Embedding Business Intelligence Systems within Organisations

Abstract. Embedding business intelligence systems within organisations requires a seamless integration of technology, business processes and routines into the fabric of the organisation. In this paper, we propose a set of five dimensions for embeddedness of business intelligence systems within organisations. We argue that these dimensions can be related to different types of problem. We then present four case studies and a number of key insights emerge from a cross case analysis.

Keywords. Business intelligence, embeddedness, maturity, problem types.

Introduction

There is long tradition of research in the support of managerial decision-making, from traditional decision support systems (DSS) to more recently business intelligence (BI) systems [1, 2]. BI systems involve identifying, storing, analyzing and reporting about relevant business data to enhance business decision-making processes and outcomes [3]. They use technologies including data warehousing, reporting, dash-boarding, data visualization and data mining. Over the last decade, enterprise systems including enterprise resource planning (ERP) systems, supply chain management (SCM) systems and customer relationship management (CRM) systems have created vast repositories of data available for use in BI systems. BI systems are widely used within organisations to enable decisions to be made based on relevant data as evidence [4]. We argue that a critical factor in measuring an organisation’s success and maturity with BI tools is whether these have become increasingly embedded into the routines of decision-makers and into organisational processes, technology infrastructure and strategy [1]. To support this contention, we explore these two fundamental components of BI maturity: the degree of embeddedness of BI systems into the decision-making routines of decision-makers and the degree of embeddedness of BI systems into the processes, technology infrastructure and strategy, in a number of organisations.

There are two motivations for this study. First, many recent studies argue that BI systems provide value and competitive advantage to organisations by enabling improvement of business processes, improving firm performance and creating competitive advantage [5, 6, 7]. However, most of these studies focus on specific ‘one-off’ BI system used within particular business processes rather than on enterprise-wide support, and do not explore support for more complex problems of an intractable nature or problems that may emerge in the future and which managers don’t fully understand yet [3]. In this study, we extend previous work by focusing on BI systems that support the whole range of decision problems, both simple and complex, and explore the organisation-wide dimension of BI systems.

Second, research on the alignment of business and information technology (IT) has mainly focused on strategy, rather than on establishing an optimal relationship between business and IT [8]. In this paper, we extend previous work and focus on the
embeddedness (or integration) of BI systems into the business. The current dynamic and turbulent business environment drives many organizations to look beyond just alignment of business and IT towards the notion of fusion [8, 9]. The concept of fusion in physics, involves combining two or more elements under the right conditions to create a new element, triggering the release of considerable energy [8]. In our context, fusion involves deeply embedding BI systems within the business to create BI-driven decision-making routines and BI-enabled organisational processes that takes managerial decision making to new levels of understanding and foresight.

In this paper, we use Adam et al.’s (2008) classification of three different problem types and related BI system use: routine (reporting), explorative (scrutinizing) and unstructured (discovering) [3] as a lens to understand the level of BI embeddedness in the decision-making routines of decision-makers. We also use five dimensions synthesized from the literature to understand and measure the level of embeddedness of BI systems into organizations. Combining these two lenses into a framework enables us to explore the relationship between the embeddedness of BI systems into the decision-making routines of decision-makers on the one hand, and the embeddedness of BI systems into the processes, technology infrastructure and strategy organizations on the other hand. We use our dual framework to analyze four case studies of BI systems within different organisations and develop insights into the BI maturity of these organisations.

The paper is organised as follows. We first discuss the relevant literature concerning BI systems, and define the three levels of BI systems use and the five dimensions of BI embeddedness within organisations. Then we present the multiple case study research approach we used. Following this we describe the four case studies. The following section presents a cross case analysis and identifies fundamental patterns that reveal insights into the maturity of BI capabilities within organisations. Finally we conclude the paper with some suggestions for future work.

1. Background

In this section we review three key areas of the literature. First, we discuss BI systems and embeddedness. Second, we define three levels of BI systems use for different types of problem. Third, we define five dimensions of BI embeddedness within organisations. We then explain how we combine the levels of BI systems use with the dimensions of BI embeddedness to form a framework we can use as a lens to explore BI maturity in our case studies.

1.1. BI and Embeddedness

BI involves the structuring, storage and use of large amounts of high quality data, typically leveraging a data warehouse to improve business decision-making. BI also typically uses such technologies as multidimensional data analysis, query and reporting tools, online analytical processing (OLAP), data and process mining, digital dashboards and scorecards [11]. In theory at least, BI systems can be designed to support decision-makers at any level in an organization for operational, tactical and strategic decision-making [3], although many reports of success are focused on the support of specific operational decisions of a well defined nature, such as monitoring product sales across different markets or reporting on productivity on the factory floor.
Embeddedness may be understood as the degree to which individuals or organizations are immersed in social networks [12]. It involves both social and economic ties within and between organizations and across society at large. Embeddedness is affected by the interactions of various constituents (people, processes and technology), and is an important determinant of competitiveness. It is an ongoing process continuously shaped by the relations between the different constituents [13]. El Sawy [9] argues that IT systems have evolved through three levels of embeddedness: the connection view, the immersion view and the fusions view, with IT systems more deeply embedded through the levels. Previous research has revealed that the immersion view, where IT systems cannot be separated from work and processes and IT systems are highly interdependent, typifies much current practice [9].

1.2. BI system use and problem type

Daly, Adam and Pomerol [3] argue that decision-makers use BI systems to address three types of problems, based on the degree of complexity of the problem. The first type are routine problems where decision-makers understand the nature of the problem quite well and require reporting functionality from BI systems [10]. The second type are explorative problems where decision-makers understand the nature of the problem within a broader context, yet they struggle to articulate it in specific terms and require scrutinizing functionality from BI systems. The third type are unstructured problems where decision-makers do not have a specific question in mind due to the highly abstract nature of the problem and require discovering functionality from BI systems. Various BI tools are used to support these types of problem, from basic reporting tools (level 1), to multidimensional data cubes and OLAP tools (level 2), and data mining and other types of advanced supports not necessarily exclusively reliant on information systems (level 3).

The three types of problem are related in that the most unstructured problems are likely to become better understood over time and turn into explorative problems as managers develop the routines to deal with them, until they become totally routinised. In their different states however, problems may be supported by different levels of sophistication of BI systems and relate to the requirements of different groups of decision makers, top managers, middle managers and line managers for instance. Thus, each type of problem is part of an overall longitudinal decision-making process that plays out over long periods as specific managerial problems are identified and then migrate through the levels of the framework from discovering through scrutinizing to reporting as they become better understood. During this evolution, problems may then be handed over from one group of managers to other groups of managers.

1.3. Dimensions of BI embeddedness within organisations

In this research, we defined BI embeddedness within organisations using a set of five dimensions synthesized from the literature. These are technology, business process, evidence-based management, renewal capability and business strategy. The overall embeddedness of BI systems is a multidimensional concept including all five dimensions with varying degrees of embeddedness. The dimensions are not independent, having some reinforcing interactions, however we argue that the set is reasonably exhaustive and clearly defined [15].
1.3.1. Technology

BI technology relies on various tools including data warehouses, reporting tools, OLAP tools, visualization tools and data mining tools. These technologies are usually developed independently of other enterprise systems including ERP, SCM and CRM systems, and other applications used by organisations. Technology BI embeddness is achieved when BI systems are seamlessly integrated with other IT systems within the organization. With technology BI embeddedness, BI systems do not require any interruption to the normal processing used in daily routine behaviour. In other words, use of BI systems does not require deliberative action by decision-makers regarding use of technology. Insights from BI systems are made available to the user within what appears to be one integrated technology infrastructure.

1.3.2. Business Process

A business process is a structured set of activities within an organization that are used to provide a product or service to customers. Hinssen [8] notes that “we’re living in the last days of the ‘silos’ and are entering the new realm of the ‘process-driven organisation’...” Many organisations use business process management to continuously change, adapt, and optimize their processes in almost real-time [16]. Business process BI embeddedness is achieved when BI systems are seamlessly integrated with business processes. With business process BI embeddedness, there should not be any interruptions to the normal processing used in daily routine behaviour when using insights from BI systems. Again, the decision-maker does not need to deviate from the business process to use BI systems.

1.3.3. Decision-making Routines

BI systems provide insights from data to enable better decision-making processes and outcomes. BI systems that are embedded into the decision-making routines of decision-makers across the organization lead to a culture of evidence-based management [4, 10]. Evidence-based management may involve individual decision-makers and groups across the organization. With evidence-based management BI embeddedness, data driven insights are used routinely, are valued by senior management and also measure the effectiveness of initiatives and decisions made.

1.3.4. Renewal capability

BI systems may provide value and competitive advantage to organisations. However in the current volatile and turbulent business environment, BI systems need to be continuously renewed to provide valuable insights. BI systems and capabilities are renewed using dynamic capabilities, comprising two organizational routines, search and select and asset orchestration [17]. Search and select routines are enabled by BI systems when opportunities for change are identified from data. Asset orchestration capabilities rest on routinely enacted managerial processes to undertake change. The changes may be in the form of new processes, new technology, new decision-making routines, new reporting relationships, etc. Asset orchestration often requires a high degree of coordination across business unit boundaries to undertake changes [17].

Dynamic capabilities require effective governance structures with relevant and transparent accountability and decision-making processes [14]. With renewal capability BI embeddedness governance mechanisms for BI renewal are well defined and
routinely used. Mature and affective change management practices are widely used to renew and evaluate BI system capabilities.

1.3.5. Business strategy

The importance and use of insights from BI systems should be embedded within the business strategy formulation process, leading to alignment of BI strategy and business strategy. Integration of BI systems with the business strategy requires an understanding of the role, positioning and focus of BI-enabled decision-making to support overall company objectives [17]. Senior management support is important to the successful alignment of BI and business strategy [18].

1.3.6. The BI Embeddedness Framework

We combine the three levels of BI system use and problem type with the five dimensions of BI embeddedness within organisations to define our BI embeddedness framework. We argue that this combination provides a means of developing insights into BI maturity within organisations [14], leveraging a large number of tangible observations about the way BI is used by large populations of actors in organisations. Table 1 shows the overall framework and illustrates how we propose to read BI embeddedness and BI maturity along its different dimensions.

Table 2. Problem Type and Embeddedness Levels Framework to measure BI maturity

<table>
<thead>
<tr>
<th>Embeddedness</th>
<th>Technology</th>
<th>Business process</th>
<th>Decision-making routines</th>
<th>Renewal capability</th>
<th>Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine (Reporting)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Explorative (Scrutiny)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unstructured (Discovery)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Within each column, the degree of embeddedness of BI systems is measured according to a specific dimension of our framework. Depending upon the category of problem type where evidence of BI embeddedness is found, cases are found to display varying degrees of embeddedness – where evidence found at all levels of problem type
indicates a greater level of embeddedness and evidence found at unstructured problem level also indicates greater embeddedness. All in all, evidence of embeddedness at many levels across the many dimensions indicates increasing levels of BI maturity.

2. Research Approach

We use an exploratory, multiple case study research approach. Case studies are particularly useful for in-depth studies of contemporary phenomena within their organisational context [19]. They provide a rich and detailed description of the phenomenon and explain how and why outcomes occur. We report four case studies, two from organisations with mature BI systems and two where BI systems were not widely used. This enables us to compare the embeddedness of BI systems between organisations with mature and immature BI systems.

Data collection included semi-structured interviews with key stakeholders in each organisation, and access to relevant documents. Each of the interview lasted about an hour and all interviews were recorded and transcribed. Thematic analysis was used to identify common patterns and themes emerging from the data [20].

When analyzing case study data, specific indicators were used to identify the type of problem being addressed [3]. Routine problems are identified when decision-makers can name specific performance indicators and know how these must be represented, and the domain of the problem has been precisely articulated. Explorative problems are identified when decision-makers do not know precisely how specific performance indicators might be measured and represented. Unstructured problems are identified when decision-makers are unaware of any specific performance indicators and problems are still being formulated.

3. Case Study Descriptions

In this section we describe the four case studies. For each case study, we first discuss the organizational context and BI systems used. We then discuss how the organization uses BI systems for each of the three types of problem being addressed: routine, explorative and unstructured. Within the discussion for each problem type we describe how each of the five embeddedness dimensions is addressed.

3.1. Case 1 (mature BI user)

Organisation A is a large Australian financial service institution. It provides a range of financial services including personal and business banking, wealth management and investment banking. A core business strategy is to provide innovative and relationship-based financial services. It is highly customer focused and was an early adopter of Customer Relationship Management (CRM) systems. The organisation has used CRM systems for nearly two decades and makes extensive use of Teradata and Seibel technology. It has a customer analytics group of approximately 20 people located within the central marketing function.

At the routine problem level, Organisation A developed a high quality data resource, comprising two data warehouses (DW). The global DW is predominantly
used for financial and risk-related analysis reporting. The marketing DW is used extensively for customer segmentation and event-based marketing inquiries. A variety of BI tools including QueryMan and SQL Assistant are used to access the marketing DW for reporting purposes (technology dimension). BI insights are an integral part of Organisation A’s business processes and mature reporting systems are widely used throughout the business, providing data for use in decision-making (evidence-based management). For example, the organisation’s operations function provides reports including measures for management information, post-implementation review measures and marketing campaign performance indicators. Measurement of the usage of and success with BI insights provided is essential to demonstrate their value. The change and communications function promotes the bank’s BI capabilities among its front-line banking staff (business process and decision-making routines dimensions). The BI governance structure comprises monthly governance meetings with BI staff, product and marketing analysts and managers. They review the performance of campaigns, and identify new opportunities for BI insights (renewal capability dimension). The use of data for reporting is recognized to be critical to the success of the organisation’s customer-focused business strategy. In fact, the organisation’s overall strategy is to promote its CRM capabilities amongst its managers and banking staff (strategy dimension).

At the explorative problem level, BI insights are seamlessly integrated with a multi-channel marketing capability. Sophisticated modeling techniques, using tools including KXEN, SAS, and Mathematica, are used to analyse customer lifecycle behavior and build propensity models. BI insights provide support for customer interaction processes (technology and business process dimensions). New uses for BI are continuously sought. The governance structure is used to identify further opportunities for providing BI insights for exploring problem spaces. For example the banker dashboard was developed to support bankers in exploring and prioritizing BI insights for inbound marketing (i.e. up-selling, cross-selling, meeting internal targets) (decision-making routines and renewal capability dimensions). The use of data for problem exploration is recognized to be critical to the success of the business. BI insights enable strategic solutions, such as the development of a sophisticated event-based marketing capability and the related banker dashboard (strategy dimension).

At the unstructured problem level, Organisation A’s BI data miners explore data for new opportunities (e.g. unusual behavior observed in transactions). Product managers seek help from data miners identifying new ways to meet their targets (decision-making routines dimension).

3.2. Case 2 (BI not widely used)

Organisation B is a large Australian research and teaching university with a student population of approximately 35,000 students, over 7,000 staff and revenue of approximately $1.5 billion. It recently initiated a major restructuring of its course offerings with a reduction in undergraduate course offerings resulting in the provision of six broad and flexible undergraduate courses. The postgraduate degrees focus on professional education and were also significantly restructured. Marketing of postgraduate degrees became crucial as these courses were fee-based and generated significant income for the University. Within this context, Organisation B developed and implemented a Microsoft Dynamics-based CRM system to better manage new student recruitment and admissions, and better understand the cycle from initial
enquiry to enrolment, graduation and finally alumni. Several graduate schools use the CRM solution in their operations.

At the routine problem level, the CRM solution uses a sequel server database, containing approximately 92,000 client records and has over 400 users. It is linked to the central student information system and can consequently check if enquiries lead to enrolments. The CRM system is flexible allowing users to create sophisticated marketing campaigns. It uses the Google analytics toolkit, routing all web traffic to the web pages of the graduate schools (technology dimension). Reporting from the CRM system enables decision-makers to track student inquiries from the initial point of contact to enrolment. The CRM system has enabled graduate schools to better manage enquiries through improved marketing processes, better targeting of prospects (business process dimension). Many graduate schools rely on the CRM system as the single source of truth for course enquiries and as the single view of clients (decision-making routines dimension). A CRM reference group meets regularly to monitor CRM system usage and discuss new reporting requirements. For example, in the area of recruitment and student enquiry management, email lists and Excel spreadsheets were replaced with flexible online enquiry capabilities (renewal capability dimension). The CRM project has been fully endorsed by Organisation B's senior executive team and has received additional funding for further development. The CRM system is now an integral part of the organisation’s common client strategy (strategy dimension).

At the explorative problem level, CRM insights are used to better understand marketing initiatives and student needs with full traceability of inquiries and visibility of various communication channels (business process dimension).

There is no evidence of BI use at the unstructured problem level.

3.3. Case 3 (mature BI user)

Organisation C is a commercial state body operating in the energy industry. The organisation is wholly owned by the Irish Government and comprises two main businesses, gas transportation and energy supply. The residential gas market is the primary area of business. A new wholesale electricity market has come into operation in Ireland since November 2007. Organisation C entered the retail electricity market in 2006, and currently holds 12% of the electricity market in Ireland.

At the routine problem level, Organisation C uses several sophisticated BI technologies to provide data for reporting and dashboards. A dashboard provides real-time reporting of indicators including gas flow, pressure and consumption. Other reporting capabilities include maintenance, accidents and claims management (technology and business process dimensions). Dashboards are also widely used in assisting decision-makers in monitoring daily operations (decision-making routines dimension). A governance structure enables new opportunities for reporting to be identified, prioritized and funded. For example, Excel-based reporting tools have been replaced with newer data analysis tools based on data warehouse technologies (renewal capability dimension).

At the explorative problem level, Organisation C is extremely mature in its development of highly complex models for planning for gas consumption and justifying the price per cubic meter charged to the different categories of customers. This has been largely based on spreadsheets of a highly complex nature, developed by specialists in econometrics and business modelling (technology dimension). Decision-makers in the transportation department run simulations for price setting and justifying
capital expenditure (**decision-making routines** dimension). BI insights are used to optimize purchase contracts, prioritise new gas and electricity opportunities, forecast pricing and efficiently operating in the new Irish energy trading environment. These insights help Organisation C to improve strategic decision-making (**strategy** dimension).

At the **unstructured** problem level, Organisation C’s BI data analysts explore data for new opportunities. For example, regression analysis assesses the relationship between gas demand and daily temperature. Optimal price changes and customer segmentation are also supported with data analysis (**decision-making routines** dimension). BI tools are also used to communicate with the regulator and lobby for changes in the rules of competition, the definition of products and services and the price levels that can be charged by operators (**Strategy and renewal capability** dimensions).

3.4. Case 4 (BI not widely used)

Organisation D is a medical device manufacturer, and a subsidiary of a US multinational company. This organisation has seven manufacturing sites around the world, with a new facility currently being built in China. The Cork site (Ireland) is the largest manufacturing facility, accounting for approximately 40% of total production. For products in this market, gaining additional market share is largely dependent on price competitiveness, with significant competition in the market. In this study, we focus on the Irish subsidiary, which has specific goals and key performance indicators defined by the US headquarters. This is important because this type of MNC relies on a very top-down view of organisation and decision making, such that subsidiaries may not be allowed to exercise autonomy in decision making. The case study shows that, where managers are not given autonomy in decision making, the development of and reliance on BIS tools will remain limited to operational concerns.

At the **routine** problem level, Organisation D has a comprehensive number of measures for day-to-day operations. An SAP ERP / BW (Business Warehouse) platform provides key operational data, including all production and quality data (**technology** dimension). Business objects reporting software is used for querying and reporting as required. There is however little integration between systems, particularly between the main transactional SAP system, and other bespoke in-house developed systems, which also record business transactions. Reports produced are currently primarily used by decision-makers for operational efficiency of production processes (**decision-making dimension**). This is explained by the fact that local managers have to report on these aspects of performance to the corporate level and this is how the effectiveness of the Irish plant is measured. Thus, each site in the corporation is measured on a nine panel Balanced Scorecard metric based on operational and quality metrics which are integrated with the corporate goals and objectives (**decision making** dimension). Most of the information provided to managers for decision making is in the form of dashboards of balanced scorecards. Data manipulation is completed by financial analysts and administration personnel who have specific expertise and training in the process (**decision making routines** dimension). Thus, company D provides an interesting assemblage of BI support systems and support staff combining to provide managers with the information they need.

Broadening our analysis to the corporation-wide level, we find that a league table generated by corporate systems ranks the twenty-three plants in terms of performance...
and alignment with corporate goals. This indicates an explorative approach, where senior management have set out the benchmark for performance measurement, but utilise the comparison across the different subsidiaries as a means to explore causal linkages between factors of performance (business process dimension).

Managers are aware of decision problems which would be classified as unstructured, where the uncertainty of the business environment would impact the day to day business decisions. However, at a local manufacturing site level, environmental uncertainty has been removed, and achieving a high performance ranking relative to the other plants, is essential for the overall and continued success of the local plant. Therefore, no BI systems are in place to support this level of problem.

4. Cross Case Study Discussion

In order to explore how BI system use for different problem types relates to BI embeddedness we now conduct a cross case study data analysis. Table 1 below shows which case studies have achieved some level of embeddedness within each of the embeddedness dimensions for each problem type.

<table>
<thead>
<tr>
<th>Embeddedness Problem type</th>
<th>Technology</th>
<th>Business process</th>
<th>Decision-making routines</th>
<th>Renewal capability</th>
<th>Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine (Reporting)</td>
<td>Case 1, Case 2, Case 3, Case 4</td>
<td>Case 1, Case 2, Case 3, Case 4</td>
<td>Case 1, Case 2, Case 3, Case 4</td>
<td>Case 1, Case 2, Case 3,</td>
<td>Case 1, Case 2</td>
</tr>
<tr>
<td>Explorative (Scrutiny)</td>
<td>Case 1, Case 3</td>
<td>Case 1, Case 2, Case 4</td>
<td>Case 1, Case 3</td>
<td>Case 1</td>
<td>Case 1, Case 3</td>
</tr>
<tr>
<td>Unstructured (Discovery)</td>
<td></td>
<td></td>
<td></td>
<td>Case 1, Case 3</td>
<td></td>
</tr>
</tbody>
</table>

Four key findings emerged from the cross-case study data analysis. These findings lead to insights into the maturity of BI capabilities within organisations.

First, at the routine problem level, BI insights from all case studies are embedded for all five dimensions. For well-understood and defined problems, organisations make extensive use of BI systems and reports, using well-defined KPIs [3]. This contrasts with the explorative problem level where only Case Studies 1 and 3 have considerable embeddedness. These two case studies are organisations with mature use of BI.

Second, at the unstructured problem level, decision-makers explore non-routine, ad-hoc problems which relate to a ‘one-off’ type of discovery. Only Case Studies 1 and 3 show some degree of embeddedness, only for decision-making routine dimension. Decision-makers within organisations with mature BI capabilities routinely use BI systems for discovery in unstructured problems, but the embeddedness does not reach into the other dimensions of the framework. This is indicates that most firms are still far away from the top of the learning curve with the application of BI tools in support of their managers. Forty years after Gorry and Scott Morton’s (1971) seminal paper [21], even organisations that are classed as mature in our framework have failed to
demonstrate significant embeddedness in most dimensions of the framework at the unstructured level.

Third, organisations in information intensive industry sectors have more mature BI system usage, greater embeddedness of BI systems across most embeddedness dimensions and routinely use BI systems for explorative and routine problem types. For example, Case Study 1 is in the finance sector which is very information intensive whereas Case Studies 2, 3 and 4 are in the higher education, energy and manufacturing industry sectors which are less information intensive.

Fourth, renewal capability dimension that reflects an ability of the organisation to constantly change to adapt to changes in its environment. This is the dimension of the framework where our case studies organisations have the least embeddedness of all dimensions. BI renewal capability is crucial for organisations to achieve and maintain competitive advantage. Seeking, prioritizing and funding new BI systems initiatives is an important capability for organisations to develop. It is strongly related to organisational learning and experimentation in organising, reporting, and analysing data [22]. The lack of embeddedness in this dimension indicates the margin for progress that many firms still have in relation to BI tools usage. This provides an impetus for more research in this domain.

Overall, the findings of the study show that the concept of embeddedness is valuable to BI practitioners and researchers. Much existing research focuses on individual systems and it has not obtained an understanding of the role of BI within organisations. It frequently has a narrow focus on BI technology rather than emphasising the use of BI by decision-makers making sense of their environments and coping with uncertainty [23]. The five dimensions of BI embeddedness provide a useful analytical tool in an undeveloped area of BI research [23]. Further research is required to better understand the dimensions of embeddedness and their use in practice and research.

5. Conclusion

This study explores the links between problem types faced by individuals and the dimensions of embeddedness of BI systems. Further research is needed to refine and improve the conceptual framework and additional case studies from different industry sectors and with different levels of BI maturity are required to better understand BI embeddedness and maturity. Such research is critical to inform practice and allow organisations to reach higher on the learning curve with BI tools in general.

References