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BALANCED SCORECARD AUTOMATION SYSTEM IN HIGHER EDUCATION INSTITUTIONS

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ABSTRACT: Due to the importance of managing organizational performance in directing organization towards achieving its goals, a lot of measuring tools were developed to measure organizational performance. One of the most important measuring tools is Balanced Scorecard (BSC) that balanced between measuring the performance from financial and non-financial aspects of organizations. Although the BSC has been applied widely in many organizations, its implementation was limited to a few studies in the public educational sector. Also, most of BSC implementation was manual or through spreadsheet applications like Microsoft Excel, which made the process of tracking the performance challenging and unorganized. Therefore, the purpose of this work is using technology to solve a major managerial issue by automating the BSC in a full-scale system that enables the user to track, monitor and evaluate the performance continuously, to ensure that organization is moving in the right direction to achieve its goals. The system applied in government higher education institutions, and specifically in King Abdulaziz University (KAU).

KEYWORDS: Balanced Scorecard, BSC, organizational performance.

INTRODUCTION

The revolution of information technology in 21st century prompted organizations to develop a strategic plan that can keep up with the rapid development of technology (Kaplan & Norton 1996). A lot of organizations become more focused on implementing an E-strategy that reflects the future position of the organization taking advantage of latest technologies (Kaplan & Norton 1996). E-strategy defined as a set of arranged policies and procedures that aim to develop economic and social aspects of the organization by using Information and Communication Technologies (ICT) (Kamel 2010). An important point must be clarified: E-strategy is not an IT strategy it's how to capitalize information technology to improve organization's performance and position in the market (Nayeri, Mashhadi & Mohajeri 2008).

One of the most effective management tools for implementing strategies and measuring organizational performance is Balanced Scorecard (BSC) (Kaplan & Norton 2004). BSC is a set of matrices that helps organizations to activate their strategies and turn them into actions. BSC help to measure organizational performance through four different perspectives reflect the financial and non-financial aspect of organizations. BSC perspectives are learning & growth perspective, internal processes perspective, customer perspective and financial perspective (Kaplan & Norton 2004). Each perspective in BSC gives managers an answer for a critical question (Kaplan and Norton 1992):

• Is the company able to develop and create value? This question represents learning and growth perspective. The goal of the perspective is to set all organization's techniques, infrastructures, and abilities that push organization toward achieving its goals.

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- What should the company excel at? Represents internal processes perspective. The perspective focuses on internal methods that organization use to reach customer satisfaction, and control organization's internal activities.
- What are customers' opinions about the company? Represents customer perspective. The core of this perspective is to meet customers' needs as well as prompt organization image in the industry.
- How does the company deal with shareholders? That represents financial perspective. Financial perspective focuses on developing the relationship with the shareholder, and improves the financial status of the organization. It should be mentioned here that the non-profit organization focuses on this perspective on how to invest in its internal resources to earn value (Chen, Yang and Shiau 2006).

The role of the BSC is translating strategy objectives into targets that represent numerical goals to achieve, key performance indicators (KPIs) also called measures and represent the measurable value of achieving objectives, and initiatives that represent action plans for the objectives (Kaplan and Norton 1992).

Research problem:

A lot of studies conducted on BSC topic, and many profit organizations in different fields adapting BSC matrix after formulating their strategies and objectives (Yu et al, 2009). But a few studies focus on BSC implementation in nonprofit organizations and specifically in higher education institutions (HEI) (Papenhausen & Einstein 2006). As the nations' economy is based mainly on education, HEIs have an important role in the renaissance of nations' economy. So any HEI should concern not only on formulating its strategic plan but also concerned about how to activate it to reach HEI its future objectives and vision (Nayeri, Mashhadi & Mohajeri 2008).

By focusing on one of the biggest government universities in Saudi Arabia, which is King Abdulaziz University (KAU) in Jeddah, found that KAU formulates its strategy and objectives based on five important strategic themes. Strategic themes are: teaching & learning, social responsibility, scientific research, entrepreneurship, leadership & management (Strategic Plan II-King Abdulaziz University 2009). After conducting the strategic plan, the university prepares different performance tracing forms supervised by the Strategic Plan Committee to see the progress of implementing agreed projects & programs, and ensure achieving strategic objectives (Strategic Plan II-King Abdulaziz University 2009). Performance tracing forms adapted based on the concept of BSC. And despite that, it didn't achieve the most important goal of BSC which is monitoring and tracking the performance continuously from one integrated source. Furthermore, it didn't engage all university members to unify the efforts for one purpose which is achieving university's goals. All of that necessitating developing the concept of BSC implementation and make it more dynamic and effective, by automating the BSC in a full-scale system.

Research Objectives

The main goal of this work is developing BSC automated system that can be adapt in HEIs. The system implemented in KAU as a model, to control the process of measuring university performance through achieving its strategic objectives. The developed system aims to enable the user to:

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1. Construct

- Setting BSC objectives, KPIs, targets, and initiatives
- Updating and modifying BSC objectives, KPIs, targets, and initiatives
- Add new achievements
- 2. Track
 - Tracking KPIs achievements through indicators that show KPI status at the moment.
 - Monitoring the performance from different organizational level of the university.

3. Evaluate

• Extracting periodical reports for performance.

LITERATURE REVIEW

Performance Measurement

Based on Kaplan and Norton (2004) principle "you can't manage what you can't measure", a lot of researchers in the past few decades focused their studies and researches on how to measure organizations performance to manage the business in the optimal way (Kaplan & Norton 2004). Teague and Eilon (1973) explained the purpose of performance management from helping the organization to reach its goals to control corganization processes. In addition, performance management evaluates the performance of the organization as a whole or the internal teams and individuals. Performance management depends on different metrics to measure performance called performance measurements (Neely, Gregory and Platts 1995). Neely, Gregory and Platts (1995) identified Performance measurements as the process of measuring the efficiency and the effectiveness of certain job. Efficiency and effectiveness are fundamental dimensions of performance, where efficiency refers to the degree of company investment in resources, and effectiveness refers to the degree of customer satisfaction. (Neely, Gregory and Platts 1995).

A lot of researches have emerged during the 1970s to 1980s, criticized the traditional way of measuring the performance that focused only on financial perspectives and how to gain more revenues (Kaplan, 2010). In the late 1980s, the process of measuring performance started to change, and many researchers encouraged to concentrate more on non-financial measures like quality, on time deliveries and employee ethics that benefit companies in the long term (Hoque 2014). Researchers' orientation at that time prompted Fitzgerald (1991) to come up with a performance model consist of six measures that are: financial success, competitiveness, quality, resource utilization, flexibility, and innovation.

Balanced Scorecard

After a year of study, Kaplan and Norton (1992) proposed to the world the idea of combining financial and non-financial perspectives in one model called balanced scorecard (BSC) because it balanced the view between financial and operational measures. Benefited from Fitzgerald

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(1991) model, Kaplan and Norton developed a model in 1992 collects all six measures into four perspectives. The perspectives are learning and growth perspective, internal processes perspective (it combines quality, resource utilization, and flexibility dimension), customer perspectives, and financial perspectives. Kaplan and Norton defined BSC in their article as a set of matrices that enables corporations to measure their performance more comprehensively and from different aspects (Kaplan and Norton 1992).

After Kaplan and Norton article in 1992, a lot of private and public organizations started implementing BSC as a part of its strategic management system and even admitted its value and importance to achieve strategic goals. BSC helped organizations to (Kaplan & Norton 1996):

- 1. Make regular reviews on performance to improve and update company strategies.
- 2. Link short-term objectives with long-term objectives and annual targets.
- 3. Specify strategic initiatives to achieve company's goals.
- 4. Align the goals of departments and individuals with organizational strategy.

In 1996a, Kaplan and Norton published a book called (The Balanced Scorecard: Translating Strategy into Action). The concept of BSC model was developed to show objectives linked together in cause and effect relation as drivers and outcomes.

Early in the second millennium, some statistics shows that half of US enterprises already implemented BSC, which led to increasing the number of companies that provide services helped in BSC implementation process (Marr & Neely 2003). One of the researchers claimed that companies need only papers and pencil or spreadsheet program to implement BSC, but managers found that is a long and slow process in BSC implementation (Marr & Neely 2003).

Balanced Scorecard Implementation

After reviewing BSC background and development phases, let's take a deep review on BSC implementation in HEIs, since the scope of this work focused on HEIs sector.

Although the proliferation of the BSC concept in the business industry, it is not applied widely in the education sector (Chen, Yang and Shiau 2006). Universities around the world are seeking for excellent academic staff and researchers, which resulting in the increase of universities quality outcomes and improve its reliability and value proposition (Aljardali, Kaderi and Tadjine 2012). For these reasons, some researchers turned to study how to measure universities performance using the BSC.

One research examined the possibilities of BSC application in India and discussed the benefit of implementing BSC in Indian universities, with the absence of any specific Indian case study (Umashankar & Dutta 2007).

Papenhausen and Einstein (2006) highlighted an important point in their study about BSC implementation in the college of business in the US, which is the lack of research that focused on applying BSC in the non-profit organization especially educational organization. Therefore, Papenhausen and Einstein (2006) relied in their implementation on what Kaplan and Norton cited in (2004), that non-profit organizations don't focus on the financial perspective as a goal and mission, instead these organizations can rearrange BSC perspectives to place customer

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perspective at the top, then internal process, learning and growth and at the bottom financial perspective. But from another side, a study conducted in Taiwan believed that financial perspective should be at the top, for both profit and non-profit organization. Because the non-profit organization has to make sure that the organization has suitable mission and vision, then in a good financial position to be able to maintain the stability of organization performance (Chen, Yang and Shiau 2006). All of this shows that BSC perspectives can be personalized based on individual needs and organization orientation and believes.

Although a few studies that have focused on BSC implementation in the Middle East, and fewer studied BSC implementation in HEIs. Lebanese study emerged in 2012 taking advantage of Kaplan and Norton (1992) BSC and Umashankar & Dutta (2007) framework for BSC implementation. The study developed a model that is composed of four components which are: BSC, Human Resources (HR), Information system (IS), and authority of university deans. The proposed model is a conceptual framework with all essential elements that helps in the process of implementing BSC in public HEIs (Aljardali, Kaderi and Tadjine 2012).

Balanced Scorecard Implementation in Saudi Arabia

By reviewing some of the latest research in the field of BSC in Saudi Arabia found that Al-Aama (2013) published a paper addressed the importance of prioritizing BSC perspectives based on the organization type: profit organization or nonprofit organization or government. Al-Aama (2013) study how to develop BSC in IT Department at the Jeddah Municipality (JM), by placing financial perspective at the bottom, and customer perspective at the top as the most important outcome of the organization, to suit more JM orientation as a government organization. The research also suggests two tools that can be used to support BSC implementations. The first tool is Project and Strategic Objectives Matrix that is used to map each initiative with one or more objectives in JM BSC. The other tool is Project and Budget Planning Matrix, which focus on the weight of initiatives so that the higher initiatives priority has a priority in funding.

Al thunaian (2013) conducted research to evaluate the implementation of BSC in King Faisal Specialist Hospital and Research Centre (KFSH-RC). Al thunaian (2013) stated that BSC in KFSH-RC consists of five perspectives which are: Medical Care, Education and Research, Quality of Care, Financial, and Employees.

Technical Studies in Balanced Scorecard Implementation

Despite the development of studies in BSC implementation, but most of those studies focused on manual or Excel sheet implementation of BSC through developing frameworks and applying some measurement methods (Yu et al, 2009). BSC needs to be visualized in order to take the most advantage of its implementation and to give managers more comprehensive and materialize view of developed BSC. Therefore, a study was conducted in Malaysia to developed e-BSC prototype that measures academic staff performance in universities by aligning each lecturer objectives to university goals and strategy. E-BSC enables each lecturer to identify his targets, and then monitor his performance in order to achieve the targets. The users of the system are academic staff that is responsible for updating the system with achievements, faculty dean who is responsible for setting facility KPIs based on university KPIs, system administrator who manage and monitor the system and finally appraiser who monitor individual and facility performance and assign performance scores. Researchers used step-by-step workflow of the e-BSC to visualize the flow of system activities (Yu et al, 2009).

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As noticed through this literature review, in the last ten years a lot of organizations start to focus more on BSC development and implementation. But in HEIs (especially non-profit ones) studies shows that BSC application is not widely diffuse (Chen, Yang and Shiau 2006). Furthermore, most of BSC implementation was manually implemented or applied in spreadsheet applications like Microsoft Excel (Papalexandris et al, 2005). As been shown, by focusing on the Middle East and particularly in Saudi Arabia found that BSC implementation was limited to few studies (Al-Aama, 2013). All of this necessitating taking BSC implementation to the next level by developing an automated full-scale BSC system that measures the performance from one integrated source and directs the organization towards achieving its goals. The system applied in KAU in Jeddah to develop the performance in one of the biggest universities in Saudi Arabia.

RESEARCH METHODOLOGY

The goal of this work is to develop the process of measuring performance in HEI by using BSC. The research implemented on KAU as a model. But first, it's important to review all possible BSC implementation approaches with advantages and limitations (Table 1) to make sure that the chosen approach is the best approach to follow in BSC implementation.

	Advantages	Limitations
Manual (pencil & papers)	Easy to useLow cost solution	 Difficult to monitor & track the performance Not scalable Lack of integrity
Spreadsheet applications (Microsoft Excel)	 Users familiarity with Microsoft applications Low cost solution 	 Difficult to monitor & track the performance Not scalable Lack of integrity Can't display BSC dynamically in GUI
BSC as a full scale system	 Scalable High level of security Continues monitor & track of the performance. Ability to extract periodical performance reports. Possibility to alter or edit BSC components and list of credential users Flexible to suit organization requirements. Dynamic GUI Communication between users and developer is smooth and fast. 	 Complexity in development Needs user training

 Table 1: Summary of possible BSC implementation approaches

European Journal of Computer Science and Information Technology

Vol.5, No.4, pp.25-49, August 2017

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BSC software packages	 Scalable Continues monitor & track of the performance Ability to extract periodical performance reports Possibility to alter or edit BSC components and list of credential users Dynamic GUI 	 Costly solution Needs user training with software developers Not flexible to suit organization requirements. Communication between users and developer is difficult and slow.
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It can be concluded now that building a full-scale system is the best solution to adapt BSC concept in any organization and specifically in HEIs

Analysis Phase

The first step of building BSC system is studying the current process of managing the performance in HEI, and analyzing HEI strategic plan. After that, it's important also to study how to improve the way of measuring the performance in HEI (Papalexandris et al, 2005).

Understand HEI's vision, strategy, and performance management system

Have a deep understanding of HEI's vision, strategy and performance management system is a critical stage in BSC automation project (Papalexandris et al, 2005). First, it's important to know HEI strategic directions, to be able to specify the suitable order of BSC perspectives in the developed BSC. Since the system implemented in KAU it should be noted that KAU is Government University, which means that government invests in citizens and provides community services by allocating specific budget for the University (Al-Aama, 2013).

KAU vision is "Globally distinct sustainability of university and community partnership" (Third Strategic Plan for King Abdulaziz University "TAZEEZ" 2015). The vision is seeking to reach global excellence at all university levels (educational and institutional). Vision also aims to focus on community service to achieve individuals, groups, privet or public organization partnership. KAU vision conjoins five educational strategic themes (ESTs) that university adopts in its strategic plan which is (Third Strategic Plan for King Abdulaziz University "TAZEEZ" 2015):

Teaching and Learning, Scientific Research, Social Responsibility, Entrepreneurship and Leadership and Management.

KAU Strategic plan formulates every five years and contains university mission, vision, values, strategic objectives, initiatives (projects & programs to achieve university objectives), KPIs for each initiative and responsible parties about achieving the KPIs (KPI owners) (Strategic Plan II-King Abdulaziz University 2009). University objectives described the internal and external environment of the university and divided over ESTs based on objective orientation.

Measuring performance process in KAU passed through several phases as followed (Third Strategic Plan for King Abdulaziz University "TAZEEZ" 2015):



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Figure 1: Measuring Performance Process in KAU

After formulating university objectives, objective KPIs are defined to set measurable value for each objective. Then initiatives are specified that contains actionable programs and projects to be followed toward achieving university objectives. After that responsible individuals or parties to achieve the objectives are assigned and timetable to follow is determined. Then tracing performance forms are conducted to find out objective achievement percentage. Tracing the performance works as a sequence of cause and effect, starts from tracking project achievements that lead to program achievements then objective achievements and finally effect on vision achievements as the highest level. After conducting tracing forms and starts working on achieving university objectives, bi-annual achievement reports are prepared as a milestone in performance measuring process. Then achievement reports are presented to the university president.

The current process of measuring the performance in KAU is not accurate because it's done manually through paper forms and Excel spreadsheets, which make the process of monitoring the performance and measuring the achievements very hard and takes a lot of time and effort (Marr & Neely 2003). The developed system makes measuring the performance process controllable, more effective, and from one integrated source that involved a larger segment of university's members. Figure 2 below shows how measuring performance process implemented in the system.

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Figure 2: Measuring Performance Process in BSC Automation System

The first step is constructing the BSC with all its components objectives, KPIs, targets, initiatives and objective duration. Then distributing objective target (goal value) and baseline (current value) conducted over all university organizational levels. After that assigned staff members starts adding new achievements that will reflect automatically over all university levels. Then performance can be traced easily through colored indicators that represent status of the objective, and by extracting performance reports from the system.

Data Collection

As mentioned earlier KAU plan conducted every five years, so the focus in the system was to implement university strategic plan for 2016-2020 which titled (Strengthening of the national transformation). BSC in the system depend on the four BSC perspectives and five. BSC components distributed in a tree structure consist of different objectives on the intersection between BSC perspective and EST. Under each objective there is one KPI and target, and different initiatives that help to achieve the objective.

Objectives distributed over perspectives and ESTs based on the orientation of the objective and what it serves. Figure 3 below clarifies the framework of the BSC in developed system.

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It should be noted here that financial perspective at the top has been replaced into vision perspective to suit KAU directions as a government HEI.

BSC automation system implemented in a hierarchy of four levels which are: BSC on university level, BSC on faculties' level, BSC on departments' level and BSC on staff members' level. The hierarchy structure of the system helps faculty, department and staff member levels to inhernet university's (top level) objectives and KPIs. And that inheritance helps all organizational level of the university to concentrate all efforts on achieving university's main objectives, even if the adopted programs and projects to achive these objectives deffer. System hirarchy structure also helps to distribute university's targets over faculties, then distribute faculty's targets over faculty's department.

Since the system was implemented over all organizational levels of the university, it has been taking into consideration all KAU faculties (20 faculty represent main faculties' headquarters) and departments (124 departments of the main headquarters faculties). As for staff member level, it has been taking a sample of one to two staff members under each department, and that sample represents staff members from different managerial level. Staff member could be: academic administrator, institutional administrator, administrative employee and academy professor.

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BSC automation system implemented over a sample of most comprehensiveness objectives of KAU. It has been focused on 20 objectives from KAU strategic plan for 2016-2020 (Third Strategic Plan for King Abdulaziz University "TAZEEZ" 2015). The 20 objectives distributed over the four BSC perspective and the five ESTs based on objective orientation. The table below contains all university objectives applied in the system.

	Teaching & Learning	Scientific Research	Social Responsibility	Entrepreneurship	Leadership & Management
Vision Perspective	Increase Jobs Opportunity for University Graduates	Increase access to patents in the research fields	Enhance university image in community	Support and activate business incubators	Achieve global excellence
Customer Perspective	Qualify students intellectually and behaviorally	Increase the publication of scientific research	Offer awards for best participation in community services	Qualify and support talented students	Achieve academic accreditation standards for all programs
Internal Process Perspective	Sustainability of teaching quality	Establish support and assistance unit for researchers	Provide courses and advisory services to community	Develop talent and innovation programs	Develop integrated quality management system with international standards
Learning & Growth Perspective	Attract excellent academic staff	Sustainabil ity of scientific research	Prepare social responsibility and community needs guide	Establish innovation lab	Promote culture of quality and excellence

Table 2: BSC objectives in the system

Under each objective there is KPI, baseline, target, initiative, objective duration and follow up frequency. For example the table below (table 3) shows one of university objective and its details

Table 3: Examp	le, Objecti	ve details
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Objective	KPI	Baseline	Target	Initiative	Duration	Follow-up frequency
Increase the publication of scientific research	Number of scientific research	460	1000	 Support science researches with global achievements Create mechanisms to increase university research citation 	2016- 2020	Monthly

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- 1. KPI: represents measurable value that shows how effective the objective achieved.
- 2. Baseline: represents the initial achieved value before start working on achieving the objective.
- 3. Target: represents numerical value to achieve. Target and baseline values divided in the system into five data types as followed:

Table 4: Target & Baseline Data Types

Data type	KPI (Examples)	Baseline (Examples)	Target (Examples)
Number	Number of published scientific research	400	1000
Percentage	Percentage of developed educational programs	20%	100%
Yes or No	Existence of assistance unit for researchers	No	Yes
Ratio	Number of activities taken by students	0.5:1	5:1
Ranking	University ranking worldwide	300	120

- 4. Initiative: represents action plan, projects and programs to achieve the objective.
- 5. Duration: represents the time specified to achieve the objective, and since the work is applied in HEI, (semester / year) time frame was adopted.
- 6. Follow-up frequency: represents recurrence duration for the user to enter the system and add new achievement, and it could be: yearly, quarterly, monthly, half month, weekly and daily, and it depends on objective nature.

How to measure the performance?

The main question in this work is how university performance will be measured through developed system. Performance measuring in general depends on the following basic steps in figure 5:



Figure 5: Performance Measurement Steps

Setting target relies on a series of processes, starting from formulating strategic plan to identifying detailed objectives. The process of formulating strategic plan and objectives needs a lot of studies and analyses to identify internal and external strength, weakness, opportunities

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and threats of organization. There is many technique that can help to formulate strategic plan and objectives like SWOT analyses (strength, weakness, opportunities, threats) (Kamel 2010). The details of all these processes will not address here, since it's out of research scope. After specifying objectives and setting target for each objective, work begins to achieve defined KPIs by recording any new progress. The third step is measuring objective progress which means measuring the achievement of the KPIs, and it's calculated based on this basic equation:

$$Achievment\% = \left(\frac{Actual}{Target}\right) * 100$$

Where Actual: refers to value that recorded as a new achievement.

Target: refers to numerical value to achieve.

In BSC automation system the first two steps entered to the system by the user and the third step calculated automatically through the system. Now will be explained in details how these steps implemented in developed system.

1- Setting baseline and target

As mentioned before one of BSC variables defined in the system is baseline that represents achieved value before start working on KPI, and since the system implemented over all organizational levels of KAU, both values target and baseline should distributed from university level to lower levels.

• University Level

On university level user specified target and baseline values for each objective while constructing new BSC. Target reflects value that user looking forward to achieve, and baseline reflects the total baseline values of all facilities. Target value in university level should be more than baseline value.

• Faculties Level

On facilities level user distributes target values of university's objectives over university's facilities, and distributes baseline value that reflects the total baseline values of departments under each faculty. Target value in faculties level can be more than or equal to baseline value, because facilities and lower levels is deeper and more branched than university level, so some faculties may not require to accomplish more than what it already accomplished.

• Departments Level

On departments level user distributes target values of faculty's objectives over faculty's departments, and distributes baseline value that reflects the total baseline values of staff members under each department. Target value in departments level can be more than or equal to baseline value.

• Staff members Level

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On staff members level user distributes target and baseline values of department's objectives over department's staff. Staff member who get part of target distribution is responsible to work on achieving that target based on his already achieved value (baseline). Target value in staff member level can be more than or equal to baseline value.

As mentioned earlier, BSC automation system enables user to enter baseline and target values in different data types. Number, percentage and ratio data types distributed normally over all levels lower that university level, based on size of faculty or department. But yes/no and ranking data types have a special case in distribution, and that is refers to their nature. Yes/no values can't be distributed to lower levels, so it takes the same value from upper level. As for ranking data type, it represents the rank of university and the rank can't be distributed to lower levels. what happens is that all levels under university level takes the same value of ranking from university level, and staff member level try to work on achieving higher rank for university that will reflects automatically over all organizational levels of university.

2- Adding Achievements

In BSC automation system the process of adding new achievements to defined KPIs happens from the lowest level of hierarchy. All staff members who get part of target distribution from their departments are responsible to work on achieving these targets and enter their achievement values to the system.

3- Measuring Achievement

Measuring the achievement% starts from the lowest level which is staff member level then achievement reflects to upper levels.

• Achievement% on staff members level

When staff member enter new achievement, system automatically calculate achievement percentage. In BSC automation system baseline value was taken into account along with target value in achievement% calculations. And the following equation was adopted:

$$Ach\% = \left[\frac{Actual}{(Target - Baseline)}\right] * 100$$

Let's take an example on how to calculate Ach% for each target data type. Below table shows sample of KAU objectives and KPIs from 2016-2020 strategic plan (Third Strategic Plan for King Abdulaziz University "TAZEEZ" 2015) with baseline and target values in each data type.

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	Objective	KPI	Baseline	Target
Number	Attract excellent academic staff	Number of excellent academic staff	20	50
Percentage	Sustainability of scientific research	Percentage of stored researches	60%	100%
Yes / No	Establish assistance unit for researchers	Existence of a unit	No (0%)	Yes (100%)
Ratio	Qualify students intellectually and behaviorally	Number of activities taken by students	0.5: 1 = 50%	5: 1 = 500%
Ranking	Achieve global excellence	Global university ranking	rank 274	rank 100

Table 5: Example, How to calculate Ach%?

Now based on variables in above table, the calculation of achievement% over a period of time for all target data types was clarified in below table.

	Befo (Basel	ore ine)	Ja	n	Feb		Mar		Apr		May	
lber	*B	20	*A	10	Α	5	Α	10	Α	3	Α	2
Num	*Ach%	0	Ach%	33	Ach%	50	Ach%	83	Ach%	93	Ach%	100
entage	В	60%	Α	10%	Α	15%	Α	5%	Α	10%	Α	-
Perce	Ach%	0	Ach%	25	Ach%	63	Ach%	75	Ach%	100	Ach%	
/No	В	0%	Α	Yes	Α	-	Α	-	Α	-	Α	-
Yes	Ach%	0	Ach%	100	Ach%		Ach%		Ach%		Ach%	
tio	В	0.5:1	Α	1:1	Α	2:1	Α	1:1	Α	0.5:1	Α	-
Ra	Ach%	0	Ach%	22	Ach%	67	Ach%	89	Ach%	100	Ach%	
cing	В	274	Α	170	Α	145	Α	130	Α	110	Α	100
Rank	Ach%	0	Ach%	60	Ach%	74	Ach%	83	Ach%	94	Ach%	100

Table 6: Cont. Example, How to calculate Ach%?

* B: Baseline value, A: Actual value, Ach%: achievement%

The table shows that before start working on the KPI and records any achievements, the ach% for all KPI types equal 0%. Once the user start enter new achievement (A), Ach% value will increased based on Ach% equation. The actual value takes its cumulated value over specified period of time.

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Since the system implemented over all organizational level of university, there is a variance in target distribution between entities from the same level. Therefore, weighted achievement should be taken into consideration beside achievement%. Weighted achievement depends on target weight that calculated based on university target as followed equations:

University target weight = 100%

Faculty target weight: W Faculty = (T Faculty * 100) / T University

Department target weight: W Department = (T Department * 100) / T University

Staff target weight: W _{Staff} = (T _{Staff} * 100) / T _{University}

Where W: weight and T: Target

As for weighted achievement equation it is:

$$Weighted \ Achievement = \left[\frac{Actual}{(Target - Baseline)}\right] * W$$

The figuer below shows how the wieght calculated in system herarchy by taking Faculty of Computing and Informaton Technology (FCIT) and one of KAU objectives from 2016-2020 strategic plan (Third Strategic Plan for King Abdulaziz University "TAZEEZ" 2015) as an example. The objective is: Increase the publication of scientific research, KPI is: Number of published scientific research.

T: Target, B: Baseline and W: Wieght.



Figure 6: Target, Baseline Distrbuting and wieght calculation

• Achievement% on departments level

Achievement% for each department is the total actual values of staff members under that department based on department target and baseline. The equation is:

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$$Ach\% = \frac{\sum staff \ Actual \ s}{(Target - Baselien)}$$

For ranking and yes/no data types, achievement% from staff member level will reflected as it is automatically on department level.

• Achievement% on Faculties level

Achievement% for each faculty is the total actual values of departments under that faculty based on faculty target and baseline. The equation is:

$$Ach\% = \frac{\sum Department \ Actual \ s}{(Target - Baselien)}$$

For ranking and yes/no data types, achievement% from staff member level will reflected as it is automatically on faculty level.

• Achievement% on University level

Achievement% on university level is the total actual values of all faculties of university based on university target and baseline, the equation is:

$$Ach\% = \frac{\sum Faculties \ Actual \ s}{(Target - Baselien)}$$

For ranking and yes/no data types, achievement% from staff member level will reflected as it is automatically on university level.

Performance Indicators

When KPI owner entered new achievement, colored indicators will occurred to show the level of progress in KPI to achieve the target. A scale of 13 colors developed to facilitate the process of monitoring the performance, and to motivate KPI owners to come up with greater achievements. The scale of indicators is illustrated in figure below with Ach% result intervals.

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Figure 7: Performance Indicator Scale

As shown the scale starts with dark red as zero achievement up to dark green as 100% achievement. Blue shades reflect achievements more than 100%, and black color means that achievement doubled and exceeded the target.

Performance Evaluating

One of the basic goals of this work after measuring the performance is the ability to evaluate it. Developed system enables the user to extract performance reports for analytical overview and evaluating purpose. Performance report that system support are:

• Overall View Reports

This view shows an overall performance through BSC objectives with its cross ponding colored indicators. The view supports all system levels.

• Objective Wise Reports

Objective view is more detailed view that shows the performance based on each objective in BSC, and enables the user to make a comparison between objectives in performance.

• Perspective Wise Reports

It's another detailed view that display the performance based on BSC perspectives, by taking the average of all achievement% value under each perspective. The view enables the user to make a comparison between perspectives in performance.

• ESTs Wise Reports

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This view provides reports in performance based on ESTs, and it takes the average of achievement% value under each EST in BSC. The view enables the user to make a comparison between ESTs in performance.

These are the basic reports currently supported by the system, and there is a possibility to add more according to needs in the future.

Set up System Requirement

Moving to operational side of the work, BSC automation system developed as a web based system. The developing environment of the system was visual studio, and C# was the programming language, as well as SQL server for database.

Modeling Phase

To identify system users and visualized their interaction with the system, use case diagram was conducted as follows in (figure 8).



Figure 8: Use case Diagram

The system includes five users' categories, and their roles will be clarified as followed:

- System Admin who's responsible about identifying system users and specifying their authorities, and adding new faculty and department under identified faculty.
- University Agent who's responsible about identifying new BSC according to university plan, setting BSC details (objectives, KPIs, targets, baseline, initiatives, objective

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duration and follow up frequency), distributing target and baseline over university's faculties. University agent can also extract performance reports from the system for evaluating purpose, and monitoring objectives achievement from university level.

- Faculty Agents (agent for each faculty) responsible about distributing objective targets over faculty's departments, and can extract faculty performance reports and monitor performance from faculty level.
- Department Agents (agent for each department) responsible about distributing objective targets over department's staff. Department agent has also the ability to extract department performance reports and monitor performance from department level.
- Staff members responsible about adding new achievements to objectives, extract staff performance reports, and monitor performance from staff member level.

Research Results

BSC automation system developed as a web based system, and below screens shows the main views in the system.

- Define new user
 - Actor: System admin

In this page system admin can add new user, and give user access to the system.

	Sta	uff Page
ff Name	Staff Role	Select
ulty Select.	Department Name	
ername	Password	

- Construct new BSC
 - > Actor: University agent

Here university agent can define new BSC by specifying its duration.

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Home		
		dit BSC Page
BSC Duration: From Date Semester1 •	2016 • To Date Semester3 • 2020 •	
Main BSC ID		
Description Plan2016 - 2020		
Save		

- Add objective
 - > Actor: University agent

In this page university agent is able to set all objective details.

Home						
			Ad	d Objective	Page	
Objective Duration:	From Date Select.	Select To Date	Select • Selec	1. 7		
Perspective	Select.					
Strategic Theme	Select.	٠				
Objective						
KP5						
Target Types	Select					
Reseline						
Target						
Initialise						
Follow up Frequenc	Select. *					
Add Cancel						

- Set university objective
 - Actor: University agent

Here university agent can monitor objective achievement form university level through colored indicators. The same view also supported on faculty level, department level and staff member level for faculties' agents, departments' agents and for each staff member.

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Hame							Set D	nivers	ity BS	æ		
BIC Descrip Find BSC	fion Plan2016	2020 • E	fucational Sita	degic Them	e Téachi	ng And Learnin						
	Objective	KPIType	KPIName	Baseline	Tarpit	Interior	Duration	Follow Up Frequency	Weight(%)	Weighted Achievement(%)	Table Achievement(55)	Indicate
Mage	Increase Jobs Opportunity for University Graduates		Percentage of graduates peting jobs after 5 months of graduation	85.0P	10.00	5-Bludy the effect of educational occornes in tabor market 2-Clustifying graduates by enter the vicational tests	From Bern1 2016 No Sent3 2020	Quetty	100	67.27	57.27	1
Gustamer	Guardy students interfectually and behaviorally	Ratu	Number of activities taken by students	90.00	505.00	1-Motivate attidents to participate in global conferences 2-Support students to participate in university activities 3- Motivate	From Been1 2018 No Sect0 2018	Weekly	100	19.36	19.36	

• Distribute target over faculties

This page enable university agent to distribute university's targets for each objective over faculties. The same view supported to distribute faculties' target over department, and departments' target over staff members.

lome						
	Distribute Target Over Faculties F Back Increase Jobs Opportunity for University Graduates					
bjective						
	Faculties	Baselines	Targets			
Faculty of Engineering		6.00	7.00			
Faculty of Science		2.00	4.00			
Faculty of Computer & Information Technology		4.00	6.00			
Faculty of Environmental Designs		1.00	2.00			
Faculty of Economics and Administration		4.00	6.00			
acuity of Arts a	5 Humanities	1.00	4.00			

- Add achievements
 - Actor: Staff member

This page enable staff member to add new achievement to selected objective, then automatically calculates ach%.

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lack	Add New Achievement Page
lack	
······································	
Directive Increase Jobs Opportunity for University Graduat	tes
inget Type Persentage	
arget 1 00	
ate Select. • Select. •	
ew Actual	
udd .	
Data Actual Achievement	
Aug 2016 0.40 80.00 Edit Delete	

• Evaluate performance

Here is an example of report views in the system.

o Overall view

$\begin{bmatrix} 1 & \\ \end{pmatrix}$ of 1 \Rightarrow	P-8 [Fund Name 🛃 •	
		Universi	ity Overall View
		Plar	2016 - 2020
Educational St	rategic Theme: Te	aching And Learning	
Perspective	Objective	Achievement Value	
Vision	Increase Jobs Opportunity for University Graduates	E	57.27
Customer	Qualify students intellectually and behaviorally	1	9.36
Internal Process	Sustainability of teaching quality	4	11.03
Learning And Growth	Attract excellent academic staff	11	3.33

• Objective view

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Research Boundaries

This work concerned about implementing BSC in HEIs, and focused on Appling ESTs over institution objectives that is special for educational institutions only. The work also devoted on implementing BSC in Government Universities, through changing financial perspective in BSC to vision perspective to be more suitable for Government Universities. The developed system implemented in KAU in Jeddah and can be adopted in any government university or any non-profit HEI.

CONCLUSION

Since Kaplan and Norton first article about the concept of BSC that explained the importance of measuring organizational performance from more comprehensive perspective, many organizations adopted BSC matrix in its performance management system (Hoque 2014). Despite the wide implementation of BSC in different profit organization, its implementation in non-profit and government organizations was not so wide (Al-Aama, 2013). Also most of BSC implementations were through peppers or spreadsheets application or through expensive BSC shelf software (Marr & Neely 2003). All of this was an incentive to take BSC implementation to another level that makes the process of measuring the performance in organizations more effective and accurate.

This work focused on implementing BSC. And because educational institutions are considered to be the cornerstone of any society, it's important to focus on how these institutions monitor its performance to reach its objectives.

The focus of this work was on developing BSC system that can measure the performance in HEIs, and the system implemented on KAU as a model. The system was implemented in hierarchy structure that covers all organizational levels of university, to ensure alignment of objectives over all levels. The five ESTs were dropped over BSC matrix to make sure that university's objectives serve all these themes. BSC automation system enable large segment of

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university staff to be part of achieving university's objectives. Users in the system can construct new BSC, add objectives under perspectives and ESTs, distribute targets and baseline values of university over lower levels, add new achievements and extract performance reports that provide summary of performance results from different views.

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