Integrating the Balanced Scorecard and Web Analytics for Strategic Digital Marketing: A Multi-criteria Approach using DEMATEL

Dimitris K. Kardaras
School of Business, dept. of Business Administration
Athens University of Economics and Business
Athens, Greece
e-mail: kardaras@aueb.gr

Bill Karakostas
VLTN GCV
Antwerp, Belgium
e-mail: Bill.karakostas@vltn.be

Stavroula Barbounaki
Merchant Marine Academy of Aspropyrgos,
Aspropyrgos, Greece
e-mail: sbarbounaki@yahoo.gr

Anastasios Papadopoulos
School of Business, dept. of Business Administration
Athens University of Economics and Business
Athens, Greece
e-mail: anastasiopapadopoulos@gmail.com

Stavros Kaperonis
Dept. of Communication Media and Culture
Panteion University
Athens, Greece
e-mail: skap@panteion.gr

***Abstract*—Web analytics tools provide a wide range of information regarding the performance of a company. This information is valuable for assessing the strategic performance of a company. However, Web analytics tools at their current state of development fall short in providing all the necessary information and data analysis functionality that is required to assess the strategic performance and the digital marketing priorities of businesses. This paper utilizes DEMATEL (i.e. Decision Making Trial and Evaluation Laboratory) method in order to investigate how the Balanced Scorecard Model can be associated with data collected from the Google analytics. The data in this study are collected from the management and the Website of a company that provides tourism services in Greece. This research also examines the potential of using Web analytics in strategic decision analysis.**

Keywords-Google analytics, DEMATEL, Digital Marketing Analytics, Multi-Criteria Analysis.

I. INTRODUCTION

Information that can be found on Web analytics tools relates to the number of visitors, their demographics, their location, the paths of Web pages they visited, etc. Such information is valuable in assessing the current performance of a firm but also in planning its future development. Firms have already recognized that business activities on the Web are of particular importance for their growth. Subsequently they increasingly invest in digital marketing [1], [2]. Indeed, spending in digital marketing, including paid search, display advertising, social media advertising, online video advertising and email marketing will account to 46% of all advertising in five years from 2017, and it is expected to reach $120 billion by 2021 according to [3]. In another survey, by [4], 65% of marketing leaders surveyed in the US plan to increase their spending on digital advertising, due to factors that impose a continuing and consistent shift of offline media spending to digital advertising, a decline of organic social in favor of paid social and the rising importance of video, which is more expensive than other digital techniques.

On the other hand, a large number of strategic planning frameworks, such as the Balanced Scorecard (BSC), have been developed with the aim to assist top management designing the future development of their businesses across business sectors. For example, in logistics services, within the context of the SELIS ('Towards a Shared European Logistics Intelligent Information Space') research project, it is important to establish the conceptual links between Web analytics and business performance, i.e. to identify the appropriate KPIs (Key Performance Indicators) and model their interrelationships. Despite the large number of studies pertaining to strategic decision making, little research has attempted to integrate business strategic frameworks with Web analytics. Few are also the studies who attempt to explore the potential of Web analytics in strategic planning. [1], [2], and [5] argue there is very little academic or empirical work examining how Web analytics might impact an organization and what benefits they might bring. They have examined the strategic use of Web analytics but they did not investigate how Web analytics affect or affected by business metrics and KPIs defined in strategic frameworks such as the BSC. The need to develop a BSC model that

 ISBN: 978-1-61208-603-3

takes into consideration the recent developments in e-business and Web analytics has already been recognized. An application for a "balanced web analytics scorecard" patent has been submitted in the US in 2014 by SAP (Systems, Applications and Products) AG (Aktiengesellschaft (i.e. in German: Stock Corporation) [6]. A balanced Web analytics scorecard considers perspectives, objectives and (KPIs) based on Web analytics. According to the patent application, the balanced Web analytics scorecard suggests at least one perspective related to Web-based activities, such as a traffic generation perspective, a visitor engagement perspective, a growth and innovation perspective or an e-commerce perspective. Scores for Web analytic-based measures are calculated based on the Web analytics, while the patent suggests that updated balanced Web analytics scorecards can be stored and be made available on a computing device. The consideration of multiple KPIs implies multi-criteria methods' suitability for assessing the business strategic performance. This paper suggests the use of DEMATEL, which is well established and used in similar studies [7]. The DEMATEL is proposed for it allows decision makers, e.g. business managers, to express their beliefs regarding the inter-relationships among KPIs, as well as to indicate their business priorities. In addition, the DEMATEL produces the cause-effect model that can be used to simulate several strategic scenarios and investigate their impact on the KPIs in consideration.

Thus, this research aims to:

- Propose a multi-criteria approach for identifying and assessing the interactions among the perspectives defined in the Balanced Scorecard model and Web analytics.
- Evaluate analytics tools, such as the Google analytics, as strategic analysis tools, and suggest ways for their improvement.

II. THE BALANCED SCORE CARD

The BSC is considered, by many managers, as an important tool in strategic management [8]. The use of the BSC is based on the visualization, through a specific drew up shape, of a company's strategic management plan [8]. The BSC is a model for the measurement and the performance analysis of all types of businesses. It was developed by Kaplan and Norton [9], [10]. They argued that the mere consideration of the established financial criteria was not enough to measure the business performance, since financial criteria could not represent all aspects of businesses. Therefore, they suggested that the (KPIs) of a company should also include measures related to the products, the company's interaction with its customers, the holistic view of company's internal processes and the outcome of the organization's activity to improve, innovate and develop its business procedures [9], [10]. The combined consideration of both financial and non-financial criteria offers the company's management a comprehensive list of measures that reflect various aspects of the business and its current outcomes as well as indicate the potential for the business to react or even preempt against the fast changing requirements of the market's environment [11]. The BSC can be used as an additional supportive asset for the company management during decision making and it can directly contribute to the formulation of long term value based relationships with the stakeholders [8]. A BSC considers four perspectives namely, the Financial, the Customer, the Internal Business Processes and the Learning and Growth, with the associated (KPIs) for each perspective. An example of a BSC is shown in Figure 1.

Figure 1. [12]

In order to examine its research objectives, this study focuses on the financial and customer perspectives, for simplicity reasons.

III. METHODOLOGY AND METHODS

3.1 Methodology for evaluating business strategy based on Web analytics

This study proposes a multi-criteria approach in order to assess the business strategic performance by utilizing the BSC and the information that is available on Web analytics platforms. Data is collected from two sources. Firstly, from the management of the company that participated in our case study, and, secondly, from the company's Google analytics tool. The data is analyzed by utilizing the DEMATEL multicriteria analysis method. In recent years, many researchers adopted Multi-Criteria Decision Making (MCDM) approaches for solving problems such as assessing alternative solutions, selection problems, strategic analysis [13] etc. The steps of the proposed methodology adopted follow.

Step 1: Collect data from the business management regarding strategic priorities (management data). The data in our study are selected from a company that operates in the tourism industry in Greece. Through its website, the company allows tourists of higher income to book luxurious villas for their holidays. A group of five (5) managers, dealing with digital marketing and business development, had agreed to participate in our study. At first, the managers were asked to review the BSC and specify a list of KPIs that

would represent the BSC perspectives most appropriately to their business. Next, the managers were asked to review the Google analytics data set of the company and to select a list of parameters they would consider most important. The group of managers was also presented with a comprehensive list of Web analytics KPIs as found in [2]. The Fuzzy Delphi method [13] was utilized in order to prioritize and finally select managers' suggestions. The final list of parameters is shown in Table I:

TABLE I. THE SELECTED KPIS RELATED TO THE BSC PERSPECTIVES AND THE GOOGLE ANALYTICS TYPE STYLES

The selected BSC and Google Analytics Criteria and their abbreviations used in Figure 2
Reduce cost (RC)
Revenue growth (RG)
Customer satisfaction (CS)
New customers (NC)
Sales (SALES)
Views (VIEWS)
Nationality of visitors (NATIO)
Device used by visitors (DEV)
Returning users (RU)
Products that visited on Website and attracted the interest of users (PR)
Network through which visitors reached the Website (NET)
Navigation program used (NavPr)

A questionnaire was developed and sent to five (5) managers of the company that participated in this case study. The questionnaire consisted of questions that referred to the extent the selected criteria affect each other. A 5-point Likert scale ranging from 0 to 4 representing the 'no influence' to 'very strong influence' scale was used for the respondents to report their beliefs regarding the interactions among the criteria considered in the study. The sample size of five is adequate for applying DEMATEL, since a group ranging between 5 and 15 experts is more appropriate [14].

Step 2: Apply DEMATEL and construct a strategy causal model. The selected criteria were evaluated by utilizing the DEMATEL method, so that importance priorities for each criterion are calculated and their interactions are specified in the DEMATEL causal model.

Step 3: Collect Google analytics data. Data from the company's Google analytics are selected and analyzed.

Step 4: Assess the strategic performance of the company. Examine the proposed model's ability to produce results upon which conclusions can be drawn regarding the strategic performance of the company.

3.2. The DEMATEL Method

The DEMATEL method was developed by the Battelle Geneva Institute [16]. DEMATEL is a multi-criteria method which is used to model and analyze complex relationships among factors pertaining to a particular domain. The method is applied to real life problems where the consideration of the interactions among important criteria is needed. DEMATEL produces causal models that show how interrelated factors affect each. The method can equally handle qualitative and quantitative factors. The DEMATEL method has been extensively used in MCDM problems such as marketing strategies, e-learning evaluations, control systems, safety problems, and environment watershed plans [17]-[26]. The steps of DEMATEL are shown below:

Step 1: Generate the Direct Relation Matrix. The direct relation matrix is calculated based on experts' responses. The experts comment on the influence a factor exerts on another by using the following scale: 0 for no influence, 1 for somewhat influence, 2 for medium influence, 3 for high influence and 4 for very high influence. The direct relation matrix $A=[a_{i,j}]$ is a nxn matrix, where $a_{i,j}$ indicates the degree to which factor (i) affects factor (j). In the case of a group of experts, all responses are averaged to produce the average matrix Z, where $Z = [z_{i,j}]$, with i,j indicating performance criteria.

Step 2: Calculate the normalized initial Direct- relation matrix D. The Matrix D is calculated using the following formulas.

$$D = \lambda * Z$$

where,

$$\lambda = \min\left[\frac{1}{max\sum_{j=1}^{n}(z_{i,j})}, \frac{1}{max\sum_{i=1}^{n}(z_{i,j})}\right],$$

and

$$1 \le i \le n \; and \; 1 \le j \le n.$$

Step 3: Derive the Total relation matrix T.

Where,

$$T = D(I - D)^{-1}.$$

Step 4: Calculate the sums of rows and columns of matrix T. The sum of rows is calculated by $r = r_i[i,j]_{nx1} = \sum_{j=1}^{n} t(i,j)$ and the sum of columns is calculated by $c = c_j[i,j]_{1xn} = \sum_{i=1}^{n} t(i,j)$. The value of r(i) indicates the total effect given by criterion (i) both directly and indirectly. The value of c(j) shows the total effect received by criterion (j) both directly and indirectly. If (j = i), the value of (ri+ci) represents the total effects both given and received by factor (i), while the value of (ri-ci) shows the net contribution by factor (i) on the system. If (ri-ci) is positive, then factor (i) is a net cause, which means factor (i) affects other factors of the model. If (ri-ci) is negative, then factor (i) is a net receiver that implies factor (i) is affected by other factors of model.

Step 5: Set a threshold value (α). The threshold is calculated with the formula,

$$a = \frac{\sum_{i=1}^{n}(t_{i,j})\sum_{j=1}^{n}(t_{i,j})}{n^2},$$

where n is the number of criteria. The threshold is used to cut-off the most important criteria, which will be included in the DEMATEL causal model.

 ISBN: 978-1-61208-603-3

Step 6: Build the DEMATEL causal model. A cause and effect relationship diagram, by mapping all coordinate of $(r_i + c_i, r_i - c_i)$. The causal model indicates the importance of the most important criteria, i.e. those above the threshold and the degree of influence among criteria.

IV. EMPIRICAL STUDY AND DATA ANALYSIS

After all responses from the group of the five managers were collected, the average matrix Z was calculated. The matrix Z is shown in Table II.

TABLE II. THE AVERAGE MATRIX Z

	REDUCE COST	REVENUE GROWTH	CUSTOMER SATISFACTION	NEW CUSTOMERS	SALES	VIEWS	NATIONALITY	DEVICE	RETURNING USERS	PRODUCTS	NETWORK	NAVIGATION PROGRAM
REDUCE COST	0	3,2	2,4	3,2	2,6	2,6	1,6	3,2	3,4	2,4	1,8	2,8
REVENUE GROWTH	3,8	0	4	4,2	4,2	3,4	1,6	2,6	3,8	3,6	2,6	2,8
CUSTOMER SATISFACTION	2,4	3,8	0	3,6	4,6	3,8	2,2	3	5	3,6	3	3,2
NEW CUSTOMERS	2,6	4,4	3,8	0	4,2	4	2,2	3,4	4	3,4	2,4	2,4
SALES	2,6	4,6	4,6	4,4	0	4	2,8	3,4	4,2	4,4	2,6	2,8
VIEWS	2,6	3,6	3,6	3,8	4,2	0	2,6	4	4,4	4	3,2	3,6
NATIONALITY	1,8	1,8	2,2	2,4	2,8	2,4	0	2,8	2,6	2,6	1,6	2,4
DEVICE	3	2,8	2,6	3,2	3,6	4,4	2,2	0	2,2	3,2	3,6	2,2
RETURNING USERS	3	4	5	4	4,6	4,4	2,8	2,2	0	4,2	3	3,2
PRODUCTS	2,6	4	4	3,8	4,8	4,2	2,2	3,4	4,2	0	2	2,6
NETWORK	2	2,6	3	2,4	3	3,2	2,2	3,6	2,6	2,2	0	1,8
NAVIGATION PROGRAM	2,6	3	3,4	2,4	2,8	3,4	2,2	4	3,2	3,8	1,8	0

By applying the formulas in steps 2, 3 and 4 the T matrix, shown in Table III, is calculated.

TABLE III. THE T MATRIX

$T = D(I-D)^{-1}$	REDUCE COST	REVENUE GROWTH	CUSTOMER SATISFACTION	NEW CUSTOMERS	SALES	VIEWS	NATIONALITY	DEVICE	RETURNING USERS	PRODUCTS	NETWORK	NAVIGATION PROGRAM
REDUCE COST	0,308218001	0,470585822	0,461211103	0,465791869	0,4911902	0,474115612	0,299228817	0,437481	0,489522449	0,44809138	0,337539571	0,378653706
REVENUE GROWTH	0,466686964	0,497317934	0,594040315	0,583023242	0,6300098	0,591579073	0,36322684	0,5141853	0,600439849	0,56883708	0,426011984	0,455634668
CUSTOMER SATISFACTION	0,453856301	0,602230567	0,52854184	0,591757323	0,6616532	0,622546236	0,390734308	0,5416982	0,646352489	0,59073621	0,450782508	0,480858462
NEW CUSTOMERS	0,444832259	0,59671145	0,593823454	0,494705648	0,6345533	0,608008876	0,378570753	0,5336255	0,6078002	0,56887394	0,425478468	0,45028677
SALES	0,47802957	0,644032585	0,65417287	0,633547385	0,589862	0,653131874	0,419544723	0,5734277	0,657280531	0,63180911	0,461348046	0,492835878
VIEWS	0,467774704	0,610073814	0,620314995	0,607691235	0,6668291	0,551783551	0,407369915	0,5746673	0,646429787	0,61085922	0,464407435	0,498784632
NATIONALITY	0,309924667	0,389796473	0,404752625	0,398303473	0,4400911	0,416913171	0,229001781	0,3829078	0,419923451	0,40217051	0,29523227	0,329862719
DEVICE	0,409419787	0,507093907	0,510616757	0,510157553	0,5605604	0,557865385	0,342217335	0,4088316	0,511976852	0,50853649	0,40940187	0,401465457
RETURNING USERS	0,485513525	0,631907946	0,662326711	0,625068065	0,689412	0,660424093	0,419716851	0,5493407	0,565829931	0,62771885	0,468949811	0,501424492
PRODUCTS	0,456017154	0,603806125	0,613344594	0,593642703	0,6629522	0,627696778	0,388549798	0,5472155	0,627668866	0,59805716	0,427971657	0,466356439
NETWORK	0,346176758	0,44754376	0,46307883	0,439242527	0,4890355	0,476492212	0,306306639	0,4375116	0,462621509	0,43391927	0,289284715	0,349518747
NAVIGATION PROGRAM	0,400246217	0,509197727	0,52562471	0,4918617	0,5428635	0,536065483	0,340776164	0,4943119	0,53064973	0,52006352	0,369926815	0,349763895

The shadowed numbers are those who exceed the threshold (a=0,49). The (ri+ci) and the (ri-ci) for each criterion are calculated and shown in Table IV.

In Table IV, the criteria that give effects (positive ones) and those who receive effects (negative ones) are represented in different colors. The results in the Total matrix (T) show how business criteria conceptualized in the BSC are associated, affect or affected, with data from the Google analytics. For example, "cost reduction"" and "revenue growth" are interacting with the "number of views", the "number of the returning users", which are data collected from the company's Website. Equally important, the T matrix shows how Web analytics data, e.g. the "number of the returning users", affect business criteria such as "sales", "cost", "revenue growth", etc.

Therefore, the utilization of DEMATEL constitutes a way to unveil and study the interactions among business and Web analytics data, regarding the performance of a firm.

TABLE IV. THE TOTAL EFFECTS GIVEN AND RECEIVED AND THE IMPORTANCE OF EACH CRITERION

Sum of r(rows)	Sum of c(columns)		r+c	r-c	Business and Google Analytics Data
5,061629505	5,026695907	REDUCE COST	10,08832541	0,0349336	-2%
6,290996263	6,510298112	REVENUE GROWTH	12,80129437	-0,219302	5%
6,561748218	6,631848803	CUSTOMER SATISFACTION	13,19359702	-0,070101	7%
6,337270655	6,434792725	NEW CUSTOMERS	12,77206338	-0,097522	5%
6,889022248	7,059012203	SALES	13,94803445	-0,16999	3%
6,72698575	6,776622343	VIEWS	13,50360809	-0,049637	35%
4,418880139	4,285243924	NATIONALITY	8,704124064	0,1336362	data on certain nationalities
5,638143416	5,995208339	DEVICE	11,63335176	-0,357065	data on certain devices
6,887633076	6,766495643	RETURNING USERS	13,65412872	0,1211374	2%
6,523279002	6,419672744	PRODUCTS	12,94295175	0,1036063	5%
4,940732114	4,826335149	NETWORK	9,767067263	0,114397	data on certain network providers
5,611351369	5,155445864	NAVIGATION PROGRAM	10,76679723	0,4559055	data on certain browsers

In addition, by focusing on the (r+c) the results show that the top 5 of the most important performance criteria in the e-tourism industry are the "sales" which is the foremost important factor, followed by the "number of the returning users", the "number of views" of the Website and the "customer satisfaction", thus indicating the importance of the Web channel for companies to improve their performance. By examining the (r-c) column, the results indicate that the most affected criteria, those with negative (r-c), i.e. criteria affected by other are the "type of device", the "revenue growth", the "sales", the "returning users" and the "number of views". The results also show the important role of the "navigation program" that users use, in affecting other criteria such as the "sales". Although outside the scope of this study, this could possibly be an indication that the browser and the type of device that users use could be features of the users' profile.

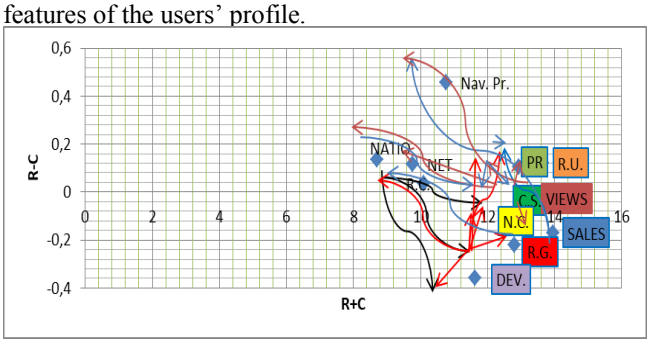

Figure 2. The DEMATEL Causal Model.

The causal model shown in Figure 5 is produced by applying the threshold in order to distinguish the criteria with

higher than the threshold interactions. The causal model shows how each KPI affects or is affected by other KPIs. This model does not only show the interactions among KPIs but it can be used in scenarios simulations that investigate the impact of alternative business strategies on selected KPIs.

As T matrix in Table III shows, the criteria "nationality" and "device" do not affect or are not affected by any criteria with impacts higher than the threshold. It implies that the management of the company does not have any particular interest in distinguishing customers based on their nationality or the network provider they use. In other circumstances these interactions would have been different if specialized promotion programs had been in place to address customers from certain countries or network providers. The application of the threshold also shows in Table III that the "reduce cost" criterion is not affected significantly by other criteria, but it affects sales.

Finally, by reviewing the actual performance of the company as shown in the "Business and Google Analytics Data" column in Table IV, the management can contrast their priorities with the real outcomes. Management can compare and contrast the (r+c) column with their top priorities and judge to what extent their expectations have been realized. For example, Table IV shows that the "number of views" which is the third most significant priority exhibited the top actual performance. Similarly, "customer satisfaction" which is the fourth most important priority, is actually the second most successful area. However "sales", which is the top priority, did not return the results that the company anticipated, thus indicating that sales related policies should be reviewed.

V. CONCLUSIONS

Web analytics play an important role in assessing the effectiveness of business development and strategy. Currently Web analytics tools do not provide the comprehensive KPIs set that is needed to address the complexity of business decisions making. This study used the BSC as business strategic framework and examined how it can be integrated with the Web analytics data sets. By utilizing the DEMATEL method, this research proposes how to identify and comprehensively analyze the interactions among business criteria as defined within the BSC framework and Web analytics data. It also identifies the most important Web analytics KPIs in e-tourism. This research also indicates that DEMATEL can be used to highlight and contrast the strategic priorities and expectations of the management with the actual performance of the company, as this is reflected in the Web (Google) analytics data. Furthermore, this research suggests that, Web analytics tools should improve their functionality by combining MCDM methods such as the DEMATEL method, with strategic frameworks such as the BSC in order to enhance their value in assessing digital marketing strategies.

The proposed approach will also be tested within the context of the SELIS research project, in order to examine its applicability in linking Web analytics and strategic performance evaluation in the logistics service sector.

Future research should focus on developing Web analytics methods and tools that provide the necessary data sets and the required functionality in analyzing and managing the interactions among data generated online within the context of business strategy and development.

ACKNOWLEDGMENT

The research described in this project has been partially funded by the Horizon 2020 Project SELIS ('Towards a Shared European Logistics Intelligent Information Space') Grant agreement no: 690588.

REFERENCES

[1] J. Järvinen, and H. Karjaluoto, "The use of Web analytics for digital marketing performance measurement." Industrial Marketing Management Vol 50, pp. 117-127, 2015.

[2] D. Jayarama, A. Manrai, and L. Manrai, L. "Effective use of marketing technology in Eastern Europe: Web analytics, social media, customer analytics, digital campaigns and mobile applications." Journal of Economics, Finance and Administrative Science, Vol 20, pp. 118-132, 2015.

[3] Forbes, "US Digital Marketing Spend Will Near $120 Billion By 2021." Available from URL: https://www.forbes.com/sites/forrester/2017/01/26/us-digital-marketing-spend-will-near-120-billion-by-2021/#4aa2e6b278bb, 2017, last viewed 31/7/2017.

[4] Gartner, "Gartner CMO Spend Survey 2016-2017 Shows Marketing Budgets Continue to Climb." Available from URL: http://www.gartner.com/smarterwithgartner/gartner-cmo-spend-survey-2016-2017-shows-marketing-budgets-continue-to-climb/, 2016, last viewed 31/7/2017.

[5] A. Phippen L. Sheppard and S. Furnell, "A practical evaluation of Web analytics", Internet Research, Vol. 14, pp. 284 -293, 2004.

[6] Balanced Web Analytics Scorecard. Available from URL: http://www.freepatentsonline.com/20140052502.pdf, 2014, last viewed 1/8/2017.

[7] A. Keramati, and F. Shapouri, "Multidimensional appraisal of customer relationship management: integrating balanced scorecard and multi criteria decision making approaches." Information Systems and e-Business Management, Vol 14, pp. 217-251, 2016.

[8] J. Jassbi, F. Mohamadnejad, and H. Nasrollahzadeh, "A Fuzzy DEMATEL framework for modeling cause and effect relationships of strategy map." Expert Systems with Applications Vol 38, pp.5967–5973, 2011.

[9] R. Kaplan, and D. Norton, "The balanced scorecard-measures that drive performance." Harvard Business Review Vol 70, pp.71–79, 1992.

[10] R. Kaplan, and D. Norton, "Using the Balanced Scorecard as a Strategic Management System," Harvard Business Review, January-February, pp.35-48, 1996.

[11] M. Tseng, "Implementation and performance evaluation using the fuzzy network balanced scorecard." Computers & Education, Vol 55, pp. 188-201, 2010.

[12] Figure 1. Balanced Score Card (URL: http://bi-insider.com/wp-content/uploads/2012/05/Balanced-Scorecard-Four-Perspectives.png).

[13] N. Moghaddam, M. Sahafzadeh, A. Alavijeh, H. Yousefdehi, H. Hosseini, "Strategic Environment Analysis Using DEMATEL Method Through Systematic Approach: Case Study of an Energy Research Institute in Iran." Management science and engineering, Vol 4, pp. 95-105, 2010.

[14] Y. Kuo, and P. Chen, "Constructing performance appraisal indicators for mobility of the service industries using Fuzzy

 ISBN: 978-1-61208-603-3

Delphi Method." Expert Systems with Applications, Vol 35, pp. 1930-1939, 2008.

[15] J. Teng, "Project evaluation: Methods and applications. Taiwan, National Taiwan Ocean University," 2002.

[16] E. Fontela, and A. Gabus, (1976) The DEMATEL observer, DEMATEL 1976 Report. Battelle Geneva Research Center, Geneva, 1976.

[17] Chang, H. H. and Chen, S. W. (2008). The impact of online store environment cues on purchase intention: Trust and perceived risk as a mediator. Online information review, 32(6), 818-841.

[18] Chang, H. H. and Chen, S. W. (2009). Consumer perception of interface quality, security, and loyalty in electronic commerce. Information and management, 46(7), 411-417.

[19] Y. C. Chen, H. Lien, G. Tzeng, and L. Yang, "Fuzzy MCDM approach for selecting the best environment-watershed plan." Applied soft computing, Vol 11, pp. 265-275, 2010.

[20] S. Hori, and Y. Shimizu, "Designing methods of human interface for supervisory control systems." Control engineering practice, Vol 7, pp. 1413-1419, 1999.

[21] C. Lin, C. Chen, and G. Tzeng, "Planning the development strategy for the mobile communication package based on consumers' choice preferences." Expert systems with applications, Vol 37, pp. 4749-4760, 2010a.

[22] C. Lin, M. Hsieh, and G. Tzeng, "Evaluating vehicle telematics system by using a novel MCDM techniques with dependence and feedback." Expert systems with applications, Vol 37, pp. 6723-6736, 2010b.

[23] C. Lin, and G. Tzeng, "A value-created system of science (technology) park by using DEMATEL." Expert systems with applications, Vol 36, pp. 9683-9697, 2009.

[24] J. Liou, G. Tzeng, and H. Chang, "Airline safety measurement using a hybrid model." Journal of air transport management, Vol 13, pp. 243-249, 2007.

[25] O Yang, H. Shieh, J. Leu, and G. Tzeng, "A novel hybrid MCDM model combined with DEMATEL and ANP with applications." International journal of operations research, Vol 5, pp. 160-168, 2008.

[26] G. Tzeng, C. Chiang, and C. Li, "Evaluating intertwined effects in e-learning programs: A novel hybrid MCDM model based on factor analysis and DEMATEL." Expert systems with applications, Vol 32, pp. 1028-1044, 2007.

 ISBN: 978-1-61208-603-3