From Analytics-as-a-Service to Analytics-as-a-Consumer-Service: Exploring a New Direction in Business Intelligence and Analytics Research

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Abstract

Business Intelligence and Analytics (BI&A) applications have been investigated predominantly within organizational contexts, with users in formal, normatively regulated roles. This research explores what happens when BI&A is taken out of organizational context and made available to consumers, rather than organizational (e.g. business) users. The paper offers an exploratory case study of such an environment called MySchool, providing highly sensitive data and business analytics tools to a wide range of consumers for more than four years. The paper identifies different types of information users in this environment and explores various (intended and unintended) consequences of their combined data-informed decisions and actions. Based on our research insights, we propose a new direction in BI&A research, extending and combining previous research in BI&A, Analytics-as-a-Service and Consumer Information Systems.

1. Introduction

In today’s information-intensive business environment, the combined need for relevant data, timely insights and data-informed value-adding actions has propelled the field of Business Intelligence &Analytics (BI&A) to the top of business and technology priority lists worldwide [1-3]. While rapidly advancing across all industry sectors, the latest developments, such as the emergence of big data, have not altered the main purpose of BI&A – that is decision support.

However, compared to decision-making support offered by more traditional business intelligence (BI), today’s needs and requirements of a wider range of decision makers have considerably changed. For example, there is a new requirement to support decision-making processes at all organisational levels, especially those of front-end customer-facing employees. “A goal in many companies is to make BI more pervasive, that is to put BI in the hands of more people, and thereby – democratize BI for the masses. This spread of BI is not only to employees but also to suppliers and customers”. [4, p.500].

The need to create decision environments for a wide range of information workers, enabling them to access data and perform analytical operations themselves, without or with minimal IT intervention, resulted in a new direction in BI&A, increasingly known as “Self-service BI”. Thus, “self-service BI is defined as the facilities within the BI environment that enable BI users to become more self-reliant and less dependent on the IT organization. These facilities focus on four main objectives: easy access to source data for reporting and analysis, easy-to-use BI tools and improved support for data analysis, fast-to-deploy and easy-to-manage data warehouse option such as appliance and cloud computing, and simpler and customizable end-user interfaces” [5, p.4].

The emerging trend of Self-service BI” is also consistent with another new development coming from the fast growing field of service science, with decision support increasingly offered as a service. For example, Delen and Demirkan [6] distinguish among “data-as-a-service”, “information-as-a-service” and “analytics-as-a-service” – representing three different types of service-oriented decision support. Thus, with “analytics-as-a-service” decision-makers can use analytic tools, typically in a cloud, wherever they may be located, in order to make sense of data (that could be also offered as a service). However, compared to data-as-a-service and information-as-service, analytics-as-a-service is less established and is considered to be an emerging concept in the business world, due to its complexity and very unique challenges [5].

Furthermore, the same service oriented thinking paradigm, has also captured interest of information systems researchers (beyond business analytics). They see the need as well as new opportunities to offer information systems as services, especially digitized services. More importantly for our research, the IS researchers now consider the challenge of offering those services no longer to organizational users (as it was the case with traditional IS) but to consumers. As
suggested by Tuunanen et.al. [7], “…we are entering a new era of consumer information systems. We need to start designing and developing systems for consumers as contrasted with users” (p.48). Taking IS outside of organisational boundaries from formal organisational ‘users’ to ‘consumers’ in a wider society, create many interesting research challenges, yet to be explored by the IS researchers [8].

Informed by the above emerging developments in BI&A (i.e. self-service BI), service science research (i.e. “analytics-as-service”) and IS research (i.e. consumer information systems), we set to explore a new type of BI&A environment, where data and analytical services are offered, not to organisational users in formal roles, but to consumers. This line of thinking was inspired by a real-life example of such an environment in Australia that has been offering simple, cloud-based analytics services to consumers, now for five years.

Using an exploratory case study, we aim to investigate what happens when the power of data and analytics tools has been given to a wider society and a very wide range of ‘information users’, who, through their data-driven insights and interaction, continue to create various anticipated and unanticipated actions (‘actionable intelligence’), with some resulting in serious consequences for a wider society, including human well-being. We offer an exploratory analysis of different types of consumers (‘information consumers’) that have been using this environment, types of decisions that have been making, and most importantly, a wide variety of positive and negative consequences that have emerged so far. Informed by our research insights, we propose a new direction in BI&A research, here named “Analytics-as-a-Consumer-Service”. We also identify and discuss other opportunities for future research in BI&A, as well as in information systems (IS) in general.

2. Foundation concepts and related work

2.1. Organizational BI&A Environment

In spite of a very wide proliferation of analytics applications, there is no single well-accepted and agreed definition of BI&A. According to Watson [4], “Business Intelligence (BI) is a broad category of applications, technologies, and processes for gathering, storing, accessing, and analysing data to help business users make better decisions (p.491). Another definition by Chen, et.al. [9] uses a generic term Business Intelligence and Analytics (BI&A), reflecting the current research and industry trend, with BI being gradually extended towards business analytics. Thus, BI&A includes “the techniques, technologies, systems, practices, methodologies, and applications that analyze critical business data to help an enterprise better understand its business and market and make timely business decisions. In addition to the underlying data processing and analytical technologies, BI&A includes business-centric practices and methodologies” [10, p.1166].

Both definitions extend the view of BI and BI&A beyond technology and both consider the main purpose of BI&A to be decision-making support. The same views are also adopted in our research.

Furthermore, while acknowledging that different organisational settings do require different types of BI&A support, Watson [10] proposes a widely used concept (framework) of a generic BI environment, describing a conceptual relationship between data sources, data repositories and BI applications. Thus, various source systems provide data that need to be prepared (extracted and transformed) before being uploaded to a decision support data repository (i.e. data warehouse and data marts). These repositories are then accessed by various users, using different tools and applications. Finally, the metadata, data quality and governance processes must be in place to ensure that BI continues to meet its intended business objectives.

For the purposes of our research, it is important to note that the concept of a generic BI environment is applicable to an enterprise-based BI and as such is intended primarily for organisational users (decision-makers) in different formal roles. For example, potential users may include: IT developers, front line workers, analysts information workers, managers, executives, suppliers, customers, and regulators [4].

Successful deployment of complex BI&A systems remains an important research and practical challenge. Consequently, many BI&A researchers continue to investigate various Critical Success Factors (CSFs). For example, prior research [10-15] identifies important CSFs such as executive support, the need to lead the project from the business side, full alignment with business objectives, change management including management of organizational resistance, well-defined project scope, effective project teams, user involvement during implementation, adequate resources, data quality as well as various technical issues including BI architecture and user-friendly BI tools. It is important to note, once again that, all these CSFs apply to organizational applications of BI&A.

So far, the mainstream BI&A research demonstrates a strong focus on organisational context and business users. However, the current literature remains silent on BI&A environments and applications used by consumers, especially those from a wider society. Thus, previous statement made by Tuunanen...
[7] about the mainstream IS focusing on end-users rather than consumers, does apply to mainstream BI&A research as well.

2.2. Self-service BI and Analytics-as-a-Service

The emerging area of Self-service BI offers a promise of more ‘pervasive’ BI&A with a wide-range of decision-makers from all organisational levels using data and BI&A with minimal (or without) IT support. In a recent international survey of TDWI industry community (with 587 survey respondents), Imhoff and White [5] identify that the main reasons for implementing self-service BI included constantly changing business needs, inability of IT to meet business user demands and the need to be a more analytic-driven organisation. The same report identifies three different types of “information workers” using self-service BI: information producers (also known as power business users), information consumers (i.e. task-oriented business users who gather information to make decisions or increase personal knowledge) and information collaborators who “improve the knowledge content and expertise of organisation as well as of other information workers (especially information consumers)” ([5, p.12].

In a related, still emerging area, broadly termed “service-oriented decision support”, researchers are investigating more flexible decision support enabled by the so-called ‘data-as-a-service’, ‘information-as-a-service’ and, the most complex, ‘analytics-as-a-service’ [6]. Both data-as-a-service and information-as-a-service are based on the same foundation idea that data (in any form or from any source) can be cleansed, integrated and made available to different systems, applications or users. Expanding this line of thinking even further to providing not only data, but also analytical tools, has resulted in the third type of service-oriented decision support in the form of “analytics-as-a-service”.

Delen and Demirkan [6] propose a high-level conceptual framework for service-oriented decision making where the ongoing, cyclical process of managerial-decision making is supported by service-oriented architecture, designed to provide all three forms of decision support services (data-, information-, and analytics-as-a-service). This is envisaged to enable more agility and flexibility in organisational decision making, by providing organisational decision-makers with much needed data and analytical tools they can use in their own contexts. Demirkan and Delen [16] also provide a conceptual architecture of service-oriented DSS, further expanding their earlier framework of service oriented decision support.

The promise of “analytics-as-a-service” has started to appear in the industry press too, with claims being made that with public clouds, analytics-as-a-service may solve big data’s big problems [17] or could be used to source ‘global analytical talent on the fly’ and in this way help alleviate a global shortage of qualified workers [18].

In summary, even on the basis of very limited research that is currently available, it is possible to observe that the targeted decision-makers for self-service BI and “analytics-as-a-service’ decision support are organisational users, working in complex but still normatively bound contexts, rather than consumers (e.g. members of a wider society). This is the aspect that we set to explore in our research.

2.3. Consumer IS

The third important trend related to our work could be found in the emerging area of Consumer Information Systems. (CIS) In their pioneering work Tuunanen, et.al. [7] define CIS as “systems that enable consumer value co-creation through the development and implementation of information technology enabled processes that integrate system value propositions with customer value drivers” (p.48).

Although still in early stages, CIS research challenges the traditional IS research, in several important ways. For example, in the mainstream IS research literature, users of information systems have been conceptualised as being mostly concerned with the effectiveness and efficiency of their work in formal organizational setting, while consumers seek a balance of utilitarian and hedonic utility [7]. “When developing consumer information systems (in contrast to developing information systems for organizational users), the over-riding focus shifts from efficiency and effectiveness to facilitating consumers’ service encounters and how they experience them [19].

Organisational users in formal roles are motivated to adopt and use IS in a very different way than consumers. Acknowledging that consumer context is very different from organisational context, Vanketesh, Thong and Xu [19] have recently extended their well-known Unified theory of acceptance and use of technology (UTAUT) in order to incorporate the concepts such as hedonic motivation, price value and habit – all relevant for the consumer context. In a related work, McKenna et.al. [8], propose a conceptual model to explain how information service components affect consumers’ potential adoption of such services.

In summary, the area of Consumer IS is emerging as an important future direction for IS research and practice. However, it is important to observe that so far CIS researchers do not distinguish among different
types of information systems. One could envisage that using IS for transaction management, seeking and sharing information or collaborating with others is fundamentally different from using for example, data or analytics (i.e. data-as-a-service or analytics-as-a-service) to make decisions. This is what our research is set to explore, looking at data and analytics used by consumers in their own contexts.

3. Research aims and objectives

Focusing on BI&A environments with analytics services designed for, and offered to, consumers (e.g. members of society), our study seeks to develop a better understanding of different types of information consumers and the nature of their information and analytical needs. We are interested to explore how they consume, generate and use information and analytics tools, in order to make decisions and take actions. Informed by the related literature and emerging industry developments, we focus on the following research questions:

- Who are the main ‘information consumers’ using consumer BI&A environments?
- How do consumers use data and analytics services?
- What are the known impacts of their data-driven decisions and actions (anticipated and unanticipated)?
- What are some new research challenges for BI&A researchers in this context?

4. Research context

Driven by the new education reform agenda to move towards ‘transparency in reporting and assessment’ the Australian Curriculum Assessment Report Authority (ACARA) launched the so-called MySchool web site/portal in January 2010 [20]. According to ACARA, MySchool ‘provides an important opportunity for everyone to learn more about Australian schools, and for Australian schools to learn more from each other’ [21].

MySchool can be seen as a simple analytics environment designed to provide detailed information about all schools in Australia (currently 9500 schools), along with easy-to-use analytical tools enabling interested parties to analyse provided cloud-based data. When launched in January 2010, this environment provided two sets of data for 2008 and 2009. Currently in its fifth year of operation the platform provides 6 years worth of data and has undergone a number of enhancements based on the received feedback. However, its main objective has remained the same and that is to provide information to the Australian public about the performance and resources of 9500 schools across all states and territories. “MySchool enables parents, school leaders and their communities, educators and members of wider community to: search for schools in their local areas or from any part of the country; view school-level NAPLAN results; compare statistically similar schools; identify schools that are doing well and share successful strategies” [22, p.1.].

The data provided by MySchool are collected in several different ways. When enrolling a child parents are asked to provide information about their education and occupation. Additional sources of data are sourced from the Australian Bureau of Statistics (ABS), including for example, ABS census of population and housing data for different areas. Each school is also required to provide financial data, including recurrent income, capital expenditure (presented as a total figure and an average amount per student). Furthermore, a school profile page includes information about student enrolment, attendance rates as well as staff numbers, used to determine school’s student/staff ratio. Each school is given an opportunity to provide very brief qualitative information about its context, values, ethos, programs and main achievements.

However, by far the most controversial and, many would argue, the most important of all MySchool data are the results of the so-called NAPLAN test. This is an Australia-wide test in literacy and numeracy, administered at the same time, in Years 3, 5, 7 and 9 in all schools in Australia. The tests are conducted in teacher-supervised classrooms with students’ answer booklets collected and sent to a central government authority/reporting agency. ACARA then analyses and records the results in a database. Within approximately 5-6 months students get individual reports on their performance while their school gets a comprehensive report showing the overall performance of its students. Most importantly, soon after, the results of all schools go online and are made available on MySchool.

In addition to data, MySchool also provides easy-to-use analytical tools enabling users to search and compare various aspects of school and students performance over time. The outcomes of these operations are shown in simple visual forms to facilitate better understanding. For example, users could see and re-order various lists (by clicking on the column titles), look at graphical comparisons (e.g. showing the whole school in relation to the national average), or geographical maps of up to “20 schools that are geographically closest to the selected school”.

In order to enable meaningful comparison of students in one school with students in another school, as well as grouping of similar schools (of up to 60 schools), the reporting agency (ACARA) developed an Index of Community Socio-Educational Advantage,
specifically for MySchool, i.e. the ICSEA index. Development of this index was based on related research showing that family educational and professional background factors (i.e. parents’ education level and occupation) are closely related with student educational outcomes. Consequently, each school is given an ICSEA value on a scale which has a mean of 1000 and a standard deviation of 100. For example, a value around 500 represents extreme disadvantage and up to 1300 represents high advantage.

Finally, aiming to provide useful and reliable financial information, as well as enable meaningful comparison of financial data, ACARA has developed a financial methodology specifically for MySchool. The methodology takes into account the location, type and size of each school, its programs and operations.

A very extensive literature review on MySchool-related research conducted by the author, confirms that this interesting and highly controversial environment continues to attract attention of a growing number of very diverse researchers. For example, so far they come from the education, social sciences, cultural studies, political studies and policy research areas. To the best of the author’s knowledge, the same or similar consumer BI&A environments remain unexplored by the BI&A research community.

We argue that BI&A is best positioned to provide research-based insights related to data, analytical tools and practices used in these new BI&A-environments. At the same time, we envisage that these environments are likely to create new research challenges for BI&A, not previously encountered in organisational environments where our research efforts have been focused so far. Our research aims to identify and explore these new challenges, setting the foundations for this new and important direction of BI&A research.

5. Research method

In line with the exploratory nature of this research, we adopted a research case study as the most appropriate research method because “the research topic is new and the published research is still emerging” [23]. A case study is an empirical inquiry that investigates a contemporary phenomenon within its real life context when the boundaries between phenomenon being studied and context are not clearly evident [24]. Case study is an ideal methodology when a holistic, in-depth investigation is needed [25]. Our research could be classified as interpretivist rather than positivist case study research, based on the criteria proposed by Orlikowski and Broudi [26, p.5].

Therefore our aim is to increase understanding of the phenomenon within its contextual situation, from the perspective of the participants without imposing our a priori understanding of the situation. We assume that “access to reality (given or socially constructed) is only though social constructions such as language, consciousness, shared meaning and instruments [23].

While collecting data, we also observed some important limitations of more traditional data collection methods used in interpretivist case study, research such as semi-structured interviews of the subjects. These methods are highly suitable for organizational context, while our research context is much broader and spans many organizations (including 9500 schools) as well as the whole society at large, with a very wide group of stakeholders. Any attempt to interview a subgroup of relevant participants, would only lead to a partial, and thus incomplete, perspective. This is why we decided to collect and analyze published documents and reports, media articles published over the past 4 years, as well as publicly available data previously collected in various surveys and interviews, conducted by government agencies, teachers’ associations and unions and other researchers focusing on, for example, on teachers performance, media reporting and even society issues and human wellness. As a proxy for interview data, we also analyzed over 270 submissions to two Senate (Parliamentary) inquiries (2010 and 2014), by a very wide range of self-selected stakeholders, sharing their narratives of MySchool-related challenges in their own contexts, as well as the two resulting Senate reports [27, 28]. We also downloaded and analyzed data from the ACARA’s and MySchool’s Twitter channels (using #NAPLAN and #MySchool search), posted over the past 4 years (Jan 2010 – May 2014), as well as data posted by teachers, school principles and parents on various public online forums and discussion boards. We also considered all documents made available on the MySchool web site (including user guides, frequently asked questions, help documents, video clips and press releases). Finally, we explored MySchool analytics environment from the BI&A perspective, with the author taking a role of a consumer.

When analyzing the collected data, we used the stated research questions to guide our interpretation of a very wide range of data sources, identify different perspectives and establish relationships among different stakeholders and their actions. However, our thematic analysis was not conducted in a rigid way, with the researcher being open to new insights “not fitting” the stated questions and willing to modify their own initial assumptions as recommended by Walsham, [29]. The following section describes our main findings.
6. Findings

Even in its fifth year of very extensive use, under two Federal governments, MySchool continues to attract nation-wide attention. This is due to various challenges that in essence could be traced back to highly sensitive nature of data being provided and different ways these data have been analysed, interpreted and used by a wide range of interested parties (consumers), not in isolation, but in a complex, highly intertwined way.

Looking from the BI&A perspective, MySchool could be considered a complex BI&A environment, with its use of data and analytics fitting the previously cited definition of BI&A. Although ultimately owned by the Australian government and regulated by a government agency (ACARA), this environment has been designed to operate, not in a formal organisational environment, but in a wider society. In addition to its data (i.e. “data-as-a-service”), MySchool’s simple analytical tools could be classified as “analytics-as-a-service”. Moreover, because these tools are being offered to a wide range of intended and unintended consumers rather than organisational users, we classify them as “analytics-as-a-consumer-service”.

As previously stated, Imhoff and White [5] identify three different types of users of self-service BI: information producers, information consumers and information collaborators. Similarly, Watson [30] distinguishes between information producers and information consumers. Our analysis of MySchool environment, spanning the period of over four years (Jan 2010 – May 2014) shows very diverse categories of information users/consumers and data-informed decision makers - all mutually shaping and influencing their individual and collective use of data, including generation and interpretation of analytical insights.

First of all, MySchool web site was originally intended to provide transparency and inform various key decision makers involved in the national educational system, including Federal government, parents, teachers, school principles and government agencies. However, this list of intended decision-makers expanded very quickly to include a whole range of unintended ‘information analysts’ and other stakeholders making sense of data for their own purposes. The following list offers the most prominent categories of a still-evolving list of information users and illustrate their changing roles, shaped by data and analytics services.

- Media: First Consumers of analytics-as-a-service -> Information producers -> Decision intermediaries

As soon as the web site was officially launched, providing data from 2008 and 2009 NAPLAN results, what followed was unprecedented media frenzy across all domains of the Australian media (state and national). For example, just within the first 6 months of this web site ‘going live’, over 1000 articles and editorials were published by national and regional newspapers, of which more than 480 with MySchool as primary focus [31]. The most prominent use of data and analytical tools by media, was to produce and publish the so-called league tables, with schools and even teachers being labeled as ‘good’ or ‘bad’. Going even further than this initial “information producer” role, media embraced a mission to “empower” parents through sharing of this information, helping them to make important decisions (thus assuming the role of ‘Decision intermediaries’).

Furthermore MySchool was championed as a tool for change, that might force teachers and schools to ‘lift their game’ by making their performance public [32]. Those who argued against the conversion of data into league tables (mostly teachers, parents and educational researchers), mainly on the grounds that it would potentially reinforce social and cultural disadvantage, were positioned as unwilling to embrace data transparency and commit to improvement [31].

Assuming “the voice of public, free of educational jargon’ and empowered by “objective, measurable and reputable data” [31] Australian media even went to proclaim their role in revolutionizing education. “MySchool and the NAPLAN tests on which it is based and media analysis will revolutionize education by making it possible to base decisions on data not on the education establishment’s dogma [33].

- Parents: Consumers of analytical insights -> Consumers of analytics-as-a-service -> Information producers

Although intended to be among the primary consumers of data and ‘empowered’ to perform simple data analysis by using the provided analytical tools, parents started using MySchool not as “information or service consumers”, but as “consumers of analytical insights” produced by media. Numerous data sources (including newspaper articles, twits, blogs, discussion forums and a very large number of submissions to two Parliament inquiries) show that parents consumed media insights very quickly. What stands out are the reported last-minute decisions and subsequent pressure to move children from ‘bad schools” to better performing schools, within days of MySchool going alive and school leagues being published in the national press. In addition to making those decisions
‘informed by objective data’, they also started to put pressure on ‘non performing schools, principles and teachers’ to improve quality of ‘service’. “Parents as consumers are being taught to read the abstract data to interrogate ‘good teaching’” [34, p.137].

However, judging by the number of submissions made by parents to two Senate inquiries, as well as recently published study on MySchool’s effects on stakeholders’ wellness [35], parents have had difficulties dealing with serious consequences of decisions being made by others and data-reinforced perceptions. These consequences included, for example, direct and negative effects on their own, and the wellbeing of their children being stigmatized as ‘coming from bad schools’ or with parents not being able to offer “better education” to their children.

Over time, having mastered simple analytical tools, some parents emerged as ‘information producers’ i.e. analyzing data to produce their own insights and interpretations of data and sharing them on social media to inform other parents. Looking from the BI&A perspective, this could be interpreted as sharing of analytical insights and collaboration to collectively make sense of available data.

- **Teachers:** Information Consumers -> ‘Data influencers’

Teachers were originally expected to use MySchool to assess the performance of their schools and benchmark their own performance. However, according to recent research by Mocker [31] who completed an extensive analysis of more than 400 newspaper articles and editorials, teachers’ ongoing concerns about “data-driven” assessment of complex education practices have been portrayed in a very negative light. This is because teachers are perceived to act in self-interest, fearing that own inadequacies could be exposed through data. “By accumulating data (tests) and analyzing that data to produce patterns, the database produces information that has consequences for those whose names are associated with the captured data”. [34, p.137]. Even new terms are being created by the Australian teaching standards, such as ‘Highly accomplished teacher’ or ‘Lead teacher’, to distinguish different performance levels.

The new reality of being evaluated on the basis of published data, but without any insights into teaching that “produced” these data, started to change in-class practices of teachers. In a survey completed by the Australian Secondary Principals’ Association, many teachers reported on “teaching to data” [36].

Furthermore, while many, if not most, teachers will attempt to maintain their integrity in the face of the system that does not value integrity, “increasing numbers of teachers are responding by manipulating the data” [34, p.137]. They engaged in practices that would influence data used to measure the outcome – hence “data influencers”.

The reported examples of these practices included: preparing the classrooms (with posters, charts and other visual prompts), reviewing the answers with students before submission and changing the curriculum to focus on NAPLAN-like tests [34, 36]. Some even engaged in strategies of “preparing the population” identifying students who are likely to have negative effect on NAPLAN results and using different tactics to exclude them from the test. For example, they would suspend ‘troublemakers’ [37] or encourage students with learning difficulties or recent migrants to stay at home to protect them from negative results [37-39]. To encourage positive impact, reported strategies include encouraging parents to buy preparation materials and enroll students in special (paid) NAPLAN classes [40], free breakfast during NAPLAN week and free transport to school for high-achieving students [39,40].

Taken together, the above actions illustrate serious consequences described as ‘a shift from caring about students to attention to the data” [31, 34, and 36].

- **School principles:** Information Consumers and Generators -> ‘Data Influencers’

Similar to teachers, school principles appear to share the same mistrust by the wider society, as they are also perceived to be driven by self-interest [31]. “Bureaucrats and principles of poor performing schools will not be able to use the social or economic poverty of their school community as an excuse for failure. They will be forced to look at how they resource and teach their students and justify their efforts” [41].

In addition to being avid users (consumers) of data and users of analytical tools, instrumental in providing NAPLAN data to the government, they are also given a very limited opportunity to provide (generate) additional (qualitative) data about their schools, including schools values and major achievements. As MySchool data are perceived as ‘objective’ and obtained through a systematic process, school principals are not given any other opportunity to provide any other contextual information that might be useful to inform data interpretation of various “information consumers”. However, similar to teachers, schools principles could be also seen as ‘information influencers’, with their practices being influenced by data, and consequently modified in order to influence data. For example, admission criteria are now influenced by NAPLAN results with schools making decisions to admit better students, in order to maintain or increase their performance [31, 36].
- **Industry analysts**: Emerging “Information Aggregators

The increased popularity of some schools, fueled by published insights (e.g. school leagues) and the subsequent decisions made by parents to enroll or move their children to better schools, have created further unintended consequences. For example, various industry analysts (e.g. financial and real-estate experts) have joined public discussion, providing their own analysis of data, even claiming the expected influences of MySchool data on real-estate prices, see for example [42]. They claim to base their insights on a combination (aggregation) of MySchool data with their own industry-relevant data (e.g. financial data), not available to wider public. Consequently, these industry analysts are assuming the role of ‘information aggregators’, producing additional insights and further influencing other “information consumers”.

In addition to the above main categories of information users, various government agencies and political parties, continue to use the MySchol data and produce their own insights, in order to debate future educational reforms determine school funding and assess performance improvement, all in the spirit of “accountability” and “transparency” provided by this environment.

However, the most recent Senate report [28], illustrate a brand new role of ‘regulators of analytical tools’. More precisely, having recognized the ongoing impact of data and shared analytical insights, rather than restricting access to data, a recommendation has been put forward to restrict access to analytical tools or remove some of them to prevent further analysis and publishing of school leagues. As MySchool remains in operation, one could envisage new developments and the emergence of new information-related roles.

**7. Discussion**

The previous case study illustrates what happens when highly sensitive data, taken to represent very complex knowledge-intensive practices (teaching and student learning), are made available to a wide range of consumers (without any insights into original context), along with simple analytical tools (analytics-as-a-consumer-service) so they can create their own insights in their own individual contexts. Obviously, this is very different from an organizational BI&A environment, with enterprise data and analytical tools being provided to people in formal organizational roles, sharing the same organizational context (including norms and policies) and acting in their professional capacity, with many trained to analyze data from multiple perspectives. While in an organizational context, users of analytical tools may or may not share their insights, our case illustrates that sharing of individual or collective insights becomes an important feature of MySchool. It is used to inform, influence, “empower”, “exercise the consumer rights to know” or even, “revolutionize” the very practices these insights are taken to represent. Furthermore, compared to the concept of “analytics-as-a-service” [6] where services are consumed by individual (independent) users, the example of MySchool illustrates that these services are no longer individual but continue to influence and shape each other, though a very complex and evolving network of information consumers, providers, influencers and aggregators.

With ‘performance rating systems’ being widely used to publicly rate various services (including knowledge-intensive ones, such as rating of medical specialists), one could ask what is so different about MySchool. First of all, rather than using “opinion-based data” such as customer-based rating, MySchool provides data that are perceived to be “highly reputable”, “trust-worthy” and “objective” because they are collected though a systematic process undertaken by a government agency. Another difference is in analytical tools being made available, so that consumers could create their own insights. However, these insights are not made in isolation and their sharing, for example via public forums, continues to create new insights. Additionally, insights such as “school league tables” are even changing the practices to “fit the data” or to “influence future data”.

Furthermore, in an organizational BI&A environment, a central data repository (e.g. data warehouse or data marts) is used to enable “single version of truth”. In the case of MySchool’s shared data repository different contexts, different personal, professional and political agendas, different abilities to analyze and make sense of data, as well as mutually influencing insights and actions, continue to fuel what could be best described as “multiple versions of truth”. Also, rather than from a single organizational context, Myschool data originate in many organizational contexts (i.e. 9500 schools) and are collected by a reporting agency, with the overall process overseen by yet another formal organization (i.e. Federal government).

To inspire further BI&A research, we put forward a number of BI&A-related research challenges. First of all, the MySchool environment requires us to reconsider the framework of a BI environment. This is necessary in order to capture different organizational contexts and a complex network of interactions and responsibilities for MySchool’s implementation and use in a wider society.

The existing research on CSFs of organizational BI&A systems also needs to be extended. For example, widely discussed CSFs such as executive sponsorship, resource availability, and change management are no
longer suitable for consumer-oriented BI&A environments such as MySchool.

Furthermore, the research challenge of data quality also deserves further attention of BI&A researchers. In fact, data quality has been identified as one of the key challenges of this evolving environment [27, 28]. Potentially, this may lead to development of new data quality methodologies that are more suitable for multi-organizational environments such as MySchool.

Similarly, data-related ethical challenges appear to be much more complex than in organizational environments and may require further extensions of the well-known and long-standing ethics frameworks, such as the PAPA (“Property, Accuracy, Privacy and Accessibility”) framework [43]. For example, the ethical challenge of accessibility goes beyond “access to data” to include “access to analytical tools” (proposed to be restricted [28]). Data ownership is also extended to ‘ownership of insights’, that is very important because ownership implies responsibility. Finally, rather than considering “data accuracy” (e.g. accurate financial figures), this case illustrates the need to carefully consider suitability of numerical data to represent (and thus inevitably simplify) complex practices, such as education. As our case illustrates, once this representation is being made, data are used outside of their original context and further propagated as representative and therefore taken as accurate.

Finally, consumer-focused analytics environments such as MySchool also bring an interesting perspective to the previously described Consumer Information Systems research [7]. Rather than focusing on IS offered as digital services [8], analytics services require us to “decompose” IS and consider its data and analytics tools, individually and in combination. Consumer adoption of data and analytics services is likely to bring an additional perspective to previous research on consumer adoption of IS [19], due to mutually shaping ways of adoption of tools and data-driven insights.

8. Conclusions and future work

Inspired by the real-life case of a complex analytical environment offered to consumers, this paper sets of explore what happens when data and analytical tools are made available to a wider society. The paper describes an exploratory case study of such an environment called MySchool, taking the BI&A perspective. While MySchool has been the main focus of a growing number of papers published by researchers in education, social science, political, policy and cultural studies, the BI&A literature remains silent on consumer BI&A environments.

Based on insights obtained, we propose to extend the existing concepts of BI environment, self-service BI and analytics-as-a-service - all designed for the organizational setting towards a new category of “analytics-as-consumer-service”. Our current and future work focuses on previously identified research challenges, with an objective to provide a much-needed BI&A perspective.

This paper is limited to one case study and is informed by (very comprehensive) secondary data. As per principles of case study research, focusing on one case study is acceptable [23-24] as we do not aim to generalize research insights. Instead, our exploratory research could be considered as an important starting point towards a more informed research-based discussion about analytical environments open to the public and their expected and unexpected consequences. With various open-data projects being promoted by governments all over the world, new environments like MySchool are likely to become a common practice in the near future, and therefore deserve our collective research attention.

9. References


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