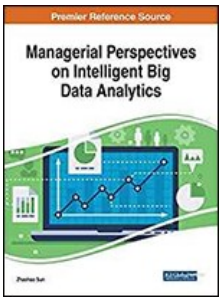

Managerial Perspectives on Intelligent Big Data Analytics

by Zhaohao Sun

Chapter 13: The Impact of Creating a Business Intelligence Platform on Higher Education: The Case of the American University in Cairo

Sherif H. Kamel,
The American University in Cairo,
Egypt
https://orcid.org/0000-0002-2758-3766

Iman Megahed,
The American University in Cairo,
Egypt

Heba Atteya,
The American University in Cairo,
Egypt

ABSTRACT

In today's ever-changing global environment, the higher education industry is facing many diversified and evolving challenges and its landscape is becoming more competitive, dynamic, and complex. To proactively operate in such a changing and complicated environment, innovation, creativity, information, and knowledge represent key competitive edges that need to be introduced, cultivated, and managed effectively. The American University in Cairo (AUC) is a leading institution of higher education in the Middle East North Africa (MENA) region that recognized early on the power of knowledge and the need for a paradigm shift in management that capitalizes on innovative information and communication technologies. Accordingly, the university embarked on an ambitious journey as the first higher education institution in Egypt to build a state-of-the-art business intelligence (BI) platform that would support proactive, informed decision-making as a distinctive and sustainable competitive advantage.

INTRODUCTION

In an age where organizations are constantly in quest of competitiveness through innovation and transformation, business intelligence (BI) becomes mandatory for organizational effectiveness. This is true for organizations of all forms, sizes and industries, profit and non-profit, small, medium and large, as well as different types including government, private and public sector organizations, including academic and higher education institutions such as university settings. Moreover, it is invaluable for all organizational levels whether strategic, operational and/or tactical. The reason being the impact BI has on the quality of the organization's decision-making process. BI creates a conducive organizational context to make better and more rational decisions by availing a comprehensive view of organizational data that would allow executives, middle managers and others to be more informed and build their decision making processes on timely and analyzed data to be more certain and accurate of the decisions made (Rouhani, Asgari, & Mirhosseini, 2012).

The role of BI is to create an informational environment with supporting processes by which operational data is gathered from transactional systems and enterprise resource planning (ERP) systems to be analyzed for strategic business and organizational insights. This is where the concept of an *"intelligent organization"* appears as one that deploys BI to enable faster and smarter decisions than its competition to create a sustainable competitive advantage. Accordingly, the *"intelligence"* element results from the transformation of huge volumes of data into information and knowledge through mechanisms for filtering, analysis and visualization, in support of the decision making process and corporate strategy tracking and progress (Gupta & Singh, 2014).

Despite the significant impact BI has in supporting informed decision making, strategy management and organizational success, the literature shows that there is a lack of agreement on the definition and real and effective implications of BI (Shollo, 2013). Based on the literature review conducted, following are some key definitions stand out and help illustrate the nature and scope of BI. For example, BI was defined as extracting the information deemed central to the business, and presenting or manipulating that data into information that is useful for managerial decision support (Gibson, Arnott, & Jagielska, 2004). Another definition suggests to perceive BI as combining data from operational systems with analytical front-ends to deliver timely information when decisions need to be made (Negash, 2004). However, in 2008, Baars and Kemper generalized the definition to encompass all components of an integrated management support infrastructure. Moreover, in 2010 Wixom and Watson defined BI as a broad category of technologies, applications, and processes for gathering, storing, accessing, and analyzing data to help its users make better decisions.

In 2011, according to Fitriana, Djatna, & Eriyatno in their analysis of the progress of BI systems, they defined BI as a process

for extracting, transforming, managing and analyzing large data to gain information and knowledge that can support decision-making; and in 2014 Uma and Sankarasubramanian identified BI to be the ability to collect and analyze huge amounts of data pertaining to the customers, vendors, markets, internal processes, and the business environment. Therefore, from these various key definitions one can conclude that BI was initially used as a collective term for data analysis abilities, tools, techniques, technologies and solutions used in transforming data into knowledge. However, this understanding with time was broadened to include all the various components and processes associated in using information and analyzing them in order to create an integrated decision support infrastructure. It is important to note that the objective of all BI infrastructures and systems is defining the fundamental direction of an organization by supporting the decision-making process and helping different organizations to forecast the behavior of competitors, suppliers, customers and environments to differentiate themselves, and compete in the global economy (Wieder & Ossimitz, 2015).

The evolution of BI and its dynamic and iterative nature makes it more agile, invaluable and increasingly demanded by various organizations given the added-value it brings to each organization's different constituents. In many ways, the definition that mostly represents the true nature of BI is the one offered by Garner Group which indicates that "business intelligence is an umbrella term that includes the applications, infrastructure and tools, and best practices that enable access to and analysis of information to improve and optimize decisions and performance" (Gartner, n.d.).

The experience of the American University in Cairo (AUC) BI platform to date demonstrates a set of lessons learnt that could be of invaluable use to organizations in the space of higher education and the objective is to understand the implications of business intelligence on academia. The early added-value demonstrates that on a strategic level, the availability of a cutting-edge BI platform unleashed the power, depth and magnitude information can have in transforming and positively impacting a non-profit institute in higher education that is celebrating its centennial in 2019 into a modern information-based and technology-driven university that is passionate, eager and has the appetite to explore, discover and capitalize on all forms of knowledge creation and dissemination in the decision-making process both academically and administratively. This includes the ability to have a timely, accurate and efficient platform that can enable decision makers both faculty and staff to manipulate the data, better understand the organizational dynamics, and develop predictive scenarios to mention a few and accordingly, take better decisions.

These decisions can relate to every academic and non-academic aspect on campus in the form of a variety of dashboards covering different data elements including, but not limited to, campus demographics, budgeting, planning, procurement, students' enrolment, faculty evaluations, staff assessment, performance appraisal, research output, teaching records, and different services offered. In other words, at a time where BI is growing in use and impact, the volume, velocity and variety of data have changed and continues to change reflecting elements that relate to governance, privacy and security challenges which are generating a new level of concerns from faculty, staff and administrators, AUC included (Boutlon, 2013).

The journey started by assessing the university's current status on BI maturity curve, defined its goals and targets and set out a strategic plan to accomplish it expeditiously and efficiently. The journey was faced with challenges such as settling on the most suitable landscape, identifying the technical specifications and sizing of the solution, selecting the architecture (full stack, multi-vendor, on-premise, on-cloud or a hybrid solution); selecting the right tools that fit the university's needs from a wide pool of tools currently available in the market; identifying the best practice project management implementation; regularly tracking and assessing the progress for improvement and most importantly identifying, recruiting and preparing the much needed human capital to transform the space of decision-making. This represented the technology side of the project but the real challenges were represented by a series of elements inherited in the university's environment and culture which required a clear strategy supported by the university leadership, a suitable governance structure; excavating for the suitable talents from within the university to help build a knowledgeable BI team; and finally availing an understanding of BI as a journey and managing the different stakeholders' expectations.

Two fundamental challenges that faced AUC included the readiness of the university population to understand the power and advantages that could be offered through the BI platform as well as the data cleansing effort across campus to reflect the most timely and accurate data infrastructure possible and integrate it with BI. Both elements represented challenges that required several orientation sessions and workshops for faculty and staff across campus and representing different units, departments and schools to understand how BI can affect their work. As for the data infrastructure, it is still work-in-progress and needs a regular and rigorous maintenance given the constant changes in the various data elements.

THE EVOLUTION OF BUSINESS INTELLIGENCE

The diversity in BI definitions reflects its long history and evolution. Looking back, it is clear that BI grew out of the concepts and technology initiated by decision support systems (DSS) in the 1950s and still deployed today in many organizations to support individual and group decision making leading to competitive advantage (Heang, 2017; Kamel, 2008; 2013).

In 1958, Hans Peter Luhn, an IBM researcher in his paper "a BI system", was the first to describe an "automatic method to provide current awareness services to scientists and engineers" (Shollo, 2013) in support of researchers to cope with the

expanding scientific and technical needs. These concepts continued to evolve until the 1990s when the term became widely adopted. To fully understand the concepts of BI, a review of the historical background and evolution of DSS to BI is necessary (Shollo, 2013). The introduction of the mainframe computer in 1950s was the starting point for all data processing systems and, eventually led to the evolution to management information systems (MIS). In the mid 1960s, DSS came into the scene. Until that point, MIS reports were basically large data lists and reports with no interactivity or visualization tools that would support executives and managers in their decision-making (Kamel, 1992). DSS were more accommodating in their ability to support decisions in a more interactive manner. The late 1970s witnessed the introduction and wide adoption of relational databases and stronger modeling practices which allowed the capture of larger quantities of data and the arrival of executive information systems (EIS) with more advanced support of decision-making for executives (Shollo, 2013; El-Sherif & El-Sawy, 1998).

Despite the presence of EIS and DSS as decision support tools, the amount of manual intervention needed to transform and upload data from multiple sources led to limited adoption and exacerbated the need for more advanced information infrastructures (Shollo, 2013). Consequently, by the 1990s, data warehousing concepts appeared with their on-line analytical processing (OLAP) and extract transform and load (ETL) tools. These tools were integrated under one umbrella term introduced by Howard Dresner of the Gartner Group in 1989 to include the set of concepts and methods used in enhancing decision making (Rouhani et al., 2012). Accordingly, BI replaced EIS as well as DSS as the primary decision-making platforms. BI, as we know it today, can initially be attributed to the extensive research behind decision support systems (Kowalczyk, Buxmann, & Besier, 2013). This research shaped BI to become the umbrella that integrates all relevant techniques, processes and technologies. It extends beyond internal and structured data to external and unstructured data needed for decision making (Shollo, 2013).

Business Intelligence and The Impact on Organizational Performance

Today, organizations around the world are facing many unprecedented challenges alongside continuously shortening business cycles. To gain competitive advantage, their need for good, reliable, accurate and timely data, information and knowledge has become a necessity for decision-making at different organizational levels including strategic, operational and tactical (Turban, Sharda, & Delen, 2010; Karen Loch et al., 2003).

With the improvement and emergence of innovative information technologies, the BI infrastructure has been able to provide this set-up through effective data collection, transformation, representation and analysis. Using BI managers can sift through massive quantities of data and only be exposed to knowledge and insights to identify key patterns and historic trends quickly (Raisinghani, 2004). BI has become one of the vital technological and innovative developments to impact modern organizations and a cornerstone in business decision making mainly through stimulating the diffusion of knowledge (Heang, 2017). S. and W. Williams addressed the impact of BI on organizational functions. Accordingly, the main quantifiable impact they pursued was the "change in value added", basically a return on investment (ROI) of BI implementations (Williams & Williams, 2003).

To be able to quantify this impact, in 2006 T. H. Davenport and J. G. Harris conducted a survey among 371 large and medium-sized organizations and found that "a high level of analytical competence had a positive impact on organizations' financial results" (Tunowski, 2015). The literature reports many potential advantages of successful BI implementations such as: having a single point of access to data; timeliness and reliability of the data results; customer-centric approach applicable to different organizational levels and departments; leveraging investments in ERPs; well-informed human capital; and ultimately better decision-making. These elements eventually lead to improving operational efficiency; reduction of waste and costs; effective relationship management with customers, suppliers and key stakeholders; improved stakeholders' communication; and enhanced market analysis, more profits and improved overall performance. All these elements and more represented some of the items in the initial action plan that AUC worked on in order to kick-start the BI experience on campus with the most relevant and effective ecosystem possible.

On a wider scope, the real and indirect potential of BI implementations is that it triggers a "series of changes that involves the entire company – from strategic to tactical structures – and penetrates into operational work, improving and increasing the efficiency and effectiveness of the organization" (Williams & Williams, 2003; Ludoslaw & Remigiusz, 2013). In the context of AUC, the changes were many and different including developing new processes, hiring human resources with the required expertise, redefining the data owners, and restructuring the Data Analytics and Institutional Research (DAIR) unit on campus to cater for the evolving mandate, objectives and targets of the BI platform. This powerful yet hidden transformation is the true force successful BI implementations have on organizations with no exceptions. These organizational developments emphasize the importance and impact of effective and well-thought BI infrastructures on organizations. However, it is worth noting that to date BI implementations are complicated and expensive in nature with high failure rates reported (Gartner, 2005).

Business Intelligence Implementation Critical Success (Enabling) Factors

In 2012, according to Gartner "less than 30% of BI initiatives will align analytic metrics completely with enterprise business drivers by 2014" (Gartner, 2012). As organizations must learn from failures to ensure success, a review of critical success

factors mostly associated with BI implementations was imperative (Tunowski, 2015). The literature has an abundance of success factors, but some are more critical than others to the success of a BI project. These factors include organization readiness for transformation and change, culture for information-based decision making, BI implementation goals, strategy and project planning, human capital availability, leadership support, and quality of data and data governance. These factors need to be in harmony and alignment with the BI project for a successful implementation.

Business Intelligence Applications With a Focus on the Higher Education Industry

BI has been widely applied to many industries, businesses and economic sectors to capitalize on the positive results and improved decision-making through enhanced forecasting and planning; customer and market analysis; channel analysis and product profitability analysis. These industries include (a) banking and financial institutions where BI is used in the identification and clustering of the customer base. BI informs marketing strategies, aids in preparing performance metrics and benchmarks and tracking performance; (b) fast moving consumer goods (FMCGs) and retailing where BI harnesses the power of predictive analysis to forecast demand fluctuations through understanding consumer behavior; optimize manufacturing and supply chain processes and enhances stakeholder relationships; (c) distribution and logistics where BI has the ability to improve communication with stakeholders and business partners resulting in more efficient and effective operations; and (d) services where BI plays a key role in managing human capital, a critical resource for performance in this particular industry. It also enhances stakeholders' relationships in general as well as render organizations more effective and efficient.

CASE STUDY: THE AMERICAN UNIVERSITY IN CAIRO

The American University in Cairo (AUC) was founded in 1919 by a group of Americans devoted to education and service in the Middle East. Its founding president, Dr Charles R. Watson, wanted to create an English-language university based on high standards of conduct and scholarship and to contribute to the intellectual growth, discipline and character of the future leaders of Egypt and the region. AUC was located on a nine-acre campus in the heart of downtown Cairo, a city of more than 18 million people and the largest urban area in the Middle East and North Africa. In 2008, AUC relocated to a new suburb of the capital "New Cairo" where it established a new 260-acre, state-of-the-art "city of learning", designed to embody the university's liberal arts tradition and provide room for growth.

AUC is an independent, not-for-profit, equal-opportunity institution offering American-style liberal arts and professional undergraduate and graduate education to students from Egypt, the region and the world. In Egypt, AUC is licensed to grant degrees and is incorporated within the State of Delaware and accredited by Middle States Commission on Higher Education (MSCHE). Its academic program enrollment has grown to over 5,474 undergraduates and 979 graduate students (DAIR, 2017). Adult education has expanded and now serves more than 24,000 participants each year in non-credit courses and contracted training programs. 95% of students are Egyptian; the remaining 5% comprised of 49 different nationalities. The university academic endeavors are led by 475 full-time faculty members, 55% are international.

AUC Infostructure

AUC has been heavily investing in building its information infrastructure "infostructure" and in introducing a state-of-the-art enterprise resource planning systems since 1988. This emphasis on technology was to ensure that mission critical and precious data was stored in well-structured formats and to facilitate the automation of its various business processes. Over time, these systems have continued to amass large amounts of data. However, leveraging this humongous amount of data to generate insights has constantly been side tracked due to the following factors which, combined, paved the way for inconsistencies, redundancies and many different versions of the truth. Some of the lessons learnt in the case of AUC includes;

- The lack of an institutional strategic information technology roadmap resulting in multiple, non-integrated systems.
- Data scattered in separate silos and a term-based, off-line data snapshot called *"census"* is the only source used for official reporting.
- Ambiguous and conflicting data governance rules, data definitions and best practice business processes to regulate data standardization and cleanliness.
- Integration across the different systems not accounted for in ERP implementations posing a major challenge for consolidated data views.
- Immature organizational culture in terms of data sharing, transparency and evidence-based decision making.
- Data gaps preventing a holistic view of key stakeholders' records including students, faculty and staff.
- Spreadmarts became prevalent culture for reporting on all levels.

- No leadership in terms of information management, organizational development, information for business; looking only at technological issues through technical expertise.

However, AUC had a strong Data Analytics and Institutional Research (DAIR) team that was aware of the problem and its implications on effectiveness, agility and competitiveness of the university. DAIR was established in 1991 to support the university in strategic planning, assessment, data and analytics functions to advance the university's mission, promote institutional effectiveness and informed-based decision making. As the clearing house for the university data, the office is committed to a process of transparency, a culture of evidence and open communication in which information is made widely available to the campus community, as well as facilitating the flow of information between the central administration and campus units. In 2016, the office started its BI journey to further advance its mission and was rebranded as *"strategy management and institutional effectiveness"* to reflect its active strategic role. DAIR continuously advocated for the need of a BI infrastructure as an initial step in a journey to transform the universities information infrastructure and harness the opportunities this transformation can bring AUC.

Business Intelligence Issues: Challenges and Opportunities in Higher Education

The higher education sector is rather late adopter of BI. However, its abundance of data and emerging challenges necessitated that it too embarks on this journey. BI has since found many cases where it can help support decision making in this invaluable, dynamic, demanding, and growing sector. This has also been reflected in the increasing number of academic and executive programs and courses that defines and explains the notion of BI (Wixom et al, 2014). Among the key elements of the higher education sector that can benefit from the depth and breadth of BI are the following:

Enrollment Management

The management of the enrollment process from start to finish is a huge concern for higher education institutions. Enrollment management starts as early in the student journey as students' recruitment. Universities allocate huge budgets for costly school visits, college fairs and hosting special events on campus to reach out to the largest population of potential qualifying and best applicants. BI using data mining and predictive analytics have helped universities in identifying those potential applicants with maximum likelihood of becoming actual admits. Universities, such as Baylor University in Texas, in the United States, raised their number of new applications from 15,000 to 26,000 in Fall 2005 after using data mining to develop a model of the different student profiles who are most likely to be admitted and concentrated their recruitment efforts to target those students (Campbell, DeBlois, and Oblinger, 2007). In the context of AUC, using BI helped better identify the enrolment targets year-on-year including the quality and diversity of the students as well as clearly identify their performance and retention rates.

Course Planning

Effective course planning and schedule building is a major challenge that higher education institutions have to overcome to ensure high completion rates. In this context, BI can be used as analytical tools to help both students and advisors in selecting and prioritizing courses (Shatnawi et al, 2014). It mines student registration records of previous semesters to identify patterns in courses registered and uses them to recommend courses for new students and future terms (Atteya, 2017). In the context of AUC, with four undergraduate degrees' granting schools on campus including a school of business (BUS) and a school of sciences and engineering (SSE) where the majority of the students want to go; BI has been instrumental in more efficiently allocate resources in terms of faculty and staff to maintain the university's ratio of 1:11 of faculty to students as well as make sure that the other schools get on a semester-basis the required number of students needed per class which is 15 through elective courses.

Major "Discipline" Selection

Selecting the suitable major/discipline is key to student' success and a major challenge facing advisers. BI analytics tools have been used to support advisers in this process. In 2013, Nagy, Aly and Hegazy proposed a framework that uses classification and clustering to recommend a specific major or track for a student. Clustering is based on a multitude of student-related variables including students' academic level before university enrollment, students' major of interest and his/her first year grades (Atteya, 2017). The framework is then used to compare new students with these clusters and aid in predicting the most suitable major for the student. Similarly in 2014, Slim et al, presented a framework that predicts the performance of students early in their academic careers and advise them into their best-fit majors (Atteya, 2017).

Identifying and Predicting At-Risk Students

Identifying students who are academically at-risk early on during their educational journey is another application of BI that enables institutions to intervene in a timely manner. The definition of academically at-risk students differs from one university to another (Krase & Nyatepe-Coo, 2012). Intervention can be through one-on-one advising or providing remedial courses for those lagging behind academically as well as counseling sessions for those with psychological concerns. An institution that is proactively pursuing student success will yield higher retention and completion rates and consequently ranking and reputation (Atteya, 2017). There are a large number of researchers and academics who addressed this problem through exploring the techniques and innovative solutions that BI and analytics techniques offer (Al-Sarem, 2015; Lauría et al, 2012; Romero & Ventura, 2010).

Predicting Student Performance and Student Success

Similar to best-fit majors and students at-risk, BI analytics techniques are able to predict university student graduation performance based on high school scores and grades in first and second year courses without having to check any socioeconomic or demographic information (Asif, Merceron, & Pathan, 2015). The researcher reported the highest performance prediction accuracy of 83.65% by the Naive Bayesian classifier. The findings were also confirmed that students' grades in courses closer to graduation are better predictors of their performance than pre-university or first-year courses (Zimmermann et al., 2007). In the case of AUC, early adoption of BI across campus helped understanding the trends associated with students' performances and accordingly students advising for courses, and scheduling of courses throughout their studies have greatly improved. However, it is important to say that AUC is still scratching the surface when it comes to BI implementation, there is a lot more to be learn, adopt, diffuse and adapt. BI is a continuous journey and not a destination.

In 2013 the research conducted by Rusk and Song, the authors were able to identify the factors that serve as good indicators of engineering student's program drop-out or failure. They focused their study on electrical and computer engineering students only and used their first academic year information only to predict the student classified as satisfactory for those who completed their degree without ever being put on probation. They identified the three foundational courses that were the most informative predictors of engineering students' academic performance. Moreover, in 2012 Yadav et al, used decision trees to predict student's performance, probable drop-outs, students who need special attention based on past student's performance in Purchanval University from 2008 to 2011. For every student, his previous semester grades, average of current semester grades, student's performance in the seminar class, assignments submission, student's attendance and completion of lab work are used to predict his overall performance.

These are sample examples that most academic institutions are facing and the evolution of BI simply provides a platform to deal efficiently and timely with most of these issues offering decision makers an opportunity to provide the best students-centered experience based on thoroughly captured and analyzed data from different sources, including social media, and providing predictive analysis and scenarios. Following is the case of the American University in Cairo in introducing BI into its ecosystem and accordingly positively affecting the decision-making process with implications on the management style of the campus at large with its multifaceted resources and the learning experience of its different constituents both on and off campus.

The Business Intelligence and Data Analytics Journey at AUC

Building on years of information and communication technology and information infrastructure investments, it was time for AUC to take this whole realm to the next level. The massive and growing importance of data analytics and knowledge management was increasingly becoming invaluable for the university as a platform for agility and competitiveness as it celebrates in the academic year 2019-2020 (Rizk and Kamel, 2013).

University Administration Vision and Buy-In Is Key

The actual transformation process from deploying state-of-the-art information technology infrastructure into using BI started in 2016 with the creation of a new position at the university leadership level in the form of a "vice president of information management". Fortunately, the holder of the position was a visionary and strongly believed in the power of data to any institution let alone AUC where he has been an administrator and a faculty member since 1992, and more importantly with a market experience in IT projects in both government and the private sector for more than 30 years. Following a few months of deliberations and regular brainstorming, the data analytics team represented by DAIR realized that it was the right time to present to the university leadership a comprehensive proposal that demonstrates their vision to unleashing the power and opportunities behind BI, predictive analytics and big data and its associated implications to AUC.

The objective of the proposal was to provide decision-makers across campus with a visual, easy to use, powerful, dynamic platform for decision-making that has the ability to predict trends, generate insights and provide directions based on extensive

analysis of historical data and recorded trends. The DAIR team was fortunate to secure the full support and endorsement of the vice president of information management in terms of budget but more importantly, in introducing on campus the much-needed cultural change, transformation of the mindset and the legacy systems when it comes to using data, taking decisions, and effectively managing it from start to finish.

AUC Gets Down to Real Business With BI

Knowing ahead of time that naturally BI projects were associated with high failure rates, the DAIR team researched a variety of diversified BI implementations to learn from their failures and successes. This helped them identify the critical ingredients to a successful BI recipe and enabled them to plan well before embarking on the actual project. This was not going to be a one size fits all venture, it needed adaptation and customization to the conditions on campus and the nature of the decision-making process at AUC in specific. The key critical success factors identified at this stage can be summarized as follows:

Project Structure, Strategy, and Human Capital

Identifying and setting a clear project vision, mission and established goals aligned with AUC strategy and business directions and objectives. The BI project had a clear mandate from the start as well as solid reporting line to the business side of the university – the DAIR team – to ensure complete alignment and ownership of business needs with BI goals and milestones. According to Boris Evelson, vice president and principal analyst at Forrester Research, "one of the essential components of a successful BI strategy is ensuring business ownership over BI" (Pratt, 2017).

Assigning a strong and capable management team with effective project management skills and a clearly defined, flexible and agile project plan. Due to the nature of the BI project that was more of a continuous effort and the expected resistance to change that accompanies any transformation effort. Therefore, a solid project organization structure was mandatory. Consequently, the project organization was very conductive and composed of the following:

- **Project Sponsor:** The project reported directly to the vice president for information management to reflect its priority institutionally, ensure timely progress and that any organizational issues were handled in a timely and effective manner. Weekly reports were submitted from the project manager followed by lengthy and productive meetings. The vice president for information management also appointed an advisor with expertise in BI and big data analytics to guide the project team in the early phases of the project.
- **Project Manager:** To ensure consistency, sustainability and a positive launch of this campus-wide mega data-driven project, the executive director of the office of DAIR was appointed as project manager due to the need for regular monitoring, accountability and expert project management skills.
- **Functional and Technical Project Managers:** The project manager was supported in this role by a functional BI project manager and a technical IT project manager. Each was responsible in their respective domains to harness resources and drive progress.
- **Project Team Members:** The team was composed of a diversified set of skillsets needed by the project and reflective of its complexity. From security officers, database administrators and network staff to data governance and BI skills were assigned to the team. Weekly team meetings and updates were carried out to ensure that the whole team remained motivated, informed and aligned. Figure 1 demonstrates the project management team without any reporting lines or segregation to enhance alignment and a common mission.

Forming a strong and motivated purple BI team with the right mix of technical and business knowledge and expertise that brings the best out of the two worlds business (blue) and IT (red). A key success factor of any BI project lies in the competence and drive of the BI human capital to deliver solutions and get things done effectively and efficiently. Once the budget was approved, the daunting mission of excavating for the right talents that can help AUC make the best and the highest returns out of its massive investment was unlocked. This was one of the most challenging steps in the project, due to the scarceness of BI resources in Egypt and the restricted compensation AUC had to offer in comparison to other industries in the local and regional markets.

Even though there is no absolute right or wrong, AUC used some general guidelines and best practices when building the BI team. In formulating the team, it was necessary to make sure that people were not just hired because they know a specific programming language or had previous experience of any of the tools; organizational fitting, and understanding the nature of the higher education landscape were other key important factors. Although some foundational technical knowledge was needed, people were also evaluated based on their belief in the power of data and information in transforming an organization

like AUC. The selection and filtering processes were based on tests to ensure the right expertise, attitude and aptitude followed by one-on-one interviews to assess fit and drive.

AUC started with a small team of five, including the project manager (Figure 2). This meant that it had to go with the multiple-hats approach in which every team member had more than one role to play, in many ways, it was a multi-disciplinary mode of operation. For example, the project manager served as a solution architect and a requirements analyst, a data modeler was also expected to build ETL codes and a data scientist also performed quality assurance checks. It was necessary to make sure that team members are capable of wearing the multiple hats whenever needed and regularly experience a daily multi-tasking routine. Multi-disciplinary teams work collaboratively and effectively in finding solutions to the problems without having to face the bureaucratic problems of the different groups of specialists. The groups of specialists work in isolation where one group throws its output to the next group in the BI assembly line without having one group holding the full ownership of the final result, this proves to be inefficient when both the business perspective and customer satisfaction is brought into focus. Multi-disciplinary groups think and work iteratively together to address the business needs and requirements. In doing that, they learn more and transfer more knowledge to each-others.

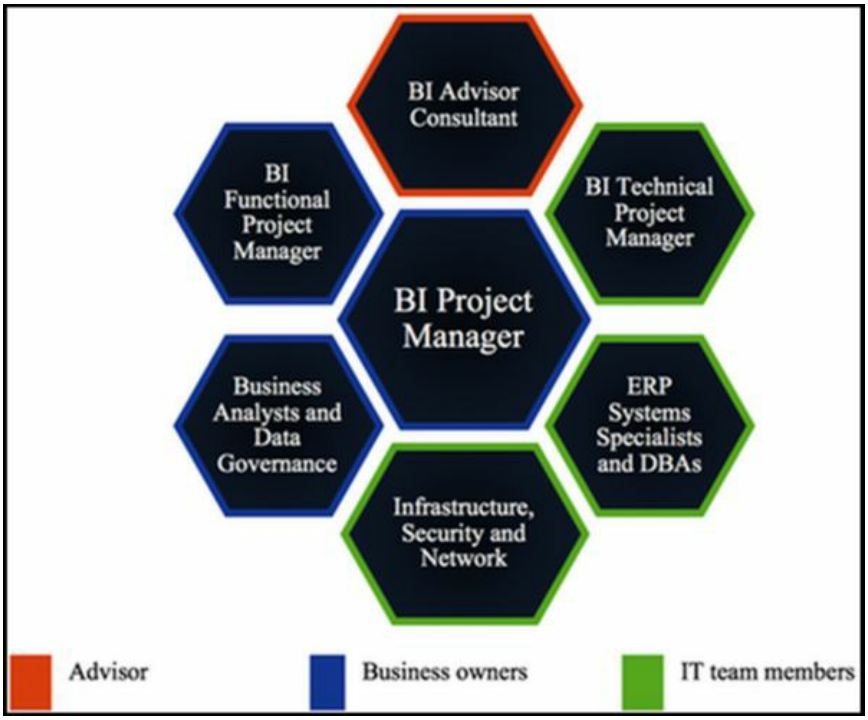

Figure 1: BI project team

Having these two essential selection criteria in mind, AUC received more than 100 applications for the five positions needed for the BI team, which were evaluated and filtered until the five positions were fulfilled by the best calibers available who were able to follow an aggressive implementation roadmap, and in some areas where ahead of it.

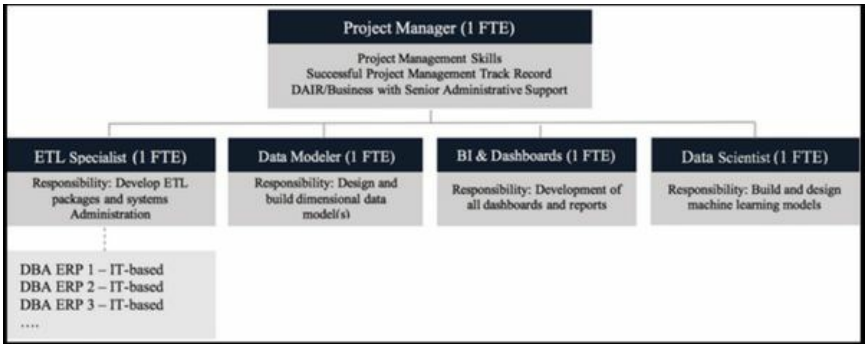

Figure 2: BI organization structure

A well-communicated campus-wide BI roadmap that addresses the institutional priorities and sets the expectations of the different stakeholders. After completing the first phase of BI in May 2017, which addressed students' admissions, enrollment, and graduation, and releasing the related dashboards to the community, it was necessary that the BI team manages the expectations of the different stakeholders. Therefore, the team started to develop different alternatives to the BI roadmap for the following year and discussed the roadmap at the university cabinet level (including the president, provost, and university

counsellor and vice presidents) to gather feedback, thoughts and reactions. After several refinements to address the different priorities of the various stakeholders, the team was able to seek final approval of the roadmap and locked it for implementation. The appendix has a sample of the most recent BI roadmap (Figure 3). This gap analysis will be used to inform the new BI roadmap for the academic year 2018-2019.

Organizational Readiness

Community Endorsement, Buy-In and Wise Change Management Strategy for Informed Decision-Making

The university senior administration endorsement was key to the success of the project. In addition to the support of the vice president for information management, the team needed key business champions across campus to help the BI team spread the word and act as role models for adopting the change. Accordingly, an impact assessment matrix was prepared and was shared with all cabinet and senior administration executives for prioritizing the different milestones of the project as shown in Table 1.

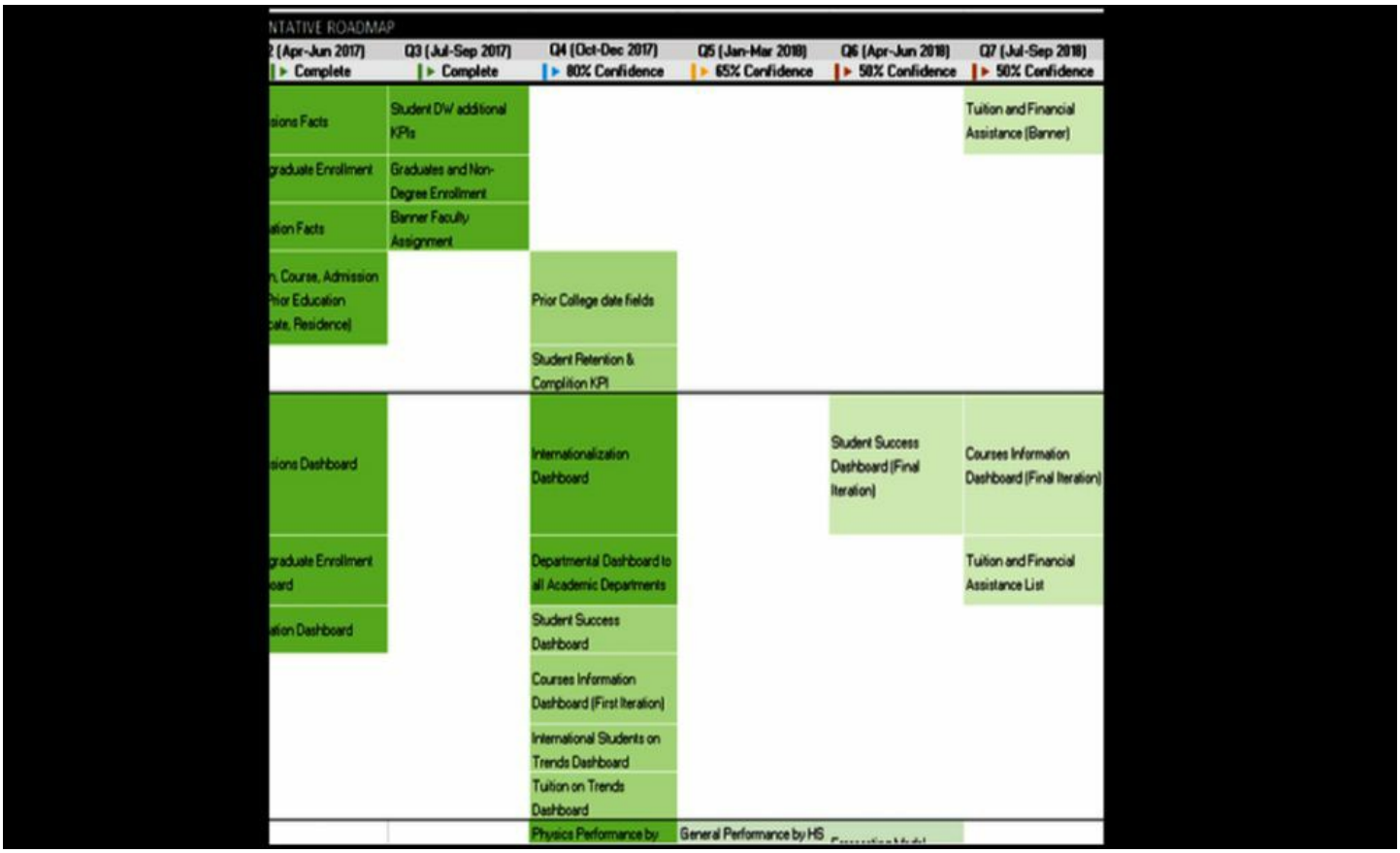

Figure 3: Sample of the 2018 BI roadmap

Table 1: BI impact assessment matrix

Business Processes	Academic School Deans	Academic Department Chairs	Registrar	Provost	Financial Area	Human Resources	Enrollment Management	Student Development	Research and Sponsored Programs
Enrollment Analysis & Forecasting	X	X	X	X	X		X	X	
Student Pipeline Analysis	X	X	X	X			X	X	X
Faculty Load Assessment	X	X	X	X		X			
Financial Analysis	X	X		X	X				
Contracts and Grants Analysis	X	X		X	X				X
Financial Aid Analysis	X	X				X	X		
Alumni Demographics/Tracking	X	X							
Human Resources	X			X					

According to the impact assessment matrix, student's academic information came in as the top priority and constituted the first

of the project. Accordingly, key champions of this area were selected to be part of the early process of requirements gathering and dashboard designing. The university senior administration involvement was further strengthened after the completion of the first phase of the project where reviews and signing-off on BI project roadmap on an annual basis was introduced to make sure it aligns with the university's overall strategy and directions. Moreover, clear and progressive change management rules and procedures were formulated to make sure that the project had sufficient stability to complete milestones on time and effectively.

Laying Grounds for Data Governance Rules, Data Standards, and Enforcing the Related Policies

One of the biggest challenges for institutions implementing BI is the quality of its data and AUC is no exception. After the launch of the BI Project, the need for data governance rules, data definitions and standards became crystal clear to the BI team and to the university senior administration. Consequently, a committee for information management was formulated with a clear assignment of writing up the first data governance policy at AUC. The data governance policy manages the quality, consistency, usability, security, accessibility, and availability of administrative data. The governance platform covers staff, policies, processes, best practices, awareness and technologies required to manage the university's administrative data as an institutional asset, and focuses on university administrative data maintained by administrative and academic offices.

After several iterations of refinement to the policy, it was communicated and shared with all stakeholders such as the university cabinet, university senate, provost council and other stakeholders. The policy was then released and published on AUC website to be accessible by all the AUC community. According to the policy, the data analytics and institutional research team became responsible for working with the appropriate data stewards to develop standard definitions of commonly used terms; define how official university metrics are calculated; work to discover data discrepancies, inconsistencies and gaps and report such to the appropriate data steward for resolution. Having this authority granted to the DAIR team, with the BI team part of it, made it easier to request access to the source systems, report data inconsistencies and access the data definitions and standards for KPIs calculation and reporting.

Revisiting Ambiguous Business Processes for Optimization Based on Best-Practices: AUC Has Constantly Had an Issue With Its, or Lack of, Business Processes

This was exaggerated with the BI implementation. One of the challenges faced in the implementation was the integration of faculty data from the students' information system (running on banner) and the human resource ERP (running on SAP). Faculty members did not have unique identification on both systems. They also had multiple identities on the same system and their records were usually inconsistent. This was due to the ambiguous business process of faculty records' creation and maintenance and the non-alignment of the two constituents owning the faculty records on the two separate systems.

Ambiguous business processes like these usually hinder smooth progression of BI projects and add more complexity to understanding the data behind it. On this note, it was a good wake-up call for AUC to revisit its business processes for re-engineering and optimization. The business process witnessed massive transformation and still work-in-progress to adapt to the new culture and requirements of BI. The presence of the two functions of business process improvement (BPI) and BI within the same team was actually beneficial and rewarding to the university. Not only that improving business processes will enhance the data quality for the BI platform, it is in the team's vision to use BI to inform different decision points in the business processes and enhance the overall efficiency of operations on campus.

Technology: Vendors and Tools Selection

Selecting the Tools That Satisfy the Business Needs as Well as the Implementation Partner Who Is Technically Capable of Building an Environment That Is Scalable and Easy to Maintain

At the earliest stages of the project, the DAIR team realized the need for formulating a standing committee, which included, in addition to the DAIR team, IT members covering the different functions of the infrastructure, networks and security for the technical assessment of the tools available in the market. The team had a consensus on favoring a single-vendor full-stack solution over the best-of-breed option for a number of reasons including; working with one vendor makes things easier for everyone involved, communication is much easier where sharing the requirements and/or problems with one vendor without having to repeat the same message with multiple vendors and risking lack of adaptation or matching across multiple vendors. Working with one vendor means an intrinsic synergy between the different tools used, and a single focal point of support leading to a more seamless and effective implementation process. The team's mission was to find that single vendor whose

different tools were innovative, and that can support all the university's needs and requirements. The team started to assess the tools provided by the market leaders; which according to Gartner Magic Quadrant of 2016 (Figure 4) included IBM, Microsoft, Teradata, SAP, and Oracle.

All vendors were invited for a proof of concept (PoC) which was an actual exercise to demonstrate the expertise and quality of each vendor and their associated implementation partner. Vendors who completed the PoC were short-listed and were further evaluated based primarily on the technical features of their solution then based on their financial quotations. The technical comparison addressed multiple dimensions with different weighting scores for mandatory and preferable criteria as demonstrated in Table 2.

After thorough deliberations and discussions, the final evaluation resulted in selecting IBM Egypt as the local implementation partner.

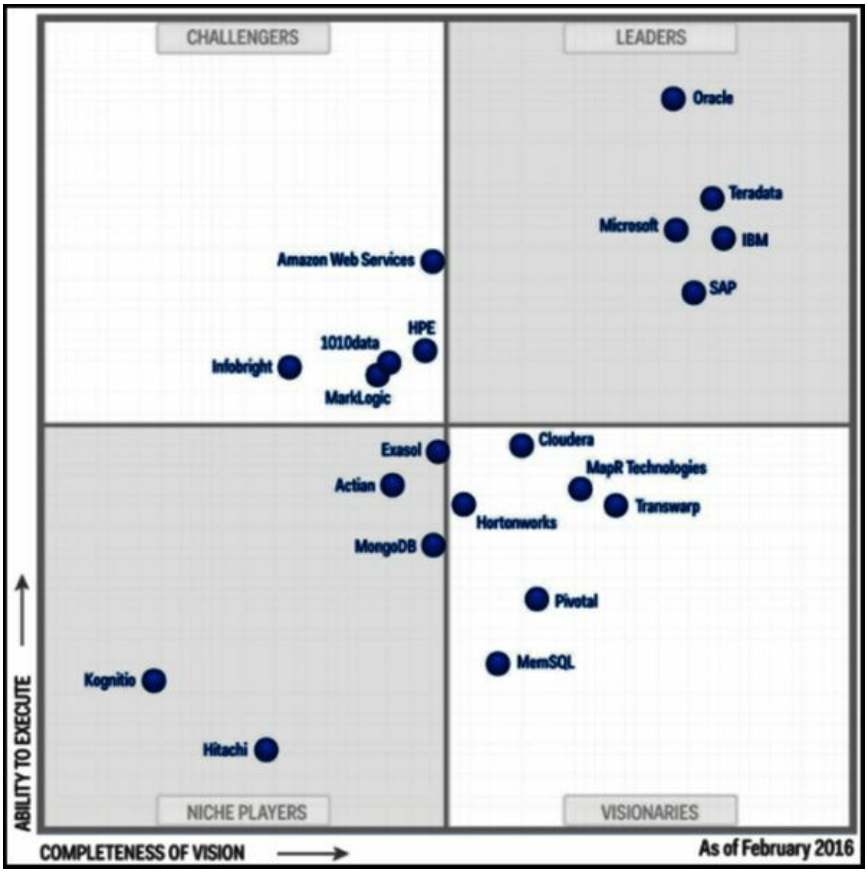

Figure 4: Gartner magic quadrant of 2016

Table 2: Vendor selection process

Mandatory Criteria	Preferable Criteria
- Ease of connecting their tools to the university's ERP system for data extraction. - Capabilities of the reporting and visualization tools. - Solution compliance with the university's security requirements. - Existence of audit logs provided by the tools for troubleshooting. - The university's previous experience with vendor support and responsiveness. - Expertise of vendor-recommended implementation partners. - Steepness of the learning curve.	- **Previous experience in implementing BI platforms in other higher education institutions in the MENA region and beyond.** - **Existence knowledge of the vendors' tools within the university team.** - **Previous projects' experience with the university, if any.** - **The availability of professional expertise through the vendor and/or the implementation partner.**

Reaping the Early Fruits of Success "Just Scratching the Surface"

Despite the fact that BI is a long journey for AUC, the beginning was strong and promising and was celebrated and acknowledged by many on campus. Not only did it address the need for an effective infostructure to support the decision-making process, but it also had several indirect effects on the performance of several units on campus. The BI early implications included; (a) gradually shifting the organizational culture to a more evidence-based decision-making process; (b) enhancing data quality, governance and diminishing the effect of silos with more built-in transparency; (c) transforming the university at its core and emphasizing the need for change and business process documentation and re-engineering; and (d) increasing the confidence and alignment at all levels of management from the board of trustees to senior administrators through to directors, managers and first-line officers by creating one point of truth that consolidates the university's views and directs common action.

Fundamentally, the successful implementation of BI at AUC has played a significant role in transforming a 100-year old university to move towards a more proactive modern higher education institution in every aspect of its management and operation. A compilation of some of the key institutional dashboards designed with the aim of supporting decision making at AUC and bringing unusual events to the attention of the administrators are listed in Table 3.

Lessons Learnt

To capitalize on the university experience acquired in planning, implementing and managing the BI infrastructure, the following lessons need to be captured.

Planning for Agility and Scalability

Having a clear vision from the outset on the scope of the BI, type of users and estimate of data sources is key. However, only a few implementations have these details at the start. Hence planning for agility, flexibility and scalability are essential for adoption and effective use. In the case of AUC, the DAIR team was keen from the beginning to select a BI infrastructure that would allow scalability in terms of data sources. However, at the start the target user group was senior administration; shortly after, and with the reveal of BI's true potential, stakeholders at various levels demonstrated a clear appetite to use it. This was later handled by acquiring more information distribution mechanisms.

Deploying Best Practices in Project Management

The quality of project management skills in a BI implementation is critical due to their complex, non-traditional nature. Preparing high-level and detailed project plans led to a more proactive implementation enabling effective and timely allocation of resources from across the university. Decisions were made early on to initiate and maintain strong partnerships with business and IT stakeholders which proved to be of paramount importance. Business stakeholders were involved in the implementation through extensive needs analysis sessions to secure buy-in and adoption. Solid partnership with IT was critical in streamlining access, securing resources, learning about integration points and much more.

Table 3: BI dashboards

Dashboard	Description
AUC trends	Trends in the university admissions, enrollment, graduation and tuition fees KPIs while allowing decision makers to compare AUC to other peers for evaluation and improvement.
Internationalization	Focuses on the international student's population and provides decision makers with information regarding their academic level, majors, nationalities, payment mode and more.
Admissions	Provides daily updates on the number of applicants, accepted and newly enrolled students broken down by their demographical information, prior institutions certificates, and more highlighting the university's selectivity and yield KPIs at a given semester.
Enrollment	Focuses on the students enrolled and addresses their demographical information, academic performance, distribution across the different schools and majors, double majoring patterns, major-minor preferences and migration patterns between the different majors.
Graduation	Focuses on the graduating cohort in a specific semester broken down by demographics, primary and secondary majors and the time to complete their degrees.
AUC and school's partnership	Describes the student journey at AUC triggered by students' high school while analyzing their schools, focuses on their behaviors starting with their freshman year, major declaration and tracks them until graduation.
Human resources	Describes the university staff demographics, headcount analysis with different breakdowns and classifications.
Human resources trends	Tracks the trends of new hires, voluntary and involuntary separations, turnover rates and total headcounts.
Faculty	Describes the faculty demographics per school and department, breaks them down by their rank and tenure status.
Financial assistance	Provides information about the number financial assistance opportunities offered by the university broken down by their different types and need/merit classification as well as showing the distribution of offerings per school, major, gender and nationalities.
AUC coin	The university has recently gone cashless with a new system that enables students, staff and faculty to top-up their ID cards with cash and use it on campus for purchasing food, reserving events and more. Accordingly, the dashboard tracks the number of transactions and their amounts performed by the different community members and integrates information from the AUC Coin and the demographical information of the users from the different ERPs showing purchasing patterns, peak times of the day, most active group of users and more.
Cash position	Designed to help the university chief financial officer (CFO) track the university cash position on a weekly basis, showing its accounts balance in the different banks, the interest rates and more.

Selecting and Investing in BI Human Capital

Investing time and resources in selecting and training the suitable skills set was an essential ingredient for success. Scarcity of competent BI human resources in the market along with restricted budgets of higher education institutions in comparison to telecom and banking institutions made this more of a challenging task. Therefore, the focus was on building a team with certain competencies that ensured future project sustainability, drive, willingness to learn, agility, commitment, passion and knowledge to handle timely information. The team was made integral to the implementation process from the early stages where they shadowed the implementation consultants and participated in the actual implementation to gain concrete knowledge and hands-on expertise. This led to a smooth transition from the consultants to the BI team and enabled them to add data sources and continue the BI journey. While this strategy implied additional initial costs, it proved to be very effective on the long run.

Maintaining a Clear Business Orientation and Coupling BI With Business Process Management, Strategy Management and ERP Systems

BI aims at supporting institutional strategy management and enhancing organizational performance. This necessitates clear business orientation, reporting and ownership to align the project with institutional business goals. It also leverages existing business process management (BPM) initiatives and enterprise resource planning systems. According to Janiesch, Matzner, and Müller (2012), the application of measurement methods to process specific data is referred to as process intelligence and process mining. The AUC team experience shows that *"process-centric"* BI has the potential to track the execution of processes and yield invaluable insights with consolidated views on operations and customers (Nofal and Yusof, 2013). AUC realized the significant value behind this integration at a later stage and steps were taken to address this through restructuring. Similarly, AUC invested heavily in ERP and BI systems ensuring a tight link between ERP and BI powers this investment to improve decision making and optimize the use of both platforms. Accordingly, AUC had an effective organizational structure

where the vice president for information management oversaw both functions and endorsed the value of information (Popovič, Vukšić, and Bach, 2013).

Business Intelligence Realistic Expectations and Strong Change Management Practices

BI is a tool to aid business stakeholders and managers to improve decision making. It also requires strong top management support and buy-in. This was clear at AUC and demonstrated in the senior administrations' shift in expectations to more realistic ones. Furthermore, clear change management practices were established to counteract the effects of turbulent environments and their potential implications on roadmap completion. BI roadmaps were built in alignment with institutional strategy, and were signed off by the university senior administration and shared with all the AUC community.

Assessment of Institutional Data Quality

The success of a BI implementation is highly associated with the quality of its data, data standards and data governance mechanisms. On campus, the discussions on poor data quality had significantly delayed the implementation of a BI infrastructure and little progress to tackle the quality issue was made. Deciding to implement the BI platform, led to a strong and clear mobilization of institutional resources to address data quality and governance at a profound level. Both elements worked in parallel with each solidifying and supporting the other. BI was used to detect and report on data anomalies which decreased with every cycle and emphasized the importance of data standards and governance. Data governance supported BI by providing functional and technical definitions and standards to follow as well as clarifying data ownership and access rights.

Future Vision and Strategy

It is worth noting that moving forward, the BI team at AUC aspires to realize the strategic objective where all their tools and processes continue to effectively support the open access to accurate and timely data and introduce new advancements in promoting the culture of evidence-based decision making at the university. Accordingly, the BI team envisions the use of BI on campus as follows:

- Users will have access to the data they need to efficiently execute their job functions.
- Users will gradually not suffer from data silos and will have an integrated data hub that provide information and analytics that span multiple systems through a one-stop-shop "the BI system".
- A well-trained and powered BI user will be secured for every administrative area/academic school to cater for customized data requests that require adjusting reports and dashboards parameters.
- A series of "train-the-trainer" sessions will be conducted to all BI users in the different departments across campus to educate them on the wealth of information currently available in the BI system and how to access it and use it effectively and efficiently.
- A set of automated data quality and governance reports based on business rules will be availed through the BI system to the governance team once a business process is reviewed and approved by the business processes team to enable prompt capturing of quality issues on the source systems.
- Data definitions and dictionaries will be linked to the BI dashboards and reports, whenever possible.
- The BI system will continue to provide the decision-makers across campus with data that was difficult to access through integrating data from external sources and systems other than the main ERPs
- The BI system will start to address "Big data" sources and predictive analytics more seriously to take the decision-making process to another level

The BI team recognizes that a future data warehouse strategy should consider both a penetration strategy and a datawarehouse expansion strategy.

Penetration Strategy

When the BI first started its journey at AUC, the university senior administrators' vision positioned the BI project as a strategic-decision making supporting tool. The BI team's experience is that it is crucial to align operational and strategic decision-making

to reach the true state of having one version of the truth. Accordingly, it was inevitable that the BI team includes in the 2019 roadmap a penetration strategy that would enable and empower department assistants and operational teams across campus to access the information they need for running smooth and efficient operational business processes.

In light of that, the BI team opted for a type of license that would enable unlimited number of users' access to restricted reporting features to cater for the large number of users who would be using BI for operational purposes. In addition to that, the BI team needs to secure a larger number of power user licenses to enable one power user per each administrative department and academic school. This power user should be able to run more sophisticated reports and dashboards in which they can change default parameters and filtering options. In preparation for this, the team has chosen the *"school of business"* as a pioneer BI user and started to gather their strategic and operational reporting needs. The school of business dashboards and reports will be used as a template to be extended to other schools and departments. Moreover, a *"train-the-trainer"* plan has to be set and periodically provided as part of the human resources orientation sessions held on a yearly-basis to disseminate the much-needed know-how of running the reports and dashboards, understanding the different KPIs and reaching out to the correct definitions of the reported figures. There is a cost to expanding the activity of the BI platform in terms of financial cost of added licenses and needed effort to support the increase in the number of BI users. However, coupled with sound project management and highly skillful BI teams with customer-oriented behavior, this challenge should be rocking waters but wreaking havoc.

Datawarehouse Expansion Strategy

The datawarehouse strategy has to address expanding the data sources of the datawarehouse to new sources of information that was hard to retrieve in the past. Therefore, the BI team decided to try to integrate the data from the alumni system into the datawarehouse such that users can access a fully integrated students/alumni record seamlessly. The alumni system has data about the university alumni who voluntarily opted of providing this information which introduces a new challenge of dealing with large portions of missing information of those who did not. In order to overcome this problem, the BI team will disembark a new challenge of addressing external data sources to retrieve LinkedIn profiles for AUC graduates. The aim of addressing the alumni information is to start providing the university senior administrators with information related to where do AUC graduates get employed and when, whether they pursue post-graduate degrees elsewhere and identify graduates of specific majors who prefer to switch careers and get employed in different industries. This wealth of unprecedented information is going to add a new perception to how the university envisions its students and alumni.

The BI team is planning to integrate the data from the academic degree evaluation system into the data warehouse to answer business questions addressing building a schedule of offerings that accommodates the registration needs of students. This can be achieved by studying the gap between the actual demand and supply of courses, the optimal number of sections to offer of each course given the number of students, the percentage degree completion of each student and whether the students adhere or deviate from their advising plans. Among the BI priorities set for this year, the team intends to complement factual data collected from the main information systems with data addressing students' perceptions. AUC has a rich calendar of institutional surveys providing a wealth of information about students' opinions, satisfaction levels, aspirations and future-plans.

Blending factual and perceptual information will give us another depth of knowledge that would support informed decision-making. The plan also includes addressing extracurricular activities data to assess student engagement. This wealth of information will contribute to providing a 360° view of the students at AUC that extends beyond students' academic information. It is also crucial that the BI team invests more time in practicing predictive modeling to answer key business questions like students at-risk of dropping out, students who are best-fit for specific major declarations and students who are most-likely to graduate on-time. The team is aware that aspired high accuracy of predictive modeling will always be hard to achieve from the first round of analytics and is intending to pursue continuous enhancements to these models as more and more information becomes available in the datawarehouse. Working on these two strategies in parallel will have a significant impact on nurturing a culture of evidence-based decision-making that the BI team thinks that AUC truly deserves and that is long overdue.

FUTURE RESEARCH

Moving forward it is recommended that further research is conducted on the experience of AUC and other higher education institutions in integrating and blending business intelligence platforms into their decision-making processes. The implications, challenges and opportunities of implementing such platforms in the context of higher education will continue to bring new insights and perceptions of the power of innovative information management and data analytics and will undoubtedly have positive implications on the students' learning experience and the management of campuses at large.

CONCLUSION

Business intelligence is a term used to describe applications and technologies which are used to gather, provide access to and analyze data and information about the organization, to help make better business decisions. The objective of BI is to provide "actionable insight" that support informed-based decision making (Wu, Liya, and Bartolini, 2007). The power of BI platforms stem from the enhanced quality it brings to the decision-making table and its impact on organizational performance. As an established 100-year old institution, The American University in Cairo was undergoing extensive management transformation to align with its ever changing and dynamic environment. However, the lack of quality, comprehensive data was crippling its advancement resulting in gut-feeling and best guess decision making. A courageous decision was made by the university senior administration to invest in and implement a state-of-the-art BI platform to tackle this weakness.

The decision was supported and endorsed by the leadership of the information management area and supported by effective project management, and competent newly established business intelligence team. This decision was a profound game changer in the university's performance and decision-making platform. The BI project proved once again that AUC is a leader and trend setter in the higher education industry in the MENA region. The implementation was challenging and complicated especially being faced with the extensive resistance to change that initially impeded the transformation initiatives typical in traditional and legacy organizations.

The challenge was exacerbated by the existing fragmented IT landscape; information silos, organizational culture; lack of data governance or clear ownership and poor business performance management practices. However, even at this early stage of the BI journey at AUC, the results were promising and gradually the BI platform started to transform one area after the other at the university. Accordingly, it was widely endorsed by many key stakeholders on campus. However, BI is a journey and AUC remains in the initial steps of building its infostructure with an aggressive penetration and expansion strategy laid out to take AUC into its centennial with solid information tools imperative for strong decision making.

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KEY TERMS AND DEFINITIONS

Big Data:
It reflects extremely large data sets that may be analyzed computationally to reveal patterns, trends, and associations, especially relating to human behavior and interactions.

Business Intelligence:
BI is an umbrella term that includes the applications, infrastructure and tools, and best practices that enable access to and analysis of information to improve and optimize decisions and performance.

Data Analytics:

DA is the process of examining data sets in order to draw conclusions about the information they contain, increasingly with the aid of specialized systems and software.

Decision-Making:
It is the process of making choices by identifying a decision, gathering information, and assessing alternative resolutions.

Emerging Economies:
An emerging economy reflects the characteristics of a developed market, but does not satisfy standards to be termed a developed market.

Information Management:
It is the discipline that analyzes information as an organizational resource, it covers the definitions, uses, value and distribution of all data and information within an organization whether processed by computer or not.

Knowledge Management:
It is the efficient handling of information and resources within a commercial organization.

Organizational Effectiveness:
It is the concept of how effective an organization is in achieving the outcomes the organization intends to produce.