database Scopus**		**Database Web of Science**	
	Number of articles	Search words:	Number of articles	Search words
Top of string	**930**		**620**	
Level 1	930	Color: 43	620	Color: 11
Level 2	43	Perception : 20	11	Perception: 2
Level 3	20	Cognition : 5	2	Cognition: 0

The analysis shows in table 6: the following results after in-text drilldown, firstly in 930 Scopus publications, keyword "supply chain" has 46 articles (level 1) and further drilldown "logistic" yielded 18 articles (level 2), and "oil and gas" one article (level 3). Identical process in keyword drilldown was performed in Web of Science and keyword "supply chain" produced 19 articles (level 1), "logistic" 4 articles (level 2) and "oil and gas" produced 0 (level 3).

The findings presented in tables pertaining to the in-text searches of Scopus and Web of Science using keywords "visualization", "data visualization", "real time data", "cognition", "eye tracking", "color",

Table 6: Search "supply chain" in Scopus and Web of Science 2006-17.

Keyword "Supply chain"				
Drilldown	**Data base Scopus**		**Database Web of Science**	
	Number of articles	Search words:	Number of articles	Search words:
Top of string	**930**		**620**	
Level 1	930	Supply chain: 46	620	Supply chain: 19
Level 2	46	Logistic: 18	19	Logistic: 4
Level 3	18	Oil and Gas: 1	4	Oil and Gas: 0

supply chain or logistics", will be discussed below. Starting with "visualization" the search of a total (930+620) 1550 publications produced 350 hits (22.6%). This result is small when taking into consideration that the visualization process is an essential element of the dashboard design process. Further, in the search using keyword "real time data" (236+114) from the 350 drilldown source, the hits were 82 (23.5%) in total from visualization search and for a further keyword "cognition" (61+21) 82, the total hit was 11 publications.

With regard to real-time data and cognition, the data analysis shows that only a small percentage of 1550 articles factor in cognition in their research or when designing or building dashboards. Further data collection on keyword data visualization (Table 3) produced a total hit of 287 (18.6%) from a total of 1550 publications, which is a low figure with regard to dashboard design process. Also, the data analysis showed (199+88) that for 287, for the keyword "real-time data", the result was 80 (28%) publications. In the last search for the keyword "cognition" there was a total of 11 (14%) publications. Based on the results, the conclusion drawn is that in research so far, the elements of visualization and cognition are not factored in to a large degree during the design and construction of dashboards. For the next keyword analysis "real-time data" from a total of 1550 publications, there were 233 (15%) hits. This indicates that 233 out of 1550 publications on dashboard designs () included real- time data.

A further level down from "real-time data" the keyword "supply chain" OR "logistics" produced 40 (11+23) (17%), and the last step used to check the presence of "oil and gas" produced only one publication. In the supply chain and logistics context, the research shows that at this point, only 17% of real-time data in this drilldown relates to the field. With regard to the search using the keyword "cognition" (Table 4), of 1550 publications, the total was (57+4) 61 publications (4%), indicating a very low representation of cognition concepts used in dashboard design. With regard to the next search using "supply chain or logistics" as the keywords,

(57+4) 61, the results were, 11 articles, and further one level down "Oil and Gas" search produced four articles. The results of the cognition search show a very low level of published research in this area, considering that the data search covers over a decade of articles globally. The next step is related to the cognition process and how the brain processes information. Eye tracking is a visual cortex activity. The following results for the search using keyword "eye tracking" are: of 1550 publications, there were 34 articles (2%) on eye tracking; further drilldown from the eye tracking results for a "perception" search produced a total of 11 articles and further drilldown found six articles with the keyword "cognition". Part of the cognition process is also how the brain processes colors and color coding. Hence, the next keyword search was "color". The analysis shows: Out of 1550 publications, the search produced (43+11) 54 (3.5%). in the next search using the keyword "perception" yielded a total of 22 articles and the keyword "cognition" resulted in five articles.

The findings to date in the key word search regarding brain wiring show that only a small percentage of designers consider designing dashboards based upon the capability and limitations of the human brain and how it is wired. It is evident that there is a gap between academia (universities) and practitioners (businesses). When a theory or process coming from academia is deployed by an organization, quite often, it does not work. The theory practice gap between the management researcher and the practitioners is due to the fact that they are looking at a process or system from different perspectives. The practitioners are in an environment where theories are put into actual practice, and where the focus is to obtain knowledge that employees and management can utilize in their daily operations. Business researchers have a different perspective in that they are examining theories in the field, seeking to gain more knowledge from a more intellectual stance by posing critical questions.

6 CONCLUSION

Based on the data analysed the representation of articles in relation to dashboards real-time data, shows the results are extremely low in the context of supply chain, logistic and oil and gas. This shows evidence *prima facie*, a gap between academia and the practitioners. With regard to brain wiring to date, shows that only a small percentage of the retrieved articles, factor in and apply the benefits of designing dashboards based upon the capability and limitations of the human brain and how it is wired, the same evidence of *prima facie* in relation to theoretical practice gap, between academia and practitioners which use the dashboard in their daily operations. Also, a low number of book chapters on the search was detected, is evidence *prima facie*, theoretical practice gap between the industry and academia.

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