

# **Adopting Business Intelligence (BI) For Performance Monitoring Through USMiR**

**by**

**AHMAD FADHLUL IRHAM YUSOFF**

**Dissertation submitted in fulfilment of the requirements  
for the degree of  
MBA (Service Science, Management and Engineering)**

**June 2015**



GRADUATE SCHOOL OF BUSINESS (GSB)  
UNIVERSITI SAINS MALAYSIA

### DECLARATION

I hereby declare that the project is based on my original work except for quotations and citation which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at USM or any other institutions.

(Signature):

Name: AHMAD FADHLUL IRHAM B. YUSOFF

Date: 15<sup>th</sup> JUNE 2015

## **Acknowledgement**

I would like to thank to my supervising lecturer Dr Rosly Othman, who gave a lot of guidance on how to improve my case study writing and analysis methodology during this process. Without him, I really struggle to translate the comments given by Dr. Tan, Dr. Yudi and the expectation of academic case study write-up.

Many thanks to Dr Tan Cheung Ling that provided us fundamental knowledge on overall steps required in writing a case study and comment during class and presentation. The format workflow of this case study given is clear and useful which enable me to complete my case study by following the process steps given.

As well thanks to Dr. Yudi Fernando who gave me useful inputs during the presentation to further improve my write up. It does trigger me about the academic expectation and my understanding gaps in a way to write a case study. This case study would not have completed without the guidance, and inputs from all of you. From the bottom of my heart, i am truly appreciate that.

My thanks also go out to USM colleague who participate in this paper and willingly to be interviewed, provide useful inputs and comments.

Last but not least, I extend my heartfelt appreciation to my loving wife, Nor Rahayu and my three kids, who stood by me through the struggles for the past three years. Your love and support contributed in no small amount to the completion of this journey.

The reason i have chosen the topic is because as a staff, i am curious to understand more on the approach taken by USM to measure and monitor the performance objectively which is based on the predefined KPIs. Base on working experience,

observation and knowledge gain from the class, i am able to identify and understand the importance on harnessing the value of the data, and well defined processes in structured manner could lead to organization capability towards competitive advantage.

As well, the awareness acquired in the class and further knowledge regarding Business Intelligence framework is well suited as solution architecture with current situation pertaining to USMiR project, objectively and technically.

# Table of Content

1.0 Introduction	1
2.0 Industry Background: Higher Education Institution Industry	6
3.0 Company Background: Universiti Sains Malaysia	12
3.1 USM’s Mission and client charter	13
3.2 Organization Structure	15
4.0 Case Issue: Failure In Meeting USMiR Project Objectives	19
4.1 Case Scenario	19
4.2 USMiR Project	25
4.3 Stakeholder momentum towards USMiR Project	29
5.0 Case Analysis	33
5.1 Qualitative Approach	33
5.2 Methods for Data collection	33
5.2.1 Primary Data	33
5.2.2 Secondary Data	34
5.3 Data Linkages	35
5.4 Analysis Approach	36
5.4.1 Ishikawa Fishbone Analysis	36
5.4.1.1 Data Flow Restriction	37
5.4.1.2 Inappropriate USMiR Solution Architecture	40
5.4.1.3 Stakeholder Momentum towards USMiR Project	41
5.4.2 Pareto Analysis	42
5.4.2.1 Weight the Root Cause	42
5.4.2.1 Pareto Analysis	44
6.0 Discussion & Recommendation	46
6.1 Inappropriate USMiR Solution Architecture	46
6.1.1 Data warehouse not available	48
6.2 Data Flow Restriction	48
6.3 Stakeholder momentum towards USMiR Project	49
7.0 Conclusion	51

8.0 References	52
9.0 Appendices	54
Appendix A Internal Audit Work Process Proses and Flow Chart MyRA - PTJ	54
Appendix B List of Interviewee	56
Appendix C List of Interview Questions	57

## **List of Abbreviations**

RU	Research University
APEX	Accelerated Program for Excellence
USM	Universiti Sains Malaysia
BUKU	Bersama Untuk Kecemerlangan Universiti
BI	Business Intelligence
PTJ	Pusat Tanggung Jawab
OLTP	Online Transactional Processing
SQL	Structured Query Language
CSF	Critical Success Factor
KPI	Key Performance Indicator
SOP	Standard Operating Procedure
MHEB	Malaysia Higher Education Blueprint 2015-2025
OECD	Organisation for Economic Cooperation and Development
GTER	Global Tertiary Enrolment Ratio
UIS	UNESCO Institute of Statistic
LMS	Learning Management System
MQA	Malaysian Qualification Agency
MoE	Ministry of Education
HEI	Higher Education Institution
SETARA	Rating System for Higher HEI
D-SETARA	Discipline based Rating for HEI
MyRA	Malaysia Research Assessment
JISC	Joint Information Systems Committee
BPI	Institutional Development Division
PPKT	Centre for Knowledge, Communication & Technology

## List of Figures

Figure 2.1. Projected Gross Tertiary Enrolment Rates.....	10
Figure 2.2. Malaysia’s HEI Student Enrolment.....	11
Figure 3.1. USM APEX Emblem, Source: <a href="http://www.usm.my">http://www.usm.my</a> .....	14
Figure 3.2. Data Flow Perspective, USM Organization Chart.....	17
Figure 4.1. MyRA Double Entry Requirement.....	22
Figure 4.2. KPI Result by School Ranking.....	23
Figure 4.3. KPI Marks by Section.....	24
Figure 4.4. MyRA Audit Process Period.....	24
Figure 4.5. USMiR Online Platform.....	26
Figure 4.6. USMiR Architecture.....	27
Figure 4.7. USM KPIs Strategic Alignment.....	31
Figure 4.8. USMiR Project Overview.....	33
Figure 5.1. Root Causes of Data flow Restriction.....	35
Figure 5.2. Root Causes of Inappropriate USMiR Solution Architecture.....	37
Figure 5.3. Root Cause of Stakeholder Momentum Declining towards USMiR Project.....	38
Figure 5.4. Pareto Chart Analysis.....	41
Figure 6.1. Business (BI) Framework Architecture.....	42

## List of Tables

Table 5.1. Positions and Roles of interviewees in this case study.....	32
Table 5.2. Data Linkages of Research Questions.....	32
Table 5.3. Weightage of Issue with Document Scoring.....	40
Table 5.4. Cumulative percentage of issue by weightage in Descending.....	41



## **Abstract**

Motivation for USM to continuously measure, monitor and improve the performance comes from various factors, mainly competition to acquire best student that contribute to the quality of researchers, research and publications, secure funding, accreditation, rating and status. USM turn to ICT with the formation of USMiR project, to have cohesive, useful and sustainable Information Repository regardless of platforms, routine operating procedures as well as bureaucracies. This case study looks into the factors that contributed to the failure of USMiR project to deliver its objectives. The study begins with understanding the current state pertaining to the data flow in USM, by using MyRA audit process as an example, for easier understanding. Also, it looks into KPI-MS online platform and USMiR architecture as well as standard operating procedure in placed. Current issues such as data/information mostly confined at every schools/PTJs or at particular database which is very time consuming to be gathered, lack of data and process integration poor solution architecture design and stakeholder momentum towards USMiR project were discussed. To further understand the potential root causes of those issues, a comprehensive analysis is performed using interview, reference of documents, Fishbone and Pareto analysis tools. The goal for this study is to understand and find a solution to the problems faced by USMiR in meeting its objective.

## Executive Summary

They are various factors contribute the pressure alongside the opportunities to the USM to continuously measure and monitor its performance. One of them is growing pool of student, locally and global mobile student and competition to get the best candidate. Also source of fund, where the allocation from the government is tightly depend to the institution performance, as well to attract external source through endowment and industry funding. In addition to that, the quantity and quality of research and publication produce by USM. As well, the accreditation bodies especially MQA and MoE that continuously measure and monitor HEI nationwide either public or private higher institution, through benchmark, rating and ranking.

By having this insight, USM turn to utilise ICT, through formation of USMiR project in 2011. The objectives are to have cohesive, useful and sustainable Information Repository regardless of platforms, routine operating procedures as well as bureaucracies. The goal is to have USM central Information Repository that provide opportunity for data mining, data analytic, data visualization through dashboard and scorecard that could depicted overall USM performance and assist in decision making.

This case study looks into the factors that contribute the failure of USMiR project to deliver its objectives. The study begins with understanding the current practice pertaining to the data flow in USM, by using MyRA audit process as an example, for easier understanding. The entire MyRA audit process will involve 42 schools in USM as well other central departments, such as Library, RCMO, Bursary, Quality Department, Institute of Post Graduate and Usains Holding, which could also be translated into eight different data source in term of data management. Also, it looks

into KPI-MS online platform and USMiR architecture as well as standard operating procedure in placed. Four areas are looked into to discover USMiR failure related issues. 1. Data/information mostly confined at every schools/PTJs or at particular database which is very time consuming to be gathered. 2. USMiR project architecture design. 3. Data and processes integration. 4. Stakeholder momentum towards USMiR project.

Interview has been performed to the related people from Project Owner, ICT Director, Portfolio Manager such as Head of System Development & Data Institution Management Section under BPI Office and Deputy Director of Hamzah Sendut Library, Application and Data Source Owner as well as School's MyRA administrator. Various supporting document has been collected and reviewed. A Data Linkage table is used to illustrate the relation among the research questions, sources of the information and justification that related to the objectives of the case study.

Followed by a fish bone analysis that identifies the potential root causes may contribute to the failure of USMiR project. Root causes are identified and grouped into four categories, Management, People, Process and Technology. Under **management**, related root causes are not pushing for data warehouse, lost focus in USMiR direction and other project is given higher priority. Under **technology** has identified data warehouse not available, various database format, unstructured data, insufficient online platform and mismatch data key index as root causes. **Process** related root causes are lack of process integration, lack of standard operating procedure, ETL not clearly understand and defined and lack or automation. Lastly **people** root causes has been identified are poor stakeholder commitment, lack of technology competency, limited technical workforce and poor design architecture.

These potential root causes later are weighted based on the respond to the root cause acquired from interviewee, as well as availability of supporting document. Later the weightage of issues is populated and arranged in descending order as well as the contributed cumulative percentage and a Pareto Analysis is produced to identify the major root causes contributed to the problem.

Base on the analysis, this paper recommends adopting Business Intelligence Framework as the USMiR architecture design. For a start, it is emphasized to develop enterprise data warehouse as crucial component to the framework. It is also suggested to develop standard operating procedure and clearly define the extract, transform and load process. In addition, this paper also recommends gaining back the stakeholder commitment, starting from the top management to provide continuous sponsorship to this project.

In conclusion, adopting BI framework as the USMiR architecture design is a solution to the project. The BI framework with clearly defined component, process mechanism and function will provide the guidance to break up the silos among people, process and technology facing by USMiR project. As well, it provides the direction to address and solve current problem, and the path to moving forward in harnessing the value of data for competitive advantage.

## 1.0 INTRODUCTION

---

Having granted as Research University (RU) and being the one and only APEX University in Malaysia, Universiti Sains Malaysia (USM) strives to maintain as a national leader in higher education institution (HEI) and achieve world class education institution. Guided by APEX pillars and yearly emphasize strategies in BUKU (Bersama Untuk Kecemerlangan Universiti) document in local language, is a clear statement of strategic objectives and a way forward to continuously improve the performance as competitive advantages.

With the APEX status, the university aspires to be sustainability-led university in the world. It is a journey for the USM which start from 2008 and will continue with the APEX Phase 11 2014 - 2025. It is governed by 7 pillars covering:

- i. Achieving Global Research Prominence
- ii. Leadership and Nation Building Program
- iii. Transformation of Higher Education
- iv. Extension and Positioning
- v. Academic & Student Development
- vi. Financial Sustainability
- vii. Institutional Development

Each of the pillars has a set of strategic objectives and Key Performance Indicators (KPI) as **performance measurement and monitoring tools**.

Apart from self-motivating, there is a requirement to **substantiate accreditations** handed out by statutory accreditation bodies. In Malaysia, the Malaysian Qualification Agency (MQA) (2015) plays the role of accreditation agency while Ministry of Education (MoE) is the Government body that oversees higher education in the country and provides the primary source of funding for Public Universities like

Universiti Sains Malaysia. Both of these bodies have **KPIs and accreditation** data requirements.

SETARA (Rating System for Higher Education Institutions in Malaysia), which was introduced in 10<sup>th</sup> Malaysia Plan and participating by USM since year 2009. The platform is developed by MQA as Malaysia's first rating system to assess the **overall performance** in teaching and learning quality of national HEI for undergraduate programmes. The measuring tool is built using Malaysian Qualifications Framework (MQF) using a six-tier category with Tier 6 identified as Outstanding and Tier 1 as Weak. SETARA '13 evaluated 53 HEI comprising public universities and private universities in Malaysia. USM was rated Tier-5 (Excellent) in SETARA '13. In addition, there is Discipline-based Rating System (D-SETARA), that was introduced in 2013 to assesses the quality of teaching and learning of a **specific field of study**. D-Setara builds upon SETARA with the view of eventually replacing the latter rating system. USM was rated Tier-4 in Medicine, Dentistry & Pharmacy and rated Tier-5 in two fields namely Engineering and Health Sciences.

In addition to that, USM participate in Malaysian Research Assessment (MyRA) (2015), an assessment instrument governed by MoE for **research related activities performance** of public universities that **validate the USM's RU status**. All public universities are required to self-assess and submit MyRA data to the Department of Higher Education of MoE. The MyRA instrument includes comprehensive assessments and data requirements surrounding:

- General information of the institution
- The quantity and quality of researchers
- The quantity and quality of research
- The quantity and quality of postgraduates

- Innovation
- Professional services and endowments
- Networking and Linkages
- Support Services

USM was rated 6-Star in MyRA'12 assessment as mention in BUKU (2014).

The latest, which is Malaysia Higher Education Blueprint (MHEB) 2015-2025 (2015), previously known as National Higher Education Strategic Plan (Pelan Strategik Pengajian Tinggi Negara, acronym PSPTN in local language) that was launched in 7 April 2015, has outlined the Financial Sustainability among the 10 Shifts, is to **align the government funding to the institution performance**. In addition, the government also encourages the institution to pursue other source of funding, such as endowments and industry funding. Other shift has emphasized on **Empowered Governance**, with the objective to transfer various right decisions belonging to the government to the institution, subject to the pre-agreed **outcomes set out in a performance contract**.

In summary, USM shares the same motivating factors as the rest of the tertiary education sector nationwide to **continuously improve the performance**, namely:

- A large student enrolment population and securing the best candidate
- The quantity and quality of researchers, research and publications
- Government funding that is depended on performance measures, as well as other source of funding
- Accreditation and assessment data requirements for status, ranking and rating
- A government mandate to achieve greater performance (deemed world class)
- Retain and attract excellence staff

- Effective and efficient administration and management to support above factors

Taking into consideration of multiple platforms that have a set of own KPIs which require USM to achieve within similar period of time, the respond is by **strategically streamlining all the KPIs**. The output of streamlined KPIs will depict **USM overall performance** which at the same time fulfilling the KPIs at all platform. Executing the whole processes manually which involve, various schools and department (in local language known as Pusat Tanggungjawab, acronym as PTJ), a lot of documents, risk of data integrity, and communication issues to name a few, is painstaking, consume a lot of time and manpower and very unproductive.

Having this insight and realizing that huge of data/information is already captured and stored somewhere, USM turn to the information and communication technology (ICT). The objective is to improve the required process to provide the output that could be used to illustrate **USM overall performance**, fulfilling the various KPIs and at the same time could **assist into decision making**. In 2011, USM has embark on project known as USM Institutional Repository (USMiR) (2015), with specific Terms of Reference (TOR) to create a cohesive, useful and sustainable data repository to the university and eventually could be used and available online to **depict the USM overall performance** regardless of platforms, routine operating procedures as well as bureaucracies. The Committee has identified and decided to start with eight data sources as a pilot that needs to be integrated:

- i. Database of University Information System for Students (SMU-P)
- ii. Database of University Information System for Staff (SMU-S)
- iii. Databases of Grant and Community Network from RCMO Office
- iv. Database of Finance from Bursary Office
- v. Database Publication from Library Office
- vi. Database of Pattern from Innovation and Productivity Office



- vii. Database from Centre of Quality Office
- viii. Data from USAINS

Take **SMU-S database** for example, where most of the **academic staff data/information** activities were captured using **Human Capital Management System (HCMS)** online platform, stored and retrieved for **MyRA KPI performance monitoring** for all school in USM. This similar data will later be combined and correlated with other seven sources of data listed above as an input for MyRA at university level. The same sources of data also will be used as an input for APEX, D-SETARA, MHEB 2015-2025 as well as USM overall performance measurement and monitoring as long as it is being streamlined, standardizing and readily available.

Until today, the project could not deliver its objective and still struggling to standardize and continuously gather the data/information from the identified sources. So, the need of carrying out this study is to understand and find a solution to the problems faced by USMiR in meeting its objective towards measuring and monitoring USM performance based on predefined KPIs.

To understand and investigate the cause of this situation, four research questions have been identified as follows:

- i. What is the current mechanism in data/information gathering for USM to measure and monitor MyRA KPIs?
- ii. How is the current solution architecture for USMiR project?
- iii. How does current mechanism or standard operating procedure being implemented to continuously capture all identified data in USMiR project?
- iv. Why the current stakeholder momentum declining towards USMiR?

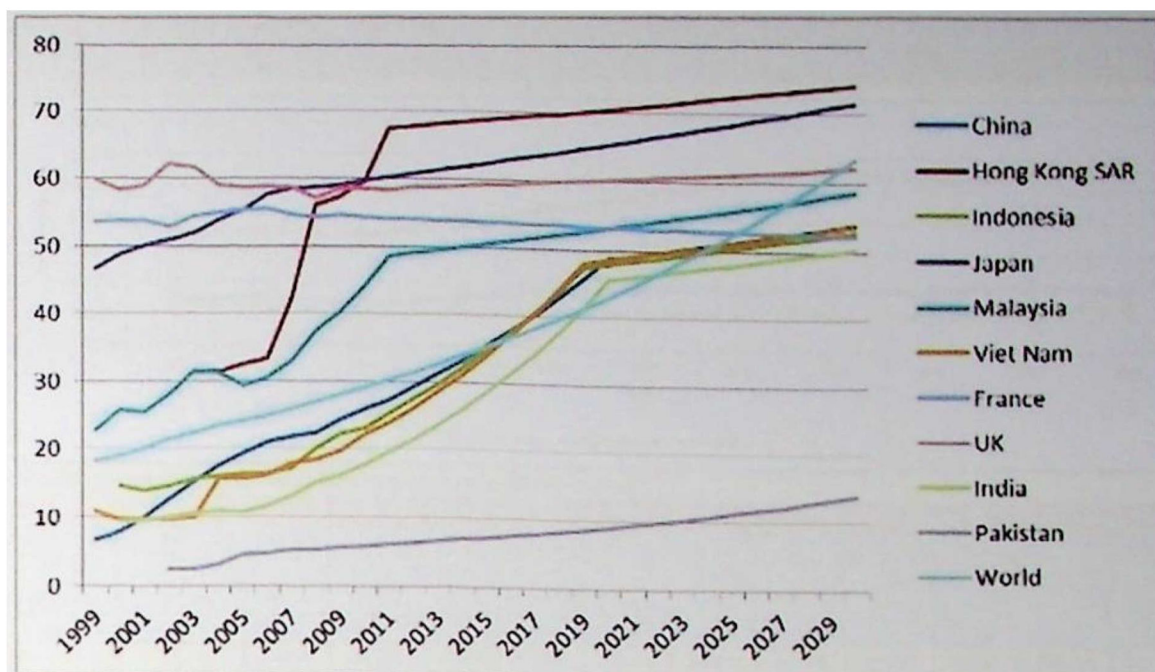
## 2.0 INDUSTRY BACKGROUND

---

Education at a Glance 2014 report which is published by Organisation for Economic Cooperation and Development (OECD, 2012) shows about 8 in 10 younger adults (aged 25 - 34) in the surveyed countries (34 OECD countries and 10 non-OECD countries) have completed upper secondary education which open access to tertiary education.

Accordingly in respond, higher education participation rates across the world surge further, in fact more than double over the past two decades. The global gross tertiary enrolment ratio (GTER) went up from 14 per cent in 1992 to 32 per cent in 2012, compared with just a four percentage point rise in the previous 20 years, according to the report by Simon Marginson, professor of international higher education at the UCL Institute of Education, depicted in Figure 2.1 (UIS, 2012) as calculated by author.

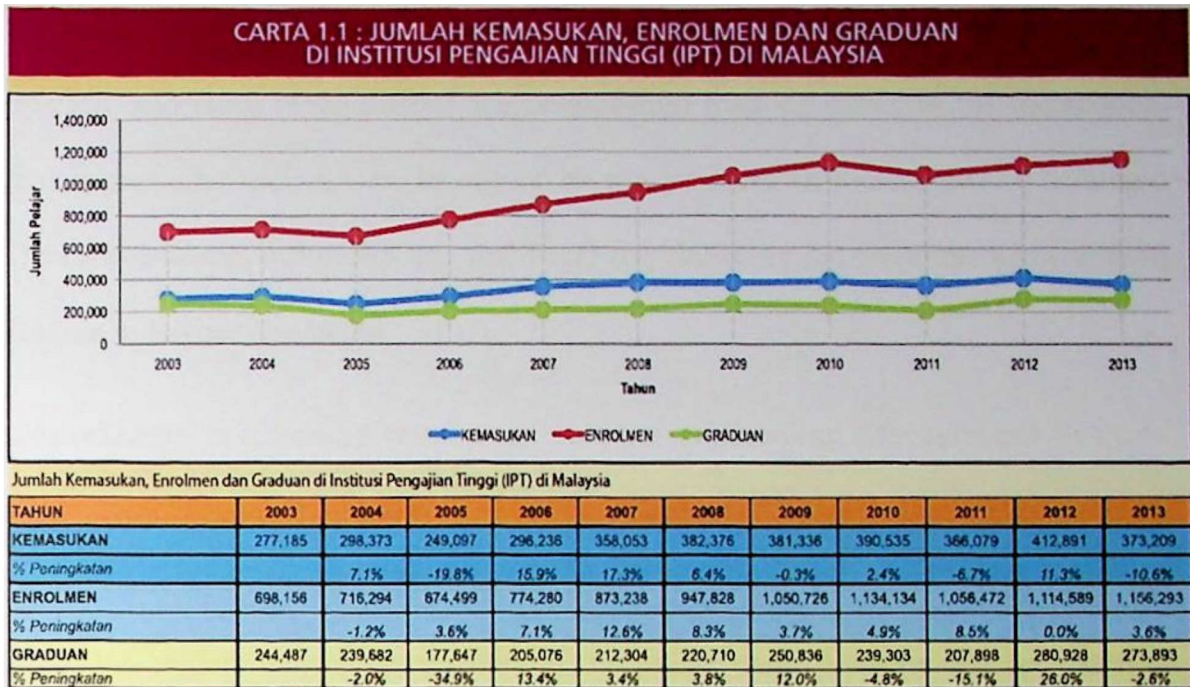
This glaring indicator, sometimes referred to as the “massification” of higher education - a pronounced shift in the role of tertiary education from, as stated by Dr Marginson, “Simply reproducing part of the social elite, to training a broad range of professionals, to adaptation of the wider population to rapid social and technological change.”



*Figure 2.1: Projected Gross Tertiary Enrolment Rates*

As well, the rise in internationally mobile students (student origin from other country) reflects growing university enrolment around the world. In 2012, at least 4 million students went abroad to study, up from 2 million in 2000, which representing 1.8% of all tertiary enrolments or 2 in 100 students globally. While, Malaysia is among top ten countries with around 55,600 students has study abroad, according to UNESCO Institute of Statistic (UIS, 2012).

MoE (2013) has reported that fast paced growth in tertiary education is also seen in Malaysia, with enrolment in tertiary educational institutions almost doubling from 698,156 to 1,156,293 students in the 10 year period between 2003 and 2013 as depicted in Figure 2.2.



*Figure 2.2: Malaysia's HEI Student Enrolment*

Increasing student enrolment in Tertiary education is highlighted again in MHEB 2015-2025. Based on 2012 data, with 48% of 1.4 million student enrolled in higher education couple with data of annual growth, the government has set the target of 70% out of 2.5 million student enrolled in higher education.

This growing influx of student into tertiary educational institutions around the world, couple with increasing demand from local student and goal set by the government, is a significant driver and leading indicator of the need for efficiently utilized, mining and analysis the data to harness the value of it for universities and other tertiary educational institutions to have competitive advantage.

Apart from the sheer volume of administrative, academic and personal data being generated simply as a result of the continued growth of the student population, there are other critical forces pushing tertiary educational institutions to evaluate, develop and deploy solution to effectively exploit the data.

University Business, a part of Edquater Hub, a publication company covering news, opinion, and event reviews from across education learning platform for the schools and higher education sector. In one of its many article (Ellucian, 2013), Strategic Decision-Making, accountability, and fiscal responsibility are common terms among leaders in Higher Education.

Desire2Learn is a leading commercial supplier of Learning Management Systems (LMS) to education institutions and provides access to Whitepapers on its website (<http://www.desire2learn.com/>), one of which (Charlene Douglas, 2012) cites the need for tertiary education institutions to prove their performance to external audiences in order to obtain funding and accreditation. An example of this need is the fact that many States in the USA have forms of performance funding, tying a percentage of budget allocations to an institution's achievement on specified performance criteria.

In recent years, organization leaders have become familiar with a platform and solution that provide dashboards, data visualization, benchmarking, analytics and data warehousing or currently popular with big data. They are the key components of **Business Intelligence (BI) solution architecture** that can help institutions make informed decisions in support of key strategies. Joint Information Systems Committee (2013), with the establishment objective to champion the use of digital technologies in UK education and research and in order to assist Higher Education understands the role and usage of BI, has launched a BI InfoKit for UK HEI via a webinar in 2013. The InfoKit is a result of the UK HEI-industry collaborating to address the importance, usage, and implementation of BI in Higher Education and reinforces the fact that BI is a vital element in decision-making. Its introduction indicates the level of interest that is building within the sector.

The Space-Time Research (2014) conclude that based on The 2014 'Higher Education Business Intelligence Conference' in Sydney, the need for more agile BI tools to help improve efficiencies in the sector which contributed to:

- i. Real-time decision making
- ii. A boost to productivity, performance and student services
- iii. Data analysis for critical insights into future market developments
- iv. The use of BI tools for forecasting future student load, course demand and commercial viability

In the meantime, they also acknowledge that while there were many issues being discussed, it was surprising to learn that many universities are still in the process of consolidating their BI capabilities, while others are still grappling with the basic concepts. The two key issues for many universities were the integration of their existing systems with BI tools, and lack of take-up due to the complexity of working with most of the BI tools on the market, mostly due to the need for customization and programming skill.

Thus, as discussed by Ellucian (2013), the adoption of BI in higher education has been considerably slower than in commercial arenas. One of the reasons is the complexity and uniqueness of higher education. 'In industry a unit is a unit; there is no debate about that. But in higher education, there are many variables, and that makes it much more difficult to measure outcomes.' says Matt McLellan, VP Sales and Marketing at Evision. 'The involvement of all departments and faculties in BI systems and initiatives provides a greater return on investment and helps managers to develop new strategies,' says Sarah Thompson, Account Director at Ellucian. 'Making use of these opportunities and implementing effective plans based on fact-based resource can provide a competitive market advantage and enhance an

institution's long-term stability.' Ultimately, the success of analytics is also dependent on people rather than on technology alone.

### 3.0 COMPANY BACKGROUND

---

USM is the second public university established in Malaysia in 1969 and was first known as Universiti Pulau Pinang. Started from an enrolment of 57 science based students, USM has grown and expanded, offering undergraduate and postgraduate programmes to 30,000 students locally and internationally.

USM employed around 10,500 staff, comprising of academic and non-academic.



Figure 3.1: USM APEX Emblem, Source: <http://www.usm.my>

USM is very committed towards transformation and sustainable development as stated in the Vision: "Transforming Higher Education for a Sustainable Tomorrow".

The commitment is emphasized again as defined in the

Mission: USM is a pioneering, transdisciplinary research intensive university that empowers future talents and enables the bottom billions to transform their socio-



economic well-being. Towards achieving the Vision and mission, USM determined to do the following which stated in 7 Client Charter:

- i. Empowering students with the values and characteristics that are accepted in local & global markets.
- ii. Empowering students to enhance future leadership talents to build a human capital that is holistic and sensitive to social issues and global changes in the process of nation building.
- iii. Empowering researchers to improve the research & innovation that are recognised and make an impact on society and the survival of a sustainable world.
- iv. Strengthening academic excellence through continuous professional development and keeping abreast with technology.
- v. Educating and strengthening efforts to realise the sustainability agenda of the University.
- vi. Strengthening University collaborations in various local & global strategic networks.
- vii. Strengthening the governance of the University through the improvement of quality & continuous professional development

Currently, USM consists of 5 campuses, the Main Campus and Sains@USM Campus in the island of Penang, an Engineering Campus at Nibong Tebal, Penang, an Advance Medical And Dental Institute at Kepala Batas, Penang and a Health Campus at Kubang Kerian, Kelantan. USM has 26 schools for undergraduates and postgraduates to further their studies and researches in following fields:

- i. Natural Sciences
- ii. Applied Sciences

- iii. Medical and Health Sciences
- iv. Pharmaceutical Sciences
- v. Building Science and Technology
- vi. Social Sciences
- vii. Humanities
- viii. Education

As well, USM has 17 dedicated research centers covering wide range of specializations which include archaeology, medicine and dentistry, molecular medicine, science and technology, Islamic development and management studies, and policy research and international studies. Dedication and commitment towards research and innovation, excellence record and high impact outcome has credited USM with the Research University (RU) in 2006. USM also provides consultancy, testing, and advisory services to the industry under provision of USAINS Holdings Sdn Bhd, the University's commercial arm.

The university operates on a budget of around a billion ringgit a year inclusive USM Hospital with most of its income coming from government grants (about 88%) and a small portion from tuition fees (12%) (BPI, 2013). As a government entity, USM is not run for profit. Nevertheless, USM is highly encouraged by the government to pursue self-generated income.

In 2008, USM was selected to implement the Accelerated Programme for Excellence (APEX) by the Ministry of Education (MoE). APEX is a fast track development programme to enable institutions of higher education to be recognized as world class entities. USM aspires to be champion in sustainability-led university globally (USM, 2015).

From data flow perspective, USM business and operation is governed and managed by key position as illustrated in Figure 3.2 below. Also to note, there are Departments, Centres and Offices being highlighted in below excerpted Organisation Chart which are directly involved in the case study.

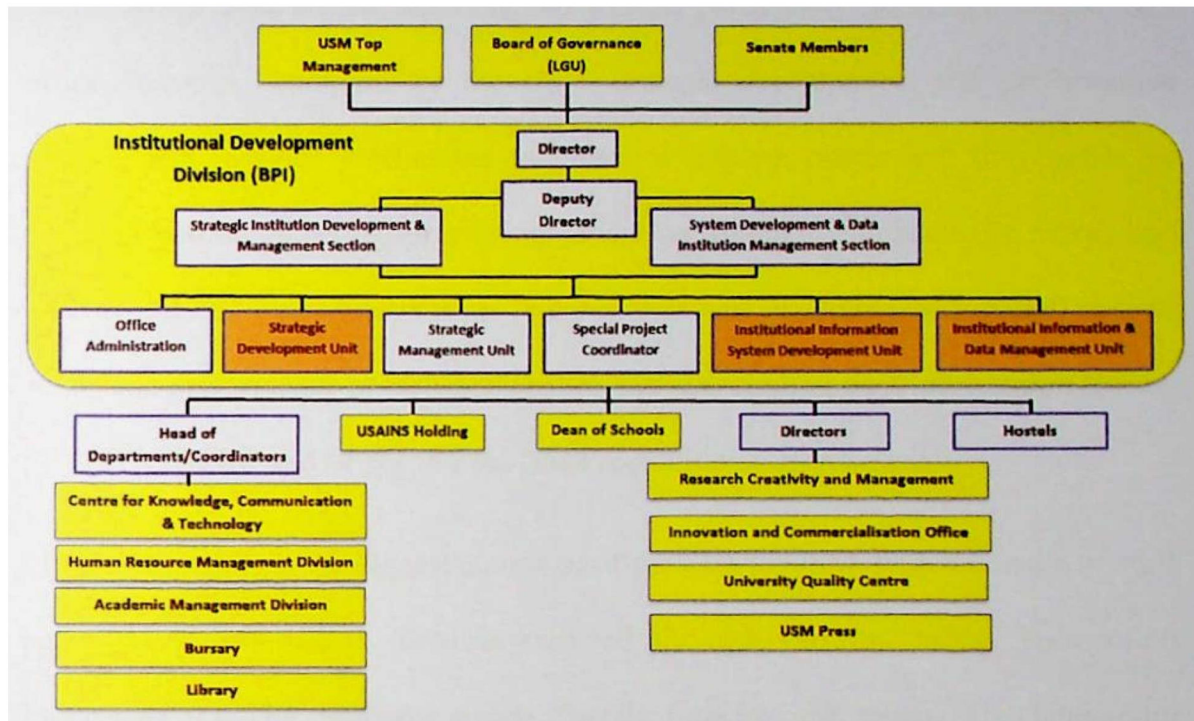


Figure 3.2: Data Flow Perspective, USM Organization Chart

In 1983, there were two primary data domains managed at USM. The first of these was student information, including enrolment and course management, was managed by the Institutional Development Division (Bahagian Pembangunan Institusi, acronym as BPI in local language). During that period Centre for Knowledge, Communication & Technology (Pusat Pengetahuan Komunikasi dan Teknologi, acronym as PPKT in local language) managed USM staff data, both academic and non-academic.

The outcome of the restructuring exercise in 2004, part of BPI that involve with data/information processing was moved under PPKT, with the objective to ensure smooth and efficient access and process of USM data/information. Since this change,

the BPI organization's primary function has evolved to provide Executive Information to the USM Top Management. The scope of the role also expanded to cover all data and information surrounding Critical Success Factors (CSF) which contributes to achieving USM's KPI as defined in the University's mission and vision which also in line with external parties, particularly MoE and MQA. BPI office becomes champion for the USM strategic development and performance management, provide mechanism and become process owner and the centre for data/information gathering, processing, analysing, mining and producing report and statistic to USM Top Management. Those outputs will illustrate USM overall current status and performance in facts and figures and also feeding data/information for the SETARA, APEX and MyRA for the USM accreditation assessment.

PPKT meanwhile is the biggest custodian of the data in USM, which consist of staff and student information. Data is captured through various Online Transaction Processing (OLTP) platforms which directly interact with users. The University Information System for Students, for example, consists of Student Affairs Information System (SMUPHEP), Examination Information System, Dormitory Information System (SMUPDESA), Post-Graduate Information System (SMUPIPS), Information System for Schools (SMUPPENG), and Information System for Registry (SMUPJPEND). Additionally, PPKT also captures and manage staff data in the Human Capital Management System (HCMS), Continuous Professional Development (MyCPD), Recruitment System (eRekrut), a system for staff furthering their studies (ASSIST) and Decentralised Staff Information System to name a few. Having student and staff data alone is far away enough for the USM to measure the overall performance. Those data at the same time need to be available at any time required, correlated with other data that could provide **multidimensional** view of

particular data. Taking example with academic data, multidimensional features will enable schools and USM to have a view from multiple combination of perspective as below:

- i. **Dimensions:** by program, school, gender, ethnicity, origin
- ii. **Measures:** by papers published and cited, funds and grants, expenditure, patent and commercialized product, teaching workload, student enrolment, training and awards to name a few
- iii. **Time:** daily, weekly, monthly, quarterly, semester, yearly

Apart from data managed by PPKT, as shown in Figure 3.2, data is also generated and hosted from the electronic Financial and Accounting System (eFAS), the Library Information System, the Emolument Information System, the Development Office Information System, the Information System from Research Creativity Management Office (RCMO) and Information Systems from Innovation and Productivity Offices. Moreover, data is also captured and held by the Division of Industrial & Community Network Information System Office, USAINS office, Healthcare Information and Management System (HIMS) as well as various Office Automation Systems and a many more data sources.

Based on USM performance requirement for analysis, reporting and statistic, as well for the accreditation participation for D-SETARA, MyRA and APEX which is streamlined and monitored by **Strategic Development Unit** in BPI office, data especially from all schools is gathered and processed using Microsoft excel format and formula. Some other data such as from bursary and RCMO is accessed and stored into database using SQL 'queries' by **Institutional Information & Data Management Unit** of BPI office. Later the data will be verified and audited against

multiple databases using SQL 'queries', evidence submitted by every school through manual comparison process and predefined rules. The output from these processes is mostly numerical which is subsequently rendered in graphs, charts, and diagrams for easier interpretation, report and statistic generation, as well will be load into appropriate platform such as KPI-MS System (KPI-MS, 2012), and APEX Monitoring System, which both of the platform are under custodian of **Institutional Information System Development Unit** of BPI.

## 4.0 CASE ISSUE

---

As discussed in Chapter 3.0 and illustrated by Figure 3.2, data in USM comes from various resources, captured through multiple online transactional **systems** and stored in multiple online transactional **databases**. Thus it is a challenge for the USM in general to ensure all the data can be continuously extracted, integrated, stored and retrieved regardless of routine in anytime.

### 4.1 Case Scenario

Among the understated scenario pertaining to data flow is data/information mostly confined at every schools/PTJs or particular database, need some processing time to be gathered, correlated, presented as a report or statistic, and hardly available at any required time by USM Top Management to assist the decision making.

Due to that, information that is captured and stored in multiple silos Online Transactional Processing (OLTP) and offline platform have **lack of integration**, thus has no multidimensional and correlated information.

Take example of MyRA audit process, an assessment instrument for Research University (RU), which is mandatory participation for all schools in USM and yearly audited by MoE. Point to note that, the entire MyRA audit process will involve eight identified source of information as listed in USMiR project. The entire process is governed by RCMO and BPI office which answerable to KPI/KIP committee, chaired by Vice Chancellor. It gets started from the information which is being regularly updated by all academicians in all school using HCMS online platform throughout the year. Twice a year, RCMO will ask all schools to submit their data to BPI through 37 Microsoft Excel forms that asked different information within three weeks. Among the forms are:

- i. Master list of Award
- ii. Master list of Memorandum of Agreement
- iii. Master list of Research
- iv. Section of Cumulative citation
- v. Section of List of Patent
- vi. Section of Product Commercialization
- vii. Section of Endowment
- viii. Section of Student Exchange

**Appointed Administration officer** at all school will collect all the required information from various sources such as HCMS, SMU-P interface, other soft and hard data evidence from school office, search at Scopus to get number of publications and eRND website at <http://ernd.usm.my/> to get grant information for each and every lecturer at school, as well International Office for network and linkages data. Then all the forms will be filled-up and the **statistic for every section** as defined by MyRA glossary will be manually key-in into KPI-MS online platform at <http://www.kpims.usm.my/> and captured under unaudited data. Later all the forms will be submitted to BPI office. Officers at BPI will confirm receiving data in hard and soft copy, cleansed the soft copy from viruses, key-in again into KPI-MS platform, inform and make a request to the school for any uncompleted information. Requirement for double key-in process is shown in Figure 4.1.



No	Criteria	PTJ	BPI	BPIComments
1	a. Number of Academic Staff (Including staff on study leave)	5	5	
	i. Professor	2	2	Dr. berdasarkan senarai induk yang diberikan Prof. M. Perayu
	ii. Associate Professor	1	1	
	iii. Senior Lecturer		0	
	iv. Lecturer	2	2	
	b. Number of Academic Staff (Not including staff on study leave)	5	5	
	i. Professor	2	2	Dr. berdasarkan senarai induk yang diberikan Prof. M. Perayu
	ii. Associate Professor	1	1	
	iii. Senior Lecturer		0	
	iv. Lecturer	2	2	
	c. Total No. of S&T Academic Staff	4	0	Perlukan kepastian. Senarai induk yang diberikan tidak menyatakan bilang staf sama ada S&T atau tidak.
	d. Total No. of Foreign Academic Staff	0	0	Dr. Berdasarkan senarai dokumen sokongan yang diberikan tidak staf bukan warga
2	a. Number of local and foreign UNDERGRADUATE students	0	0	
	i. Bachelor (Local)		0	
	ii. Bachelor (Foreign)		0	
	b. Number of local and foreign POSTGRADUATE students	41	41	

*Figure 4.1: MyRA Double Entry Requirement*

Apart from 42 schools of data, BPI office also needs to get data from various parties as listed below:

- i. Division of Industrial & Community Network (BJIM)
- ii. Bursary
- iii. Library
- iv. USM Press
- v. Training Unit
- vi. International Office
- vii. Usains Holding
- viii. Innovation and Commercialisation Office
- ix. Division of Research & Innovation
- x. Institute of Postgraduate Studies
- xi. Division of Students Affairs & Development
- xii. Human Resource Management Division
- xiii. Engineering Campus
- xiv. Health Campus

Those data is retrieve either from excel document, Innovation office and Usains

Holding for example or directly access to the OLTP database in the case of RCMO

for research related data and IPS for student data. Later, audit process will begin with submitted information from all schools will be verified against the data in-hand and evidence.

They need to do all these processes for all 42 schools various departments which is very time consuming with only eight persons.

Once all the data is audited and verified, then the data will be recorded under audited. KPI-MS is an online platform with built-in formula will auto-calculate KPI result in total marks scored by each PTJ based on statistic data. Then the platform will auto plot the bar chart that shows the PTJ's performance score in ranking, as shown in Figure 4.2. In addition, the KPI-MS platform also will auto-calculate the score by section, which is predetermined by MyRA KPI. The accumulated marks in every section will be totalled up that resulted in PTJs performance status whether, Sorry, Ok or Congratulation which is the highest achievement, as illustrated by Figure 4.3. Point to note that, this platform only capture statistic figure, for example, number of publication for each school, BUT the detail information such as who is the publisher still remain in submitted excel document. The auto-calculated result is rendered and displayed using graph, chart and table for easier interpretation.