A Framework for using Business Intelligence for Learning Decision Making with Business Simulation Games

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Abstract: This position paper will give an overview of the Business Intelligence (BI) learning framework which includes: (1) BI game; (2) data warehouse system; (3) self-service BI tools, and (4) learning assessment. The BI game is used as an educational platform to simulate business scenarios and business processes. The data warehouse system integrates all of the business transactions and results from the BI game and provides a single point of truth for analytical information. During the business processes, self-service BI tools are used to access data marts for business analytics by both students and instructors. The learning assessment component is used to evaluate students' knowledge and skills in BI and 21st Century skills.

1 INTRODUCTION

The evolution of modern *Business Intelligence* (BI) is from *Decision Support Systems* (DSS) which has emerged since the mid-1960s (Power, 2007). This decision support technology is still an important research topic in the realms of both industry and universities (e.g., DSS2.0 Conference 2014). Recently, Gartner (2013) published a survey result reported that BI has been in the top rank of CIO global technological priorities for several years – 2009, 2012 and 2013. However, the skill gap in the BI field was still significantly up to 60% of reponses from 2,053 CIOs of 36 industries across 41 countries. This skill gap has both a negative and short-term impact on business (Gartner, 2013).

Based on the survey from BI Congress 2012 regarding the status of BI in academia, there were several significant challenges in teaching and learning BI, for instance, access to data sets, finding suitable cases, providing realistic and meaningful experiences (Wixom et al., 2013). Several BI instructors have attempted to improve their BI teaching and learning methods and have considered alternative methods, for instance, proposing course components and learning objectives to teach data warehousing and data mining (Fang et al., 2006), teaching data warehousing and data mining using case projects (Rob et al., 2007), teaching BI using cloud computing technology (Mrdalj, 2011), teaching BI with puzzle-based concept (Presthus et al., 2012), proposing a pedagogical design and method for a practical technical module for a nontechnically oriented BI course (Wang et al., 2013), concerning an experiential learning concept in teaching BI (Podeschi, 2014).

As well as this, the labour market will need more new skills and more new ways of learning (Redecker et al., 2011). Thus, it is not only BI skills that are needed for the next-generation BI workforce (Wixom et al., 2010), but also the 21st Century skills for European Community.

Game is one aspect of the technology trend that will be able to support the future of learning to build up new skills (Redecker et al., 2011). Game characteristics, for instance, competition and goals, choice, rules, fantasy and challenges, can contribute and sustain 21st Century skills (Romero et al., 2014). Moreover, business simulation games have been known as one of the most effective education methods for teaching and learning managerial skills (e.g., Faria et al., 2009; Wawer et al., 2013; Williams, 2011).

Therefore, the BI learning framework (see Figure 1) is proposed to contribute learning and teaching BI for the next-generation BI workforce concerning both BI skills and 21st Century skills. The framework consists of four components as follows:

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(1) BI game – an educational platform to provide simulation realistic business scenarios, data sets, suitable cases with meaningful experiences; *(2) Data Warehouse (DW) system* – an information service to support business managerial decision making; *(3) Self-Service BI (SSBI) tools* – a personal business analytical tool to analyse and monitor business performance management, and *(4) learning assessment* – a set of evaluation methods for students' learning outcomes.

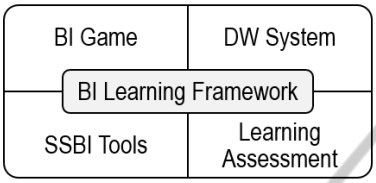

Figure 1: The four components of the BI Learning Framework.

2 BI GAME

BI game is a kind of computerised business simulation game for teaching and learning BI. Since there have been several empirical studies indicating that business simulation games enable students to learn how to make a decision, manage the business process in a modern enterprise, link between abstract concepts and real world problems and improve quantitative skills (e.g., Ben-Zvi, 2010; Wawer et al., 2013; Williams, 2011). Most of business simulation games were developed based on different learning objectives, for instance, inventory management, strategic management, marketing management, business terms. However, the learning objective of *BI game* focuses on the BI concept, knowledge and skills for managerial decision support.

BI game has been developed by the research team of BI Academy (BIA) – the learning portal and community for teaching and learning BI (www.bi-academy.eu). The prototype was launched since February 2014 and has been tested with students in several European universities.

BI game is based on the conceptual framework (see Figure 2). In each business activity students implement the management process cycle to make a decision (Gluchowski et al., 2008).

The objectives or competence goals of the game focus on students' learning for both *(1) 21st Century skills* and *(2) BI skills* – which are about using OnLine Analytical Processing (OLAP) tools for decision support, creating OLAP-based business

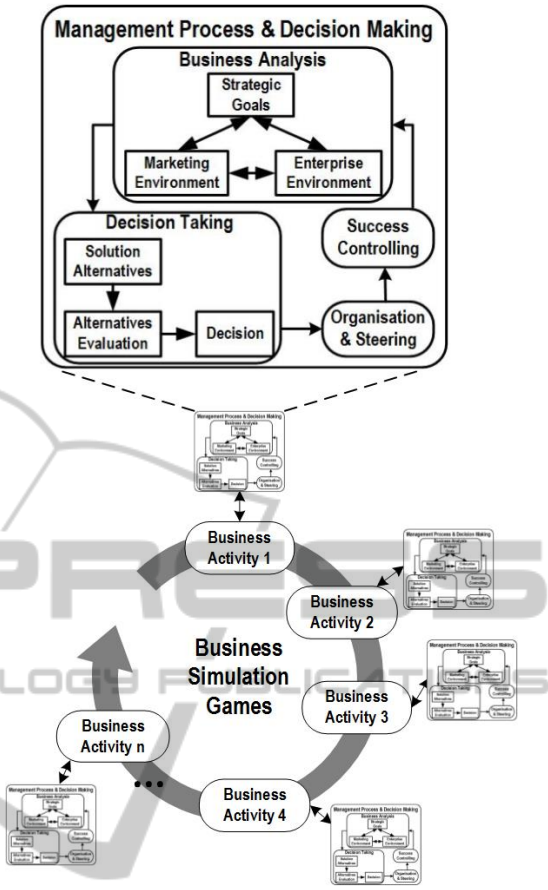

Figure 2: A conceptual framework for the BI game.

planning, designing a multi-dimensional model, designing an ETL process, appling data mining concepts and running business based on BI concepts by using SSBI tools as a business analytical tool.

The organisational or event format of *BI game* has six steps (see Figure 3). Firstly, students are assigned into groups randomly and each group represents a city opening a new bike shop. Then, they have been introduced to *BI game* and the bike marketing situation based on the city. Students have to present their business plan to get an initial market share for starting their business. Secondly, students book the initial settings for a store location, product mix, required employees and marketing campaigns. After the initial settings (step 2), the data generator with an embedded simulation algorithm generates the revenue based on the input business parameters. Next, students can access the data access layer of the ERP system, learn how to apply SSBI tools, analyse the data and make a decision to refine their business strategy.

Later, during the game play before going on each step (step 3 to 6), business problems - which are

based on the learning objectives - are given to students. The business problems should lead students to use SSBI tools to generate OLAP reports, OLAP-based business planning models, data mining models, what-if scenarios or Balanced Scorecard (BSC) dashboards.

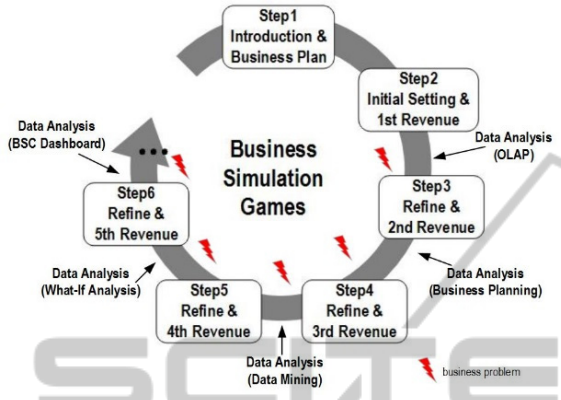

Figure 3: The organizational format of the BI Game.

The advantages of our *BI game* are as follows: (1) the implementation with modern technology (e.g., cloud computing); (2) the flexibility in the number of BI teaching modules (e.g., multi-dimensional modelling, ETL process, OLAP reports, business planning, data mining, what-if analysis, dashboard); (3) the flexibility of the duration for running the game (e.g., three days, one week, one semester); (4) the contribution for international students; (5) the usage of BI vendor university alliance programs (e.g., Microsoft MSDN Academic Alliance, SAP University Alliances); (6) the system scalability which can handle large amount of players at a time, and (7) the learning assessment to analyse learning outcomes.

3 DATA WAREHOUSE SYSTEM

"A data warehouse is a subject-oriented, integrated, non-volatile and time-variant collection of data in support of management's decision making process" (Inmon et al., 2008, p.7). It integrates heterogenous and distributed data sources. Users, therefore, are able to have access to the same sources of analytical information, gain insights of their business performance and can make better decisions which will help them to balance all levels of their business strategies (Poe, 1996). The major advantange of data warehousing is to support the vertical integration (Oehler, 2006) between different management levels – operational, tactical, and strategic – and provide a *single point of truth* for enterprise information (Inmon et al., 2001). Moreover, a data warehouse is a good practice solution for information logistics and is considered as a reference architecture to underpin a successful BI project.

With the data warehouse system component, BI learning framework can handle data from the business simulation game and learning process. Its development is based on the technical framework (see Figure 4).

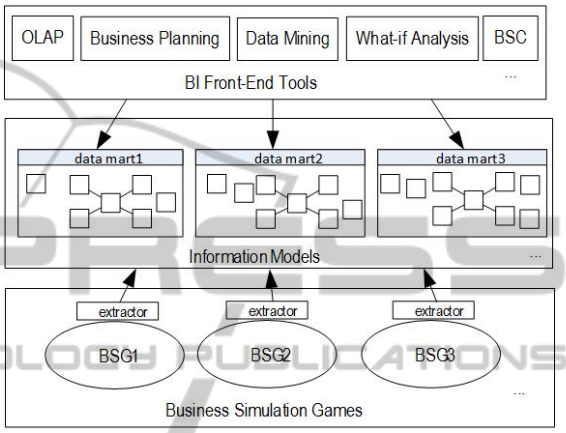

Figure 4: A technical framework for the BI learning framework.

Data sources originate from business game application and the data generator engine simulates the revenues and costs. All are based on the initial settings, initial market share and proposed business plan. The game data is stored in a game server and later will be **e**xtracted, **t**ransformed and **l**oaded (ETL) into the data warehouse system. All transactional and master data from game are stored as a relational model in Operational Data Store (ODS) layer of the data warehouse system (see Figure 5).

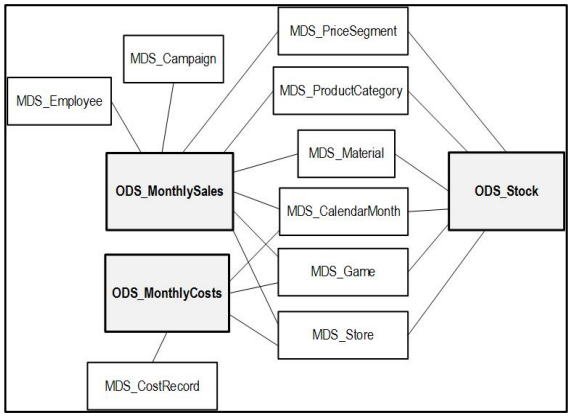

Figure 5: The relational model in ODS layer.

Later, students are assigned to design an information model for their data mart, design an ETL process and create an ETL package to populate data into data marts. Consequently, students can use SSBI tools to carry out business analytics and improve their business performance in accordance with the rights to access their data only.

4 SELF-SERVICE BUSINESS INTELLIGENCE

Self-Service Business Intelligence or SSBI is a new advanced BI technology. It provides an environment whereby users can easily create their own data models and analyse data by themselves (Imhoff et al., 2011). There are several types of information workers that are involved in using SSBI. These are: information producers, information consumers, information collaborators and Data Warehouse (DW) or BI builders (Imhoff et al., 2011).

SSBI tools cover the front-end applications of BI landscape as follows: *(1) presentation tools*, for instance, reporting and dashboards; *(2) analysis tools*, for instance, OLAP analysis and data mining; *(3) visualisation tools*, for instance, displaying data with maps or various types of charts and graphics; *(4)* integration tools, for instance, adding external data into the BI data model, and *(5) data discovery or exploration tools*, for instance, using ad-hac query (Aziz, 2014). OLAP is considered as a core technology of BI for decision makers to view data from a variety of perspectives and visualise summarised information with respect to business performance from various analysis with scorecards and dashboards (Richards et al., 2014). Moreover, modern SSBI tools will be able to access various data sources from different providers and more data mart structures (e.g., relational model, multi-dimensional model, flat files).

Students will be the next-generation BI workforce for the (business) community. They need to have more analytical skill and make faster and better decisions based on information they have in-hand. So, the faster they make a decision, the more they can save the business value (Hackathorn, 2003).

In the BI learning framework environment, students learn in a short period how to use SSBI functionalities in a tool – such as an electronic spreadsheet – to conduct business analytics concerning the business problems and learn to use SSBI tools improving their decisions based on fact. The usage of BI tools are, for instance, applying data mining concept to analyse the prospective customers for a mailing list, creating OLAP-based business planning for the next years procurement, designing a dashboard to monitor the sales performance by using Key Performance Indicators (KPIs), etc.

Instructors also can monitor how students run their business and solve the business problems, for instance, using OLAP-based reports to assess the overview of profit for each group of students (see Figure 6) and a dashboard to see the revenue for each store by price segment (see Figure 7).

ID_GAME	3						
CITY_NAME	Friedrichshafen						
	Column Labels						
Row Labels	2015.01	2015.02	2015.03	2015.04	2015.05	2015.06	2015.07
City Bikes							
Sum of SALES_AMOUNT	7	9	26	29	35	30	26
Sum of REVENUE	7.506	8.485	24.826	26.155	31.062	26.784	25.105
Sum of TOTAL_TRANSFER_PRICE_EUR	5.669	6.319	18.518	19.378	22.968	19.818	18.748
Sum of DISCOUNT_IN_EUR	0	0	0	0	0	0	0
Sum of GROSS_PROFIT_EUR	**1.837**	**2.166**	**6.308**	**6.777**	**8.094**	**6.966**	**6.357**
e Bikes							
Sum of SALES_AMOUNT	5	7	18	21	24	21	18
Sum of REVENUE	21.569	30.604	77.241	87.738	102.309	87.738	77.241
Sum of TOTAL_TRANSFER_PRICE_EUR	16.206	23.084	57.944	65.292	76.599	65.292	57.944
Sum of DISCOUNT_IN_EUR	0	0	0	0	0	0	0
Sum of GROSS_PROFIT_EUR	**5.364**	**7.520**	**19.297**	**22.446**	**25.710**	**22.446**	**19.297**
Fun Bikes							
Sum of SALES_AMOUNT	2	2	5	5	5	5	4
Sum of REVENUE	998	998	2.495	2.495	2.495	2.495	1.996
Sum of TOTAL_TRANSFER_PRICE_EUR	599	599	1.497	1.497	1.497	1.497	1.198
Sum of DISCOUNT_IN_EUR	0	0	0	0	0	0	0
Sum of GROSS_PROFIT_EUR	**399**	**399**	**998**	**998**	**998**	**998**	**798**
Kid Bikes							
Sum of SALES_AMOUNT	12	16	48	56	68	60	44
Sum of REVENUE	2.361	3.148	9.444	11.018	13.379	11.805	8.657
Sum of TOTAL_TRANSFER_PRICE_EUR	1.180	1.574	4.722	5.509	6.689	5.902	4.328
Sum of DISCOUNT_IN_EUR	0	0	0	0	0	0	0
Sum of GROSS_PROFIT_EUR	**1.180**	**1.574**	**4.722**	**5.509**	**6.689**	**5.902**	**4.328**
Mountain Bikes							
Sum of SALES_AMOUNT	9	20	47	55	67	59	47
Sum of REVENUE	22.391	47.580	103.753	124.345	145.833	129.141	108.453
Sum of TOTAL_TRANSFER_PRICE_EUR	16.574	35.007	75.529	90.843	105.935	93.901	79.469
Sum of DISCOUNT_IN_EUR	0	0	0	0	0	0	0
Sum of GROSS_PROFIT_EUR	**5.817**	**12.574**	**28.224**	**33.502**	**39.898**	**35.240**	**28.985**

Figure 6: Sample of an OLAP-based report.

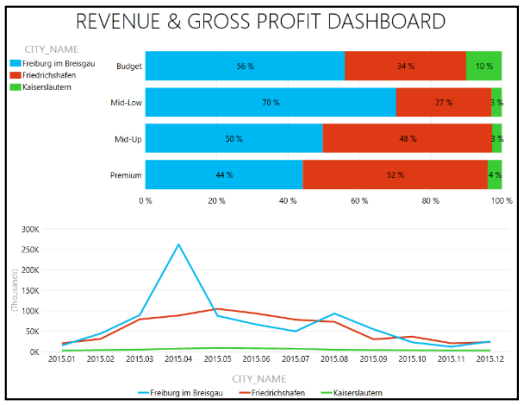

Figure 7: Sample of a dashboard.

5 LEARNING ASSESSMENT

There are at least three groups of skills that are needed for today's BI users as follows: *(1) analytical skills* – e.g., data mining, statistical analysis; *(2) IT skills* – e.g., data mart model, ETL process, and *(3) business knowledge and communication skills* – e.g., business functions,

ability to explain what is being analysed (Andoh-Baidoo et al., 2014). However, the diversity of SSBI tools and features are not trivial to use. As most of users focus on consuming the information, while others focus on producing the information. Consequently, SSBI tools could be difficult to use for some users or with a high risk to be overused by other users (Eckerson, 2012).

The next-generation BI workforce needs also to have 21st Century skills – collaboration or teamwork, communication, ICT literacy, social or cultural skills, creativity, critical thinking, problem solving, productivity, learning to learn, self-direction, planning, flexibility, risk taking, manage conflicts and sense of initiative (Romero et al., 2014). Additionally, there are two methods that are primarily used for the competency assessment: (1) self-assessment, and (2) evaluation of results from business simulation game by the instructors (Karl, 2013).

Therefore, the learning assessment for the BI learning framework will be categorised into three parts as follows:

(1) self-assessment – students are requested to complete the questionnaires before and after playing BI game. They evaluate themselves for BI skills and 21st Century skills.

(2) game results – students should pass the course or get a certificate, as and when they are able to run a business well. The game results also will be used to compare between each group for discussion or debriefing (Crookall, 2010).

(3) SSBI usage – students' level of BI skills depend on how advance they are able to use SSBI tools for data analysis as shown in the organisational format of BI game.

6 CONCLUSIONS

Our BI learning framework provides a closed-loop model started from the initial settings of business parameters based on business strategy. All business settings are stored in the ERP server, information requirements and data marts are modelled, developed and deployed in the data warehouse server. Business analytics are performed in order to make reasonable decisions and later students are able refine their business model for the next cycle.

This closed-loop approach helps students to learn to manage the performance of the business processes and is able to align business goals and processes consistently (Martin, 2014). Additionally, students are able to understand the impact between each business process because it involves human intervention to improve the way decisions are made (Kerremans et al., 2012).

We believe that the BI learning framework provides a modern, integrated and easy-to-use platform which will overcome the limitations and challenges in learning and teaching BI. Moreover, students will improve their BI skills and 21st Century skills through their learning process and have better understanding how to use BI to support decision making.

Furthermore, we are working on the integration of more business scenarios into the framework, in order to leverage BI maturity and improve 21st Century skills for students.

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