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Review

A hybrid model for a performance measurement system of business: A case study in critical logistics process

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The performance evaluation of companies is an important issue. Balanced Scorecard (BSC) and Six Sigma approaches are widely in use in business in this context. In this study, BSC and Six Sigma performance management systems have been elaborated, their strengths, which can be used in practice by a number of enterprises in a variety of sizes, have been identified; and a new hybrid model of performance measurement system has been developed by merging together the aspects of both management systems that complement each other. The hybrid system can be expressed in terms of operational availability data, and can compare performance qualifications. In practice, performance measurement results obtained for five critical branch offices of a logistics business, by applying the model for operations/processes from the perspectives of Costs, Internal Processes, Customer and System Development and Assessment have been compared by model performance and model efficiency, and the results achieved have been scrutinized.

Key words: Balanced scorecard, six sigma, six sigma business scorecard, logistics, operational availability.

INTRODUCTION

Performance measurement and assessment of complex processes or systems are indeed of vital importance. In a globalizing world, performance measurement should be regarded as a must, rather than as an option. Organizations cannot be sustained without setting strategic goals, using operational methods, achieving and maintaining targeted results; nevertheless, in cases when the changes in the management are not integrated with the performance obtained, success can only be achieved by chance.

Rapid development in information systems in recent times has both facilitated and generalized access to information. As a result of technological developments globally removing local boundaries, in addition to the concepts, price, place where the product is sold together with the distribution channels, and promotion – as set forth by Prof. Eugene McCarthy in his "Basic Marketing" (Perreault and McCarthy, 2004), "marketing mix" or so-called 4P approach (Product, Price, Place, Promotion)-performance and process management have also become essential. Products developed as a result of large scale surveys also have to be backed up by rigorously elaborated strategies, so that the products can achieve the targeted market share.

Performance assessments, as in other statistical studies, are performed on a limited number of sampling

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processes representing the characteristics of all processes. Only in this manner can a set of controllable processes and also controllable budgets, schedules, tools and staff be achieved. The processes included in the sample universe should be chosen among those processes that represent the characteristics of the whole. Negative aspects arising in chosen processes should be characterized as having tangible impacts on general performance. Those processes, which possess such characteristics as described, can be designated as critical processes in this study. Critical processes should be capable of representing business performance and assuring accordance between the strategy and process by an analysis of performance.

Performance measurement models are studied in many areas also in an academic environment. Kumar et al. (2008) emphasized the importance of the implementation cost of six sigma methods and represent new two optimization models that will assist management to choose process improvement opportunities. Parast (2011) developed a theoretical base for the effectiveness of Six Sigma projects on innovation and firms' performance. Farooq and Hussian (2011) prepared a questionnaire and collected the responses from organizations which were segregated on the basis of public and private sector and also manufacturing and service industry. Rajes et al. (2012) proposed a set of strategies for BSC of 3PL service providers by the aid of Delphi method. Jazayeria and Scapens (2008) researched the evolution of a performance measurement system in BAE Systems, for a UK aerospace company. Zheng et al. (2009) used the rough set theory and fuzzy set together to reduce the data processing and reduced computation complexity of measurement model. Yu et al. (2010) developed an organizational performance evaluation framework that takes account of the dynamical system behaviors for innovative healthcare service by the interactions in the traditional Balance Scorecard structure. Morgan and Strong (2003) presented an empirical investigation about performance management structure of medium and large, high technology, industrial manufacturing firms. Bentes et al. (2012) presented the case of a telecom company to illustrate and critically analyzed the integration of the two methodologies, Balanced Scorecard (BSC) and Analytic Hierarchy Process (AHP) with the discussion of the advantages and disadvantages of the design. Lyell and McDonnell (2007) emphasized that health system performance management is a complex problem and offered a dynamic Balance Score Card structure. Paranjape et al. (2006) evaluated Balanced Scorecard in the study and mentioned the difficulties of implementations into dynamic systems. Ahmadi et al. (2012) suggested a model based on Balance Score Card, for performance evaluation and conducted a case study through this model. Kuik et al. (2010) presented a Six Sigma implementation strategy within the global supply chain network in a developing country, i.e. Malasia. MacBryde et al. (2014) mention the positive effects of having a performance management system like Balanced Scorecard in order to have a progress towards achieving strategic goals despite the absence of nine critical success factors defined in management literature. Shahada and Alsyouf (2012) discuss the efficiency of using six sigma, balance scorecard, simulation and cost-benefit analysis in identifying the process problem(s) and solving them effectively. Zhang et al. (2010) show the six-Sigma quality process operation pattern and the differences between six-sigma quality process and traditional management method in supply-chain management processes and associated technology.

In this study, a model, which can be used in businesses on various scales, is proposed. In the model, a hybrid model of performance measurement system, which is developed by utilizing the Balanced Scorecard (BSC) and Six Sigma approaches, is used. The BSC approach has been included in the model, within the businesses organized vertically from top to bottom, considering its relatively high effectiveness – compared to its peers – in the achievement of strategic and financial targets. The Six Sigma approach, on the other side, has been incorporated into the model as an effective approach in increasing customers' satisfaction from bottom to top in hierarchical processes/operations on the business base. In the developed model, business performance is represented in terms of operational availability data used widely in the field of logistics.

Approaches to performance measurement systems

Businesses have to achieve their growth targets set in order to survive and to increase their profitability. The control of what extent the targets in question are achieved is done by methods called performance management systems.

After World War II, several national economies grew significantly, leading to a globally competitive environment. From time-motion studies to quality improvement tools, businesses employed methods to improve their performance. Beginning in the 1970s, Japanese auto makers challenged the U.S. industry by Utilizing quality management tools taught by J. M. Juran, Edwards Deming, Phil Crosby, Genichi Taguchi, and others. In the 1980s, other ways to promote the process and performance standards were created, such as the ISO 9000 quality management system developed by the International Organization for Standardization (ISO) and the Malcolm Baldrige National Quality Award (MBNQA) guidelines established by the U.S. Motorola pioneered and successfully implemented the Six Sigma methodology to reap rich benefits (Pande et al., 2000). Figure 1 shows the evolution of various techniques (Gupta, 2003).

Franceschini et al. (2007) denote that global process
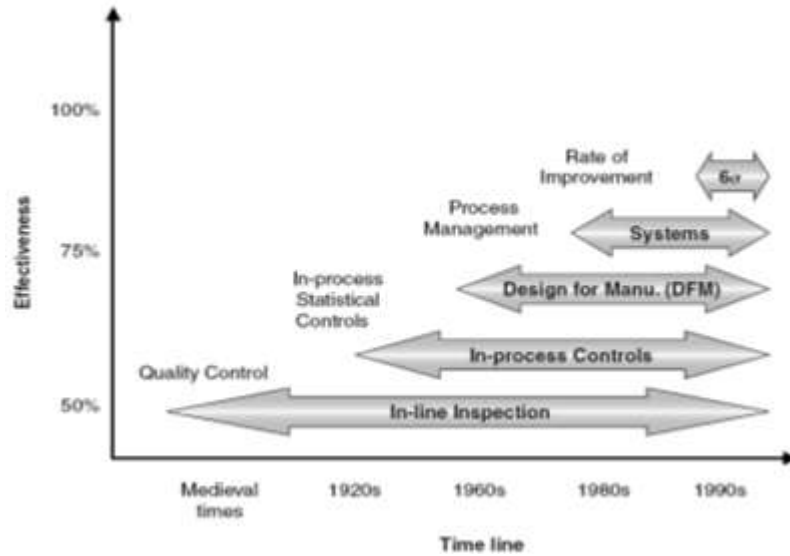
Figure 1. Performance Control Methods (Gupta, 2003).
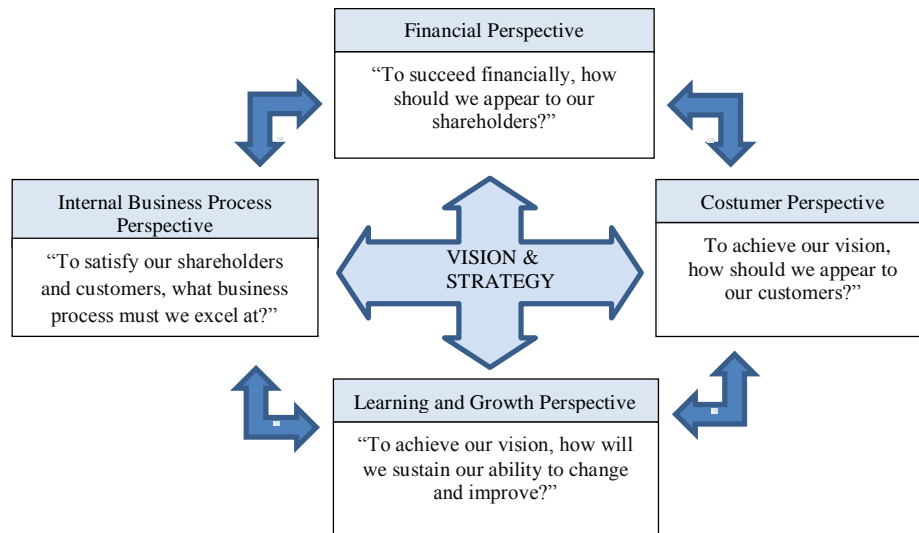
Figure 2. BSC Points of View (Kaplan and Norton, 1996a)

management and coordination are carried out by the performance measurement system that is at the highest level of the hierarchy. The performance measurement system is responsible for coordinating indicators across the various functions, and for aligning the indicators from the strategic (top management) to the operational (shop floor/purchasing/execution context) levels.

Performance control methods are utilized to monitor business processes in operation and to keep the deviations identified in performance under control. Beneath their monitoring and control functions, perfor-mance management systems are further expected to be

sensitive to internal and external developments in businesses. The Six Sigma Business Scorecard (SSBSC) model is defined as a model that was evaluated as to reduce the factors of failure of the BSC and Six Sigma approaches in practice.

Balanced scorecard

As shown in Figure 2 (Kaplan and Norton, 1996a), the BSC, instead of traditional financial data of enterprises with performance reviews, can be enriched by the

following operating processes that have been aligned with the vision and strategy (Ahmadi et al., 2012):

1. The customer perspective (How do our customers see us?)
2. Internal Business / internal process (What do we need to be superior?)
3. Learning and growth perspective (Are we developing by creating the value continuously?)
4. Financial perspective (How should we be seen by our shareholders?)

Balanced Scorecard is a dynamic performance assessment system or management technique (Zheng et al., 2009), which is based on non-physical dimensions (values) such as humans, systems, and development and perfection of incorporating activities in line with future customers' satisfaction, orientation and expectations. It is also beneficial in learning and developing the methods to keep up with the change – together with physical (financial) values derived from historical data the businesses have in hand; this measures these dimensions using specific indicators that provide strategic feedbacks to maintain equilibrium and integration between these dimensions. It also determines applicable strategies of data.

Construed in a general sense, the aim of the BSC performance management system is to achieve a steady and gradual growth of corporate development and corporate life, and to bring success to the business in a competitive environment of the recent information age by changing the performance (Kaplan and Norton, 1996b).

Moreover, BSC is not only a measurement system. Businesses open to innovation use BSC as the center and regulatory framework of management processes. Businesses may at the first stage establish a Scorecard for very limited purposes. For example, such purposes may be reaching consensus, focusing on strategy and ensuring complete penetration of strategy across the corporation. The real power of BSC is demonstrated not only as a measurement system, but also in cases when it is used as a management system (Kaplan and Norton, 1996b).

Six Sigma

Linderman et al. (2003) have defined Six Sigma as a systematic problem-solving technique aiming to decrease customers' defined defect rates substantially or to improve system inputs by using statistical and scientific methods in the development of new strategic systems, products and services.

Total Quality Management (TQM) and Six Sigma are approaches which support each other. TQM is a management philosophy targeting an ideal perfection at "zero-defect" level. On the other side, Six Sigma is a method, a methodology, which can be used for the measurement of the quality of processes as one of the focal points of TQM. Its goal is to decrease defect rates to a level of 3.4 per million. Six Sigma differs from TQM or similar approaches primarily in the measureability of its results, in its penetration covering all processes across the entire corporation without being limited to a single department or function, and in how it can alter the corporate culture (Gupta, 2003).

As a statistical measurement technique, Six Sigma is a quantitative indicator measuring how good the products, services and processes are. It shows by how much the process deviates from the zero-defect ideal.

The Six Sigma approach uses "Defects per Unit" (DPU) as measurement unit. A defect is defined as anything that causes customer dissatisfaction. DPU is the best tool for measuring the quality of a process or a product. Sigma coefficients used as three Sigma, four Sigma or six Sigma represent the occurrence frequency of defects. The higher the Sigma value is, the lower the probability of defect.

Balanced Scorecard and Six Sigma weaknesses

The inadequacy of two methods mentioned above is summarized as follows in practice.

Saydam (2007) suggests vertical and horizontal integration for an effective performance and perception management in businesses. Vertical integration represents the compatibility among all layers of an organization from bottom to top. In other words, the subject the organization seeks to manage and key messages to be created around this subject should be expressed by a newly recruited office personnel or for example by a driver, demonstrating same enthusiasm, same diligence and same content, as is done by the top manager of the corporation. Furthermore, horizontal integration is defined as "ensuring the compatibility and cooperation among communication works managed by social stakeholders, since these are interacting with each other strongly" (Saydan, 2007).

Most businesses have measurements for sales and profitability. They do not, however, have measurements for operational effectiveness (Gupta, 2003). Indeed, sales figures and profitability are the outputs of the business. Measures to increase profitability and efficiency have to be applied to the inputs. Positive outcomes from regulations to be imposed on outputs have never been observed. For performance and efficiency, one has to start with regulations on input(s) compatible with the strategy, and henceforth maintain vertical and horizontal integration.

Regarding the Six Sigma approach, it appears that Six Sigma measurements focus on performance at the process level; however, the measurements are not aggregated or correlated to corporate wellness.

Corporations have found it difficult to establish a corporate sigma level that correlates with the overall corporate performance (Gupta, 2003).

Six Sigma is a performance management system envisaging control over all organizational processes of the business. However, the impression of Six Sigma in practice is that difficulties are experienced in achieving a process/strategy synergy with Six Sigma. The effectiveness attained in process management cannot, either always or directly, be reflected towards the upper levels of the organization.

While implementing a BSC, managers articulate their strategy for the organization. Departments go through the training and attend sessions to develop the vision, strategy, and measurements that will lead to a BSC (Harry and Schroeder, 1999). They develop objectives and targets as well as action plans. Weaknesses in the organization can be identified through the reporting process and corrected through the learning process.

BSC practice starting at the management level is observed to be extremely effective in setting the vision, strategy and performance assessment parameters at the department level, by trainings and active participations. However, the strategy constituting BSC's starting point cannot be duly delegated or explained to employees at the process level. In practice, this makes the success of the BSC approach effective in many cases only up to the department level, but not at the process level. Such failure observed by 90% in the business where the BSC is applied is correlated with this practice (Gupta, 2003).

Consequently, accomplishing integration under the framework of a strategy is of vital importance for businesses from the perspective of performance management. BSC practices as performance management tools are inadequate below the department level at organizational layers and in process management, whereas Six Sigma practices are inadequate in achieving the integrity of process and strategy.

Six Sigma Business Scorecard

The strengths and convenient practices of BSC and Six Sigma practices, which could not achieve the desired success individually, have been analyzed under the scope of this study. The Six Sigma Business Scorecard (SSBSC) has been developed as an easily adaptable performance management system that inspires leaders who are going to embrace the business as a whole, and offers managers, chances for development and employees opportunities for innovation by maintaining profitability and growth at optimum level. An effort has been made to in the study to winnow out the weaknesses of the analyzed methods and to integrate the areas in which they are effective, together, in order to build integrity.

In this model, the business was considered in the form of a pyramid. The business pyramid and the positioning of the performance management systems are shown in Figure 3. The upper part of the pyramid represents the top management layer of the business. The performance measurement system used effectively for top management is the BSC approach. In this layer, strategies are developed, and, starting with the transformation of the strategy into a vision and measurable targets, BSC approach processes are run.

For middle management, which constitutes the second layer of the business pyramid, analyses of costs, internal processes, system development and assessment and also for customers' points of view are conducted and success scores are calculated, again using the BSC approach.

The Six Sigma approach is used for the base of business pyramid, the parts designated as operation/process level. At this stage, operation/process success scores are calculated using the BSC approach, and then converted into values of defects per unit and probability of corporate defect rates at the per million level, and finally into operational availability data, in order to establish a decision mechanism. The business pyramid and the positioning of the performance management systems are shown in Figure 3.

Turkey is a rapidly developing country. And most of the companies in Turkey are small and medium sized. These organizations are performing the 62.6% of the overall import and 38.5% of the overall export according to the reports published in 2014 for the year 2013 by the Turkish Statistics Organization (TUIK). It is difficult for those small and medium-sized organizations to run big ERP applications or hire BSC or Six Sigma professionals to monitor their performance. On the other hand, these organizations set goals, objectives and targets to maximize performance. With this proposed model, basic elements of the BSC and six Sigma models are combined together to support these small and medium-sized companies in establishing their goals, objectives and targets aligned with their processes.

In the developed model, the following are explained in depth in the case study;

1. Determination of the strategy,
2. Determination of indicators of viewpoints of cost, internal processes, customer and system development-evaluation, and calculation of their weights and scores of success for realization of the strategy and
3. The performance of the business to be expressed as operational availability data

Case study: The performance measurement practice in critical logistics processes

In practice, the performance of a logistics business
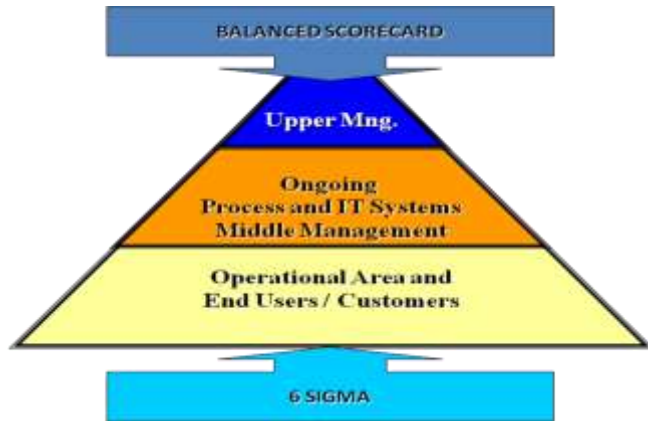
Figure 3. SSBSC performance management system model.

providing services of estimating spare part needs of branch offices, planning, and collecting spare part needs is expressed in terms of operational availability data, using the SSBSC Performance Measurement System. Data are obtained from a real case study.

The algorithm of the new model and the details of each step of the procedure are given below under relevant titles. For the selected five branch offices, performance measurement values obtained in the model are given in the section where the algorithm is detailed.

Model of SSBSC

The SSBSC model algorithm that is developed to be used in the performance measurement in a logistics business that offers spare parts management service is defined below:

1. Set strategy,
2. Identify points of view to be used in the model,
3. Identify the indicators of operation/process that reflect the viewpoints,
4. Read the maximum, minimum and average values of the operation/process indicators
5. The operation/process indicators are expressed in terms of achievement scores
6. Identify the weights of operation/process indicators by the AHP method,
7. Calculate the weighted achievement scores by multiplying the operational/process indicator values and weights,
8. Calculate the business performance by summing all of the weighted success scores,
9. Calculate the defects per unit of business,
10. Calculate the possibility of defects per million of the corporate defect rates,
11. Calculate / read the value of operational availability of the business,

12. Make suggestions for decisions on assessing the performance of the business,

The basic and major processing steps of the SSBSC Performance Measurement System model algorithm are described below.

Starting of SSBSC Model Practice and Setting the Strategy

The business and performance measurement processes, where the model is to be applied, have been analyzed. The analysis results that were obtained were used in the relevant steps of the procedure of the model.

The strategy of the business is to render a better spare parts service to a higher number of customers with a cost-efficient use of sources. All processes within the business will be performed in parallel to the strategy.

Definition of the points of view used in the model

From the logistic point of view, spare parts management is a very extensive process starting with the arising of the need, and covering the steps from meeting the need to take the procured material out of service.

In the assessment of the process performance, from the perspective of the selected branch offices and realized processes – consideration of various points of view organizationally from top to bottom is important. In establishing the model – as in the Balanced Scorecard approach, there are four points of views that constitute the general framework:

1. Costs,
2. Internal processes,
3. System development and assessment,
4. Customers' points of view.

The data examined by the Six Sigma approach at the operational/process level have been defined, measured, analyzed and re-correlated with these points of view on general framework.

Within this scope, the processes/operations have been analyzed by each point of view as follows:

From the cost point of view:

1. The financial value of all parts is needed by the branch office in terms of spare parts,
2. The financial value of the spare parts which have been used in the branch office and needed during operations until then (differing from the first criteria in that, if for example, no demand data has been created until then for a part available in the branch office, these have not been included in cost calculations),

Table 1. Selected operation/process indicators.

Points of view	Operation/Process
Cost	The indicator decreasing cost-weighted minimum level of depot reserves
	The indicator of the spare parts cost of spending for repair
Internal Process	The indication of the realization of their provision of spare parts needed
	The indicator of lead time of requirement
	Technical data quality indicator
Customer	The evaluation period for the requested part of indicator
System development and assessment	Indigenization status indicator

3. The financial value of the spare parts always kept in stock by the branch office as emergency repair spare parts, the financial value of the spare parts kept in stock for scheduled maintenance, the financial value of available spare parts kept in central warehouses, the cost of optimizing stock levels of spare parts remaining below maximum and minimum stock levels and the amounts to be re-ordered of available spare parts kept in central warehouses, by reviewing such levels and amounts, and the financial value of the spare parts used in cases when a need arises to repair of the equipment, for which support is provided by the branch office, has been analyzed.

From the internal processes point of view:

The time of procuring the parts to be supplied from the manufacturer or supplier within normal supply processes, adequacy/quality of technical specification data used in supply processes, the conditions of materialization of the supply of needed spare parts have been analyzed.

From the system development and assessment point of view:

The amounts of parts supplied as domestic goods to decrease depending on imported parts have been analyzed quantitatively.

From the customer point of view:

The time elapsing between the initiation of the process in order to meet the need and the reporting of spare part needs of the customer has been analyzed.

Selection of operation/process indicators representing the points of view

For the implementation of the strategy, the selection of indicators representing the performance of the activities grouped under the points of view is a significant process. The assessment of the effectiveness of the strategy in that point of view is based on the values of the indicators to be selected.

The aim of the performance measurement is to represent the actual condition of the business. The indicators used in representing the performance of the business should not overestimate the performance and not be of a nature to interrupt general process. For example, the number of calls answered should not be selected as an indicator value in call centers. A parameter to represent the satisfaction of the customer for the call carried out with the call center should be selected as a performance indicator.

Those selected as operation/process indicators under the points of view are given in Table 1.

Reading the values of operation/process indicators and expressing indicators in terms of success scores

Maximum, minimum and average values given in Table 1 for the operation/process indicators have been created with the help of records kept for the related processes. After creating the values of operation/process indicators to represent the performances of the points of view, the indicators are expressed in terms of success scores.

In calculating the indicator success scores, the approaches used by Franceschini et al. (2007) calculating World Development Sequences are employed.

$$B_{Score} = (D_A - D_{Min})/(D_{Max} - D_{Min}) \quad (1)$$

B_{Score} : Success score,
D_A : Average of indicator values,
D_{Max} : Maximum of indicator values,
D_{Min} : Minimum of indicator values

The success scores values range, calculated by Eq. 3-1, is between $0 \leq B_{Score} \leq 1$. The success scores for operation/process indicators measuring failure are

Table 2. Operation/process weightings.

Points of view	Operation/Process	Weight
Cost	The indicator decreasing cost-weighted minimum level of depot reserves	0.2551
	The indicator of the cost of spare parts spent for repair	0.1239
Internal Process	The indication of the realization of their provision of spare parts needed	0.2169
	The indicator of lead time of requirement	0.1735
	The indicator of the technical data quality	0.0723
Customer	The indicator of evaluation period for the requested part	0.0964
System development and assessment	The indicator of indigenization status	0.0620

Table 3. Operation/process weighted success scores.

Operation/Process	Branch Office				
	A	B	C	D	E
The decreasing cost-weighted minimum level of depot reserves	0.0002	0.0003	0.0263	0.0000	0.0596
The cost of spare parts spent for repair	0.1068	0.1084	0.1084	0.1084	0.0869
The realization of their provision of spare parts needed	0.2039	0.2059	0.2169	0.2169	0.2140
The lead time of requirement	0.1349	0.1505	0.0817	0.0747	0.1428
The quality of technical data	0.0218	0.0310	0.0271	0.0000	0.0218
The evaluation period of the requested part	0.0946	0.0835	0.0644	0.0723	0.0940
Indigenization status	0.0030	0.0053	0.0000	0.0000	0.0073

calculated using the Eq. (2).

$$B_{Score} = 1 - (D_A - D_{Min})/(D_{Max} - D_{Min}) \qquad (2)$$

In this context, the achievement scores calculated for each operation/process are presented in Appendix1.

Setting operation/process indicator weightings by AHP method

In order to implement the strategy, the values of theoperation/process indicator selected under the points of view should be arranged to represent the performance across the business in general. The importance of each operation varies from business to business. The AHP approach can be used to determine the operational priorities within the business consistently (Saaty, 1980). The weightings were calculated, as in normal AHP method, by making dual comparisons to reflect the importance of each indicator. The weightings evaluated by the AHP method for operations/processes are presented in Table 2.

Calculation of weighted success scores and business performance

The weighted success score of the operation/process is calculated by multiplying the operation/process indicator values by the weightings of these indicator values calculated by the AHP method. The weighted success score for each branch office examined are given in Table 3.

The stage of evaluating the business performance is the stage at which the meanings of the operation/process success scores for the business are assessed. The equation used in the calculation of the performance is represented by Eq. (3). As seen in this equation, the weighted success score of the operation/process is calculated by multiplying the success score calculated for each operation/process by the relevant weighting and the sum of the weighted success scores found represent the Business Performance (BP) (Gupta, 2003).

$$BP = \sum_{f=1}^{n} \left(FS_{W-f} \times B_{Score-f} \right) \qquad (3)$$

BP   : Business performance,
FS_{W-f} : Weight of operation/process,
$B_{Score-f}$: Success score of the operation/process
f   : Order of the operation/process
n   : Number of the operation/process

Business Performance values calculated by using Eq. (3) are given in Table 4.

Table 4. Values calculated for branch office, business performance, defects per unit, probability of corporate defect rates at the per million level, sigma value and operational availability data.

Branch Office	Business Performance	Defects per Unit	Probability of Corporate Defect Rates at per Million	Sigma Value	Operational Availability Value (Ao)
A	0.5651	0.5708	22833.52	Between 3.4-3.5	0.9772
B	0.5849	0.5363	21452.40	Between 3.5-3.6	0.9785
C	0.5248	0.6447	25787.89	Between 3.4-3.5	0.9742
D	0.4723	0.7500	30001.70	Between 3.3-3.4	0.9700
E	0.6265	0.4676	18703.95	Between 3.5-3.6	0.9813

Defects per unit calculation for the business

In the Six Sigma approach, the concept of defects per unit represents the ratio of the number of defects identified in the process examined to the total number of examinations (Gupta, 2003). The Defects per unit is calculated by Eq. (4).

$$DPU = \left(\sum K_Q\right) / \left(\sum I_Q\right) \tag{4}$$

DPU   : Defects per unit,
K_Q : Number of defects,
I_Q : Number of examined parts

The relation between the business performance (BP) and the defects per unit is represented by Eq. (5) (Gupta, 2003). Eq. (6) is obtained by rearranging Eq. (5).

$$BP = e^{-DPU} \tag{5}$$
$$DPU = -Ln(BP/100) \tag{6}$$

The performance of the business calculated by the Eq. (6) can be converted into defects per unit. Defects per unit values calculated for the equipments examined are given in Table 4.

Calculation of the probability of defect occurrence and the operational availability of the business

The probability of corporate defect rates at per million is also a calculation used by the calculations of the Six Sigma approach. It represents the probability of defect by unit per employee at per million levels (Gupta, 2003).

$$PCDRPM = (DPU \times 1000000) / NEOP \tag{7}$$

PCDRPM: Probability of Corporate Defect Rates at per Million,
NEOP   : Number of employees in the operation/process,

For the branch office examined, the values of probability of corporate occurrence of defect by the unit at per million levels calculated by Eq. (7) taking the number of employees working in the operation/process as 25 employees are given in Table 3.

This concept, designated as the Operational Availability or the conditions of availability, is an approach used quite frequently in technical areas. In the Logistics Support Analysis (LSA), it represents the probability of the system/equipment demonstrating the performance defined for the desired working period under predefined conditions, and is calculated as expressed by Eq. (8) (Bauer et al., 2009).

$$A_o = U_T / (U_T + D_T) \tag{8}$$

U_T : Up time
D_T : Downtime (Logistics Delay Time + Repair Time + Preventive Maintenance Time)
$U_T + D_T$: Operation Time (UpTime + Downtime)

Its portion expressed as the breakdown time (D_T) for the operational availability value is calculated, as shown by the Eq. (8), as the total sum of the time spent originally for preventive maintenance, logistic delay and repair time. However, in this newly developed model, the break-down period is used to reflect the lag/non-working times of examining operations/processes and the probability of performance of operations/processes of the business, under defined working conditions.

In the new model, the value of operational availability is calculated by direct proportion to find out the probable breakdown period of the equipment, based on the data of probability of corporate occurrence of defect by the unit at per million levels.

For the branch offices examined, the values of operational availability calculated by direct proportion made with the help of probability of occurrence of the defect at per million levels are presented in Table 4.

Deciding about the performance of the business and the finalization of the model

An assessment scale for the Business Performance,

Table 5. Performance assessment scale.

Business Performance Range	Sigma Range	Operational Availability (Ao) Range from Logistics Viewpoint	Model Evaluation Scale
0.310847000 - 0.500959603	1.0 - 2.3	0.308538 - 0.788144	Fails in Logistics Perspective
0.500959603 - 25.41133123	2.3 - 3.1	0, 788144 - 0.945201	Processes need to be reviewed
25.41133123 - 99.99150036	3.1 - 6.0	0. 945201 - 0.9999966	Successful in Logistics Perspective
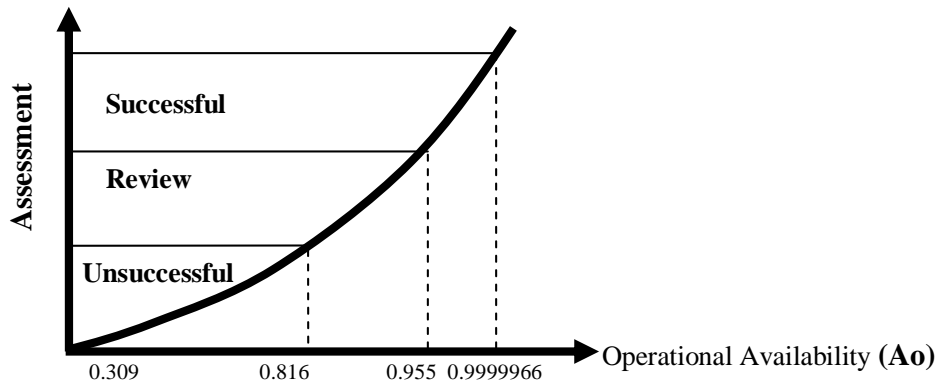
Figure 4. Performance assessment by operational availability.

Sigma value, and Operational Availability Data (Ao) results calculated by the developed model in the study is presented in Table 5. By using this scale, an evaluation of the brach office's performance in terms of materials management, decisions can be given as follows:

1. It is unsuccessful from a logistics viewpoint,
2. It is successful from a logistics viewpoint but the process needs to be reviewed,
3. It is successful from a logistics viewpoint.

The ranges of values used in the created scale may be shifted in line with the needs of the individual business and additional assessment parameters may also be added.

Performance values can be evaluated by scalar calculations as the result of the assessment of the performances for the offices within the business; a decision can also be made for this purpose by finalizing the model by choosing one of the three levels defined by the help of Table 5 and Figure 4. Accordingly, the operational availability values of the five critical branch offices (A, B, C, D and E) had been changed between 0.9700 and 0.9813; all the branch offices are successful from the perspective of logistics.

Using the operational availability data calculated in this model, adequate results can be achieved for the assessment of business performance. Operations/processes that have to be improved can be easily monitored by this model.

CONCLUSION AND SUGGESTIONS

In recent days, optimal utilization of limited sources has become the utmost priority of businesses operating in all fields. Actual performances have to be followed up correctly in order to be able to set goals for development and to assess to what extent set goals are achieved.

The Scorecard and Six Sigma performance systems have been analyzed under the scope of this study. Efforts have been made trying to develop an easy-to-use model by making use of these methods in question, each of which has relative strengths and weaknesses.

Balanced Scorecard suggests consideration of different points of view beyond cost in the implementation of strategic decisions. The Six Sigma approach, on the other hand, aims to increase effectiveness and conse-quently decrease costs of operation and process level. Six Sigma aims to achieve integrity within very low defect tolerances.

In Turkey, for most of the business operation in the logistics field, these two approaches, which are thought to require large amounts of investment, have been applied in practice in very limited areas. The application and understanding of the proposed new model are easier compared to its peers. Due to these characteristics of the proposed model, it can be easily used in businesses of any size. Hence, vertical and horizontal integration of employees within the business can be achieved. Achie-ving such integration would be reflected in the businesses as higher profitability, and on the customers as higher

quality and fuller satisfaction.

The SSBSC model, which does not require a large investment and working capital, combines the most useful and integrating parts of Balanced Scorecard and Six Sigma together. With this characteristic, the model is evaluated as:

1. Achieving highly effective results in maintaining the compatibility between the management and operations/ processes,
2. Helping the assessment of critical processes from different perspectives in performance measurement,
3. Enabling the conversion of Operational Availability value in the developed new model into data, which are linked to critical processes and are calculated easily.

With the proposed model, numerical data can be generated for the operational availability of the business. The operational availability data that have been calculated are evaluated as sufficiently qualified to contribute to the Six Sigma and BSC approaches. Interpretation of operational availability data and calculation of the costs required to increase performance and the optimum operational availability values are thought to be worthwhile as subjects for new research and case studies.

This new hybrid model contributes in that top level management and bottom level management overlap systematically by the least number of defects, under the framework of the strategy. One of the significant achievements of this study is that by this model the levels of effective performance measurement systems have been reached by the formulization of such equilibrium maintained between the management and operations/ processes to assess performance.

Each organization has its own processes at the bottom and different strategic targets, goal and objectives at the tab level. There is no crystal ball solution in establishing strategies, processes, indicators and criterion. The basic concept is to monitor the performance within the organization. As given in the case study, a logistics organization is picked for the implementation purposes. With the defined methodology, this model can be applied in different sectors as well. The user has to analyze the whole organization with a system thinking approach and define the critical variables for itself.

The defined hybrid model combines and aligns top strategic management issues with the processes and procedures conducted at the lowest level within the organization. Using this tool will help in monitoring the performance of the similar organization in operational availability figures calculated with the same perspectives. The result from the performance measure can be traced back and forth in the model as well.

Conflict of Interests

The authors have not declared any conflict of interests.

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Appendix 1. Maximum, minimum and average values of the operation /process indicator, and achievement scores.

Process	Branch office	Maximum	Minimum	Average value	Success score
The indicator decreasing cost-weighted minimum level of depot reserves	A	0.48076	0.25970	0.25954	0.0006
	B	0.48344	0.25841	0.25815	0.0010
	C	0.51321	0.25660	0.23019	0.1029
	D	0.50000	0.25000	0.25000	0.0000
	E	0.49100	0.28818	0.22083	0.2337
The indicator of the cost of spare parts spent for repair	A	54186105.94	0	7493950.01	0.8617
	B	788444.47	0	98555.56	0.8750
	C	480835.35	0	60104.42	0.8750
	D	2074.68	0	259.34	0.8750
	E	222248.71	219.59	66434.48	0.7018
The indicator of the realization of their provision of spare parts needed	A	6.32	0	0.38	0.9399
	B	8.12	0	0.41	0.9495
	C	0	0	0	1.0000
	D	0	0	0	1.0000
	E	12.12	0	0.16	0.9868
The indicator of lead time of requirement	A	1376	0	306.34	0.7774
	E	1357	0	240.24	0.8230
	B	1489	0	197.4	0.8674
	C	701	0	370.75	0.4711
	D	148	0	84.25	0.4307
The indicator of the technical data quality	A	58	0	25	0.3012
	E	97	0	97	0.3264
	B	20	0	15	0.4286
	C	5	0	3	0.3750
	D	4	0	0	0.0000
The indicator of the evaluation period for the requested part	A	104	0	1.9	0.9817
	E	450	0	11.11	0.9753
	B	48	0	6.43	0.8660
	C	27	1	9.63	0.6681
	D	64	0	16	0.7500
The indicator of indigenization status	A	1	0	0.048192771	0.0482
	E	5	0	0.215277778	0.1181
	B	2	0	0.114285714	0.0857
	C	0	0	0	0.0000
	D	0	0	0	0.0000

Full Length Research Paper

Course performance evaluation based on neural network modeling

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Modeling the performance of an academic course based on a given set of affecting factors is the goal of this research. For different institutions, these factors differ in terms of availability and usefulness. This study was conducted for the nine engineering departments at King Abdulaziz University, Saudi Arabia with a total of 281 courses for the last 8 years. First, all measurable input factors were acquired from the database, and a comprehensive statistical study to course performance was performed. In modeling the input factors to the course performance, an adaptive linear model was first implemented at three levels: the college level, the department level, and the course level. Results show that the linear model fitted only 49% of the courses with an error standard deviation of 5.41 grade points, which is above the target of 2.5. On the other hand, the proposed neural network model showed much promising results: 83% of the courses were fitted with an error standard deviation of 0.96, having 95.26% of courses being modeled perfectly. In regard to the neural network structure and type, an exhaustive analysis was conducted by constructing and training 71,295 neural networks. It showed that the feed-forward and the cascade-forward types are the best with hidden layers between two to three.

Key words: Course performance, modeling, neural network, performance indicators, statistical testing.

INTRODUCTION

Many activities influence the success of an academic course; two are of a special nature: advising for registration and the continuous improvement of the course design. Both are controllable and can be tailored to every semester's needs. First, however, it is important to study the aspects affecting the success of a course, students being the core of attention in this matter. In that, numerous factors contribute to the success of a course; yet in order to have an efficient and automated system, these factors must be:

1. collected objectively and reliably,
2. be available when needed,
3. and the process of acquiring them should be sustainable within the institution.

Once the factors have been decided for a given institution, their relationships with the course performance must then be modeled for evaluation. Knowledge of the individual factors is helpful in the general sense; however, a well-developed model would be more practical to improve the

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course performance. In this study, we highlight the most effective factors influencing the course performance for the Faculty of Engineering at King Abdulaziz University. Many approaches will be conducted, and their outcomes will be compared to find out the model that best relates the different effective factors of the course performance. Statistical analyses will also be carried out from different views for better understanding of the proposed model.

LITERATURE REVIEW

In searching the literature, one can find a number of studies relating different factors to academic performance. The work conducted by Winter and Dodou investigated the high school exam scores in relation to the academic performance at the freshman level in the engineering disciplines at the Dutch Technical University (Winter and Dodou, 2011). It shows that clustering high school courses into natural sciences and mathematics reflects the strongest predictor of the GPA. Similarly, in the Aviation College at the University of Tartu, a significant impact of the secondary school grades on academic performance is found, and that it should be set as a selection criterion (Luuk and Luuk, 2008).

Gallacher evaluated the practicability of using university admission tests as predictors of performance in under-graduate studies programs (Gallacher, 2007). The study concludes that admission tests are a useful predictor even if they are not comprehensive.

On the contrary, Thomas from the School of Physics, Georgia Institute of Technology showed that the performance of the diagnostic tests in the introductory physics course on the engineering students is a poor predictor of course performance, and that the students' performance in the previous courses has a more significant correlation (Thomas, 1993). In fact, the study by Chamillard at the US Air Force Academy, Colorado Springs employed the students' performance on previous courses to predict specific courses for curriculum improvement purposes (Chamillard, 2006). The prediction model used was a simple linear regression. Another study at the University of Technology in Jamaica shows that the performance of the first year computer science courses determines the academic performance and hence efforts should be invested in such subjects (Golding and Donaldson, 2006). Finally, a study at Coimbatore Institute of Technology in India listed a set of 7 attributes as key performance indicators to predict students' pass/fail results. The list includes the secondary and high school percentages, subject difficulty, family income, medium, and staff approaches (Shana and Venkatachalam, 2011). Some of the attributes however were measured subjectively by surveys.

Other types of factors impacting the course perfor-mances are also found in literature. A study on 864

students was made at the Department of Economics, United Arab Emirates University. Results show that the most effective factors on performance are competency in English, students' participation in class, and attendance (Harb and El-Shaarawi, 2009).

Another study on 304 students at North Carolina State University identifies some non-cognitive variables that predict first year students' academic performance. It reveals that developing a better understanding of how non-cognitive variables, such as emotional intelligence, relate to GPA and SAT scores is critical for future decisions of educational administrators (Jaeger et al., 2003).

While a lot of factors contribute to the performance of students, only the measureable and accessible ones would be feasible in maintaining a continuous monitoring system of the administration for better planning as well as to the instructors to objectively design their class activities. Input factors available in the information database will be considered in this study to model a course performance. For different institutions with possibly more accessible and reliable factors, we believe that the more incorporated input factors, the better the modeling results will be as will be shown in this paper. We first define the course performance as the average performance (grades) of its successful students excluding the failings, which might be considered at different research.

FACTORS AFFECTING COURSE PERFORMANCE

Course performance, or indeed the performance of the students registering a course, can be affected by many factors. As stated earlier, some of the factors can be measured and quantified while many others are difficult or impossible to measure or estimate (e.g. the un-predictable non-cognitive factors such as the emotional and the psychosocial). Thus achieving a comprehensive set of factors that influences the course performance is not our goal; though we believe that presenting as many measurable factors as possible for the administration and instructors would be more accurate in designing success-ful courses. The forthcoming factors were acquired from the database of the Faculty of Engineering at King Abdulaziz University, Jeddah, Saudi Arabia. For a given target course to be modeled at a given semester, the autonomously collected factors are:

Class Size: the total number of students registering the course
Students' Loads: the statistics (mean and standard deviation) of the credit hours registered by the students in the class while taking the course under modeling. High mean value means the students in the class are over-loaded, and high standard deviation means the class is

Table 1. Input factors and course performance statistics.

	Grade (μ)	Grade (σ)	Class Size	Load (μ)	Load (σ)	GPA (μ)	GPA (σ)	Prereq (μ)	Prereq (σ)	Off Plan (μ)	Off Plan (σ)
Mean	76.4	9.2	15.3	14.0	2.0	3.4	0.5	76.5	9.0	3.2	1.7
Std	6.5	3.0	9.9	2.8	0.9	0.4	0.2	6.0	2.8	2.2	0.9
Max	97.7	26.2	71.0	20.0	10.6	4.7	2.0	98.5	26.9	12.7	9.9
Unit	point	point	student	credit h	credit h	of 5.00	of 5.00	point	point	semester	semester

very diverse with students of low and high loads.

Students GPAs: the statistics of the students' GPAs registering the course; again the higher the mean the better it is for the students, and high standard deviation means the class is more diverse in terms of GPA

Students' Prerequisites Grades: the statistics of the prerequisite courses grades. If the course has more than one prerequisite course, the statistics is applied to the collective set (e.g. if 10 students are registering the course that has two prerequisites, then the set of the 20 prerequisite grades is considered for statistics)

Students' Off-Plan Delays: the statistics of the number of semesters the students delayed taking the course according to their plans

Data were collected from the Fall-2005 until the Spring-2012[1] semester for the nine different programs at the college with a total of 281 different courses. The engineering programs are: aeronautical, civil, chemical, electrical, industrial, mechanical, thermal, mining, and nuclear engineering. The dataset has 4138 records; each record has the above mentioned input factors statistics (both mean and standard deviation) along with the actual course performance at the end of its semester. Table 1 shows the basic statistics of the input factors as well as the course performance (grades).

The mean value of the grades of the different courses of the college over the years is 76.4, which is a C+ grade letter. For the different courses, the grade mean value ranges from this mean with a standard deviation of 6.5, that is 69.9 to 82.9 is the 1-σ confidence range. The second column of the table represents the variation of the students' grades within a single course. If this number is zero, then all students got exactly the same grade in that specific course. Across all the college courses over the years of study, the course grade standard deviations averaged to 9.2 and reached 26.2 at a single occurrence, which is odd unless the class size is too large. The remaining columns of the table show the input factors statistics. For instant, the students are delaying taking

their courses according to their plans by about 3.2 semesters. This number should be zero if all students took their courses as they were supposed to. At one course, this mean value reached 12.7 semesters, suggesting that a student in that course at some semester has delayed taking the course more than 7 years. In fact, the regulations prohibit students to stay more than 10 years to get their B.Sc. degrees.

The correlation coefficients between the course performance and the different input factors are also carried out for the entire dataset. Figure 1 shows how the input factors are statistically correlated to the course performance. Clearly, both the mean value of the course prerequisite grades and the average students GPAs have the most effect on the course performance. Class size has a correlation coefficient of +15% to the course performance. It was unexpected to be positively correlated; i.e., the larger the class size the better the students perform. However, the average class size is about 15 students, and one third of the college classes having less than 10 students. It might be seen that more students in a class would enrich the discussions and make the class active. A closer focus on this observation might be needed in a different study.

The next negatively impacting factor found was the students delays in taking their curriculum courses off their plans; the longer the students delay taking a course according to the plan the weaker the course performance is expected. The impact however is relatively low (10%). All other factors show almost insignificant correlation coefficients to the course performance, namely the variation of the students' prerequisite grades, the variation of the students at their off plan delays, and the statistics of the students' loads when taking the course of interest.

It is also useful to discuss some of the factors statistics for all records of the college. Table 2 shows the complete correlation coefficients of the input factors and the course performance.

The interesting relationships between the different input factors are discussed:

1. larger class sizes have higher GPA averages(-20%): it might show that good students with high GPAs and less

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[1] The convention at King Abdulaziz University is to name the fall semester starting in September 2009 as Fall-2010, unlike most international universities

	GPA mean	Prereq mean	Class Size	Off Plan mean	GPA std	Prereq std	Off Plan std	Load mean	Load std
r	0.34	0.33	0.15	-0.15	0.1	0.08	-0.07	-0.04	0.01
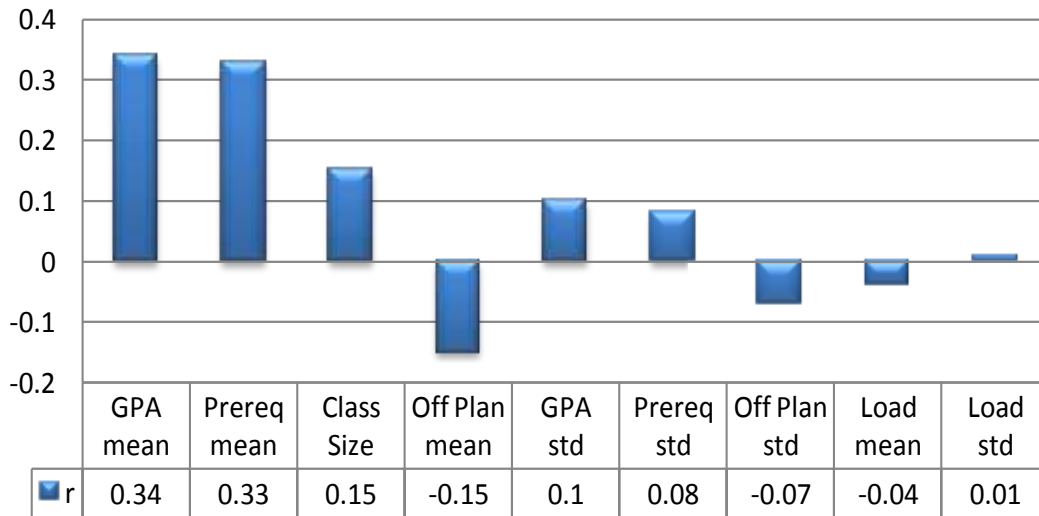
Figure 1. Correlation coefficients of input factors with course performance.

Table 2. Input factors correlation coefficients.

		Grade (μ)	Grade (σ)	Class Size	Load (μ)	Load (σ)	GPA (μ)	GPA (σ)	Prereq (μ)	Prereq (σ)	Off Plan (μ)	Off Plan (σ)
Grade	(μ)	1										
Grade	(σ)	0.05	1									
Class Size		0.15	0.14	1								
Load	(μ)	-0.04	0.01	0.12	1							
Load	(σ)	0.01	-0.02	0.07	0.09	1						
GPA	(μ)	0.34	0.16	0.32	0.10	-0.05	1					
GPA	(σ)	0.10	0.34	0.13	0.01	0.04	0.09	1				
Prereq	(μ)	0.33	0.08	0.14	0.07	-0.03	0.58	0.05	1			
Prereq	(σ)	0.08	0.26	0.12	0.04	-0.03	0.14	0.36	0.02	1		
Off Plan	(μ)	-0.15	-0.14	-0.20	0.17	0.32	-0.51	0.00	-0.35	-0.11	1	
Off Plan	(σ)	-0.07	0.04	-0.04	-0.03	0.21	-0.38	0.37	-0.19	0.07	0.44	1

off-plan delays tend to register in large classes
2. similarly, classes with high GPA students are having low off-plan delays (-51%) and less diverse too (-38%)
3. classes with students highly diverse in credit hours loads tend to have high off-plan delays (+32%) as well as very diverse students in off-plan delays (+21), yielding lower course performance
4. obviously, classes with students of high GPAs are having high average grades in the prerequisites (58%), and the more diverse class in terms of GPAs would be more diverse in the prerequisite grades (+36%)

In summary, the successful classes are the ones with high input GPA mean values, high prerequisite grades, low off-plan delays, and reasonable class sizes, which is no surprise.

PERFORMANCE MODELING

Adaptive linear modeling

The simplest scheme to model a course performance as a function of input variables is to assume additive linear relationships with adjustable weights (Priestley, 1988). For n input variables, let a course performance, y, at a given semester of interest be modeled as:

$$y = c + \beta \cdot \zeta + \sum_{i=1}^{n} \alpha_i \cdot x_i \qquad (1)$$

where, x_i is the ith input factor affecting the course performance, α_i is the dependence weight, ζ is an independent normalized random variable representing all non-modeled factors, β is the multiplicative

factor of the normalized random variable, and *c* is the regression constant.

Before applying regression to estimate *c*, β, and α_i's, let us first calculate the correlation between the course performance and each input in order to identify the most important affecting factors; let μ_I be the mean value of the ith input factor x_i, and σ_i be its standard deviation based on the dataset prior to the semester of interest. The mean and variance of *y* will then be:

$$\mu_y = c + \sum_{i=1}^{n} \alpha_i \cdot \mu_i$$

$$\sigma_y^2 = \beta^2 + \sum_{i=1}^{n}\sum_{j=1}^{n} \alpha_i \alpha_j \rho_{ij} \sigma_i \sigma_j \qquad (2)$$

where ρ_{ij} is the correlation coefficient between inputs *i* and *j*. The correlation coefficient between *y* and any of the inputs x_k is then:

$$\rho_{yk} = \frac{1}{\sigma_y} \sum_{i=1}^{n} \alpha_i \rho_{ik} \sigma_i \qquad (3)$$

In a matrix form, let:

$$A = \begin{bmatrix} \alpha_1 \sigma_1 \\ \alpha_2 \sigma_2 \\ \vdots \\ \alpha_n \sigma_n \end{bmatrix}, \quad B = \begin{bmatrix} \rho_{y1} \\ \rho_{y2} \\ \vdots \\ \rho_{yn} \end{bmatrix}, \quad R = \begin{pmatrix} 1 & \rho_{12} & \cdots & \rho_{1n} \\ \rho_{21} & 1 & \cdots & \rho_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ \rho_{n1} & \rho_{n2} & \cdots & 1 \end{pmatrix} \qquad (4)$$

Then,

$$\sigma_y B = R \times A \qquad (5)$$

Given the correlation coefficients between the inputs, *R*, and between the output and any input, *B*, α_i can be estimated for *i* from 1 to *n* as:

$$A = \sigma_y R^{-1} \times B \qquad (6)$$

from which α_i's are calculated; *c* and β, can be estimated from Equation (1), and hence:

$$\alpha_i = \frac{A_i}{\sigma_i}$$

$$c = \mu_y - \sum_{i=1}^{n} \alpha_i \cdot \mu_i \qquad (7)$$

$$\beta^2 = \sigma_y^2 - \sum_{i=1}^{n}\sum_{j=1}^{n} \alpha_i \alpha_j \rho_{ij} \sigma_i \sigma_j$$

To sum up, for a given course, its performance can be modeled by calculating all of its affecting factors statistics (μ_i, σ_i, and the correlation coefficients between them, ρ_{ij}'s) based on the dataset available. The statistics of the course performance from the dataset is then calculated, namely, μ_y, σ_y, and ρ_{yi}. Estimates of α_i, *c*, and β are carried out using Equations (6) and (7). The modeled course performance can finally be calculated using Equation (1) where x_i's are the input factors evaluated for the registered students; $\beta \times \zeta$ is the adjusting independent random quantity and will be eliminated

from the model. Effectively however, β is an estimate of the standard deviation of the modeling error.

The parameters α_i, *c*, and β can be estimated differently at three levels:

1. all college courses are evaluated in one model,
2. courses of each individual department have a model,
3. or each course has its own model separately

Neural network modeling

More effectively, one may utilize the dynamic learning property of the artificial neural networks in modeling the course performance. Since the discovery of the human brain function, artificial neural networks have been used to mimic the way our brains identify and predict events based on prior knowledge acquired (Krose and Smagt, 1996). A neural network consists of neurons which are small mathematical engines that sum some input signals from other neurons with certain weights and output a mapped activation function of the sum. The activation function of a neuron is a non-linear, monotonically increasing, continuous, differentiable and bounded function; the most commonly used are the sigmoid functions (Russell and Norvig, 1995):

$$y = f\left(b + \sum_{i=1}^{n} w_i x_i\right) \qquad (8)$$

where, *y* is the neuron output, x_i are the inputs, w_i are the weights of the inputs, *b* is the bias, and *f*(.) is the non-decreasing arbitrary activation function, a sigmoid function in this paper.

Neural networks are structured in layers, each having a number of neurons. The signal streams between the neurons of the different layers distinguish the network architecture, and the simplest neural network is the feed-forward where the outputs from the neurons in a given layer are fed only to the immediate next layer neurons as inputs. Figure 2 shows the neural network architectures used in this study.

The activation function assigned to the different neurons is also a concern. Together with the size and structure of the network, one could obtain the best or the worst model for a specific problem. In general, the feed-forward networks are best used in classification applications such that used by (Sejnowski and Rosenberg, 1987) in converting English text to speech. Machine classification of sonar signals are also best modeled by feed-forward network, while the cascade-forward and the Elman networks are suitable for complex and large systems.

Regarding the network size in terms of the number of layers and neurons in each layer, an exhaustive search has been carried out in this study to compare the different networks and to decide the best model, starting by a single layer with neurons from 1 to 20, and up to three layers with combinations of neurons in each layer. These sets of networks were constructed and trained for the college courses first, and then for each of the 9 departments separately, and finally for the 281 courses. A total of 71,295 neural networks were simulated for this study.

MODELING RESULTS

Historical averages

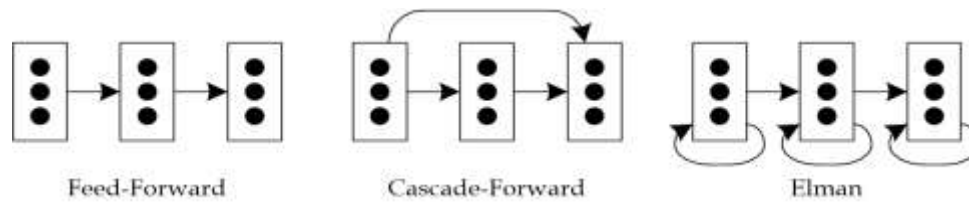Several basic calculations were first tried to compare with

Figure 2. Neural network architectures used.

the two proposed models: the adaptive linear model and the neural network model. Considering the course performance statistics only, one may claim that the college or a department or even a course would retain its historical average performance without even considering any affecting input factor. For that claim, an error analysis was carried out to see the actual course performance in relation to its historical mean value. Results are as follows[2]:

1. Considering the college's mean value, which is 76.4, as the performance model for all courses in the college, the error statistics has a standard deviation of 6.5 grade points. Note that the error mean value is negligible and has no significant interpretation since some of the courses have positive errors while others have negative values. The standard deviation is our meaningful indication of the error size.
2. When considering each department of the college alone, i.e., each department having its mean value as the model to all of its courses, the performance errors have standard deviations ranging from 4.73 to 7.88 for the different departments.
3. Now considering each course alone regardless of its department, the error statistics in modeling the different courses is in the range from 1.05 to 13.52 points. Figure 3 shows these statistics.

In summary, the best case scenario of the historical average based modeling has a standard deviation of 4.73 for one of the departments, and an average of 4.91 grade points among all courses when considering each course alone. These figures are now our reference for the model improvement.

Adaptive linear model results

When incorporating the abovementioned affecting factors in modeling the course performance, results show better modeling results. Figure 4 shows the modeling errors as follows:

1. Fitting all the courses of the college into one linear model gives an error standard deviation of 5.95 points. This is an improvement of about 8% to simply taking the college average as a model of performance. The college linear model parameters are[3]:

$$\alpha_i = \{0.04 \quad -0.23 \quad 0.01 \quad 3.42 \quad 1.75 \quad 0.23 \quad 0.07 \quad 0.41 \quad 0.20\}$$
$$c = 46.17$$
$$\beta = 5.95$$
(9)

2. When grouping the courses according to their departments and having a linear model for each department, the errors are again better than the simple average model ranging from 4.4 to 6.65 points, with improvements of 7 to 15% for the different departments.
3. When it comes to fitting a linear model for each course alone, the overall error standard deviations are much better; they range from almost perfect modeling for some of the courses to 5.41 points in the worst case. However, only 49% of the courses fit the linear modeling while 51% fail to fit. Careful investigation reveals that the regression did not converge for these courses due to the few data points available. Since there are 9 input factors to fit the linear model, there should be at least 10 or more data points to fit. For the 281 courses in the database, 142 courses of them have fewer records than 10; thus could not be modeled. Figure 5 shows the histogram of the data sizes of the courses.

We might conclude that the linear model is better than the simple average model, whether considering the courses in the college, in their departments, or individually. Next we move to the hypothesis that information in the input affecting factors is not linearly correlated to the course performance. Modeling results of the neural network model follow.

Incremental modeling results

In this section, we show the effectiveness of modeling

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[2] Course performance has a maximum grade of 100 points

[3] The input factors are in the following order: class size, load mean, load standard deviation, GPA mean, GPA standard deviation, prerequisite mean, prerequisite standard deviation, off-plan mean, off-plan standard deviation.
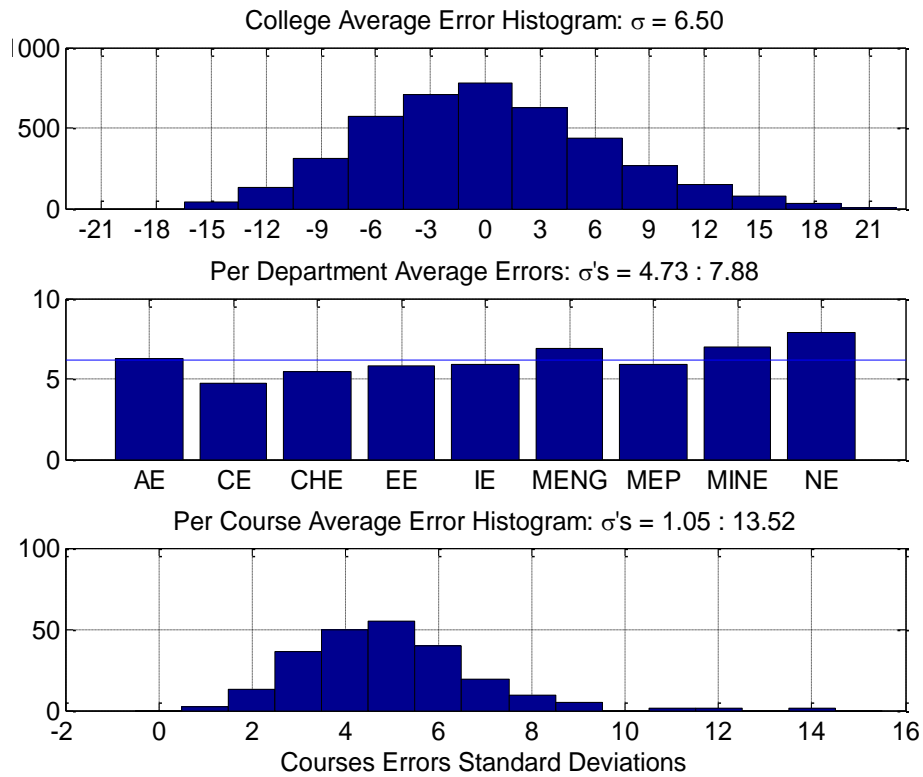
Figure 3. Course Performance Errors Based on Historical Performance Averages.
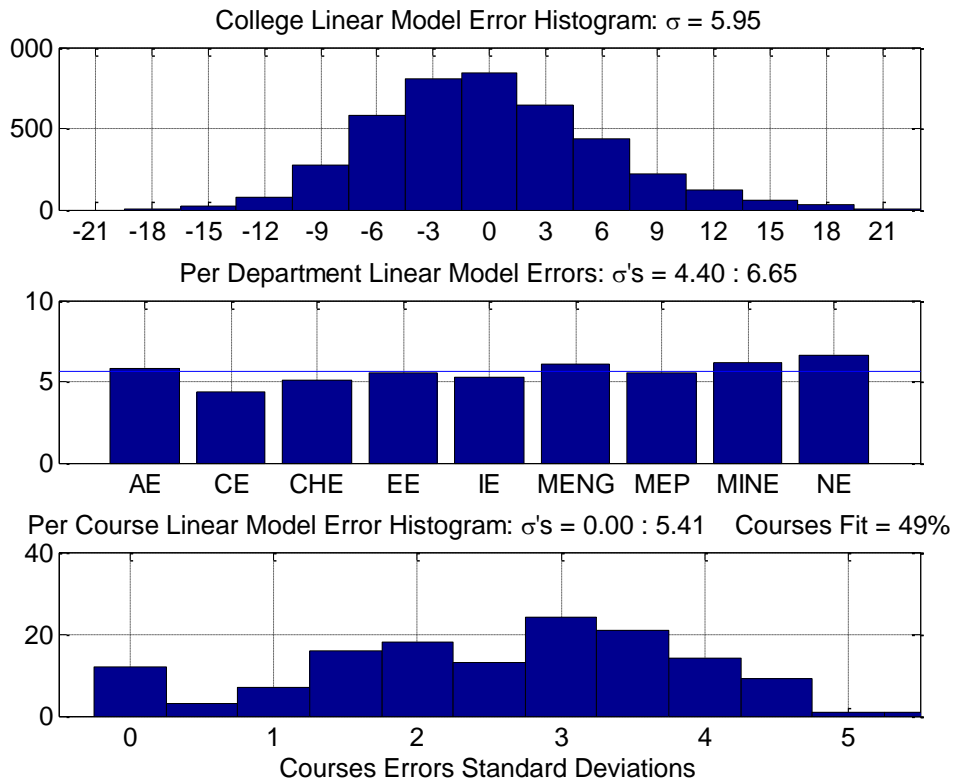
Figure 4. Course performance modeling errors based on linear modeling.
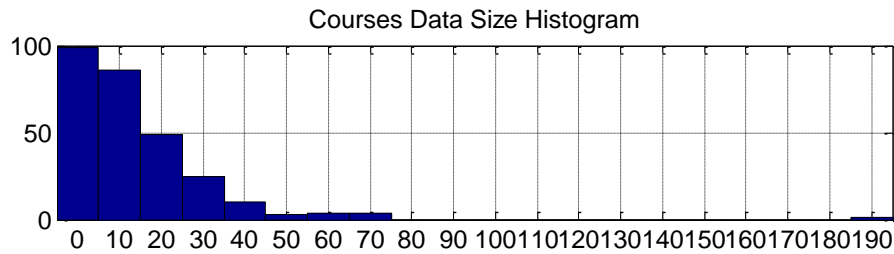
Figure 5. Courses data sizes.
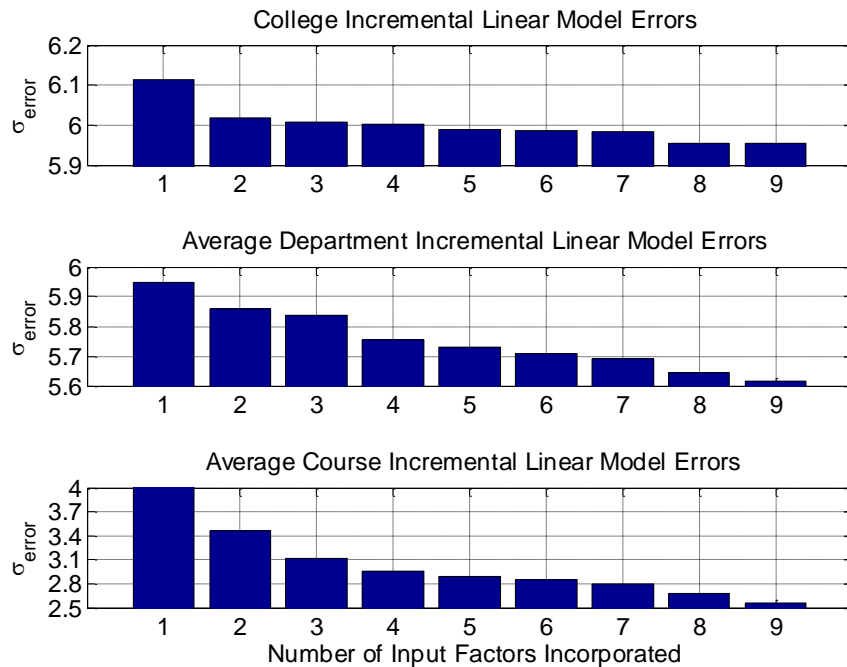
Figure 6. Incremental improvement of linear modeling.

when more input factors are considered. Figure 6 shows the linear modeling error standard deviation when adding more and more inputs. When considering only one input factor, namely the GPA mean average, the errors were the worst compared to the case where two input factors are considered, and so on.

Neural network model results

Similar approach is maintained in modeling course performance when treated at the college level, the department level, and individually. As stated earlier, a number of neural networks were configured and trained in each case, and the errors of the models were then reported. Results are shown in Figure 7:

1. At the college level, the best neural network was the cascade-forward with two internal layers of sizes (9 and 3 neurons). The error standard deviation is 5.45, with about 8% improvement to the linear model, and 16% improvement to the historical average.
2. At the department level, each department has its own neural network, and the errors range from 3.85 to 5.04 points with better modeling than the adaptive linear.
3. When building a neural network for every course, results are of a much improved values.

On the average across the different courses, the modeling error is 0.96 points ranging from almost zero up to 3.78. With a target error of 2.5 grade points, 95.26% of the courses were modeled correctly, and the remaining 4.74% of the courses were modeled one letter grade off.
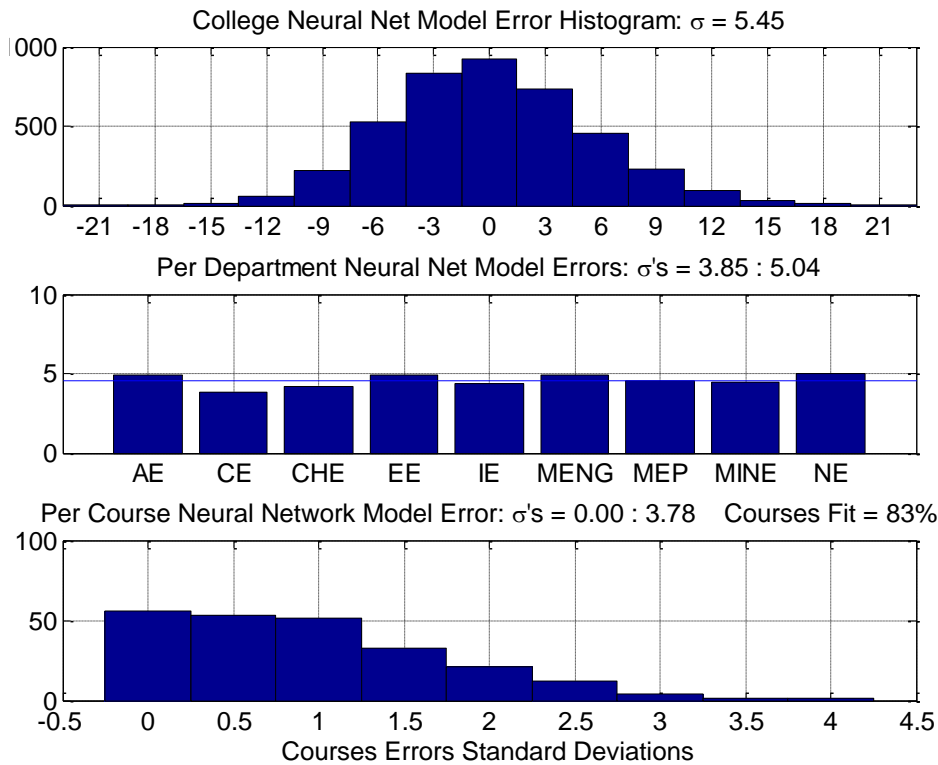
Figure 7. Course performance modeling errors based on neural network modeling.

Moreover, the neural network modeling was able to fit 83% of the courses unlike the linear modeling.

Analyzing the trained and simulated neural networks at the different levels, we find that 50% of the courses were best modeled by the CF neural networks type, 48% of the courses by the FF networks, and only 2% by the ELM type. Thus, the Elman neural network does not model the course performance of the affecting factors very well. Regarding the cascade- versus feed-forward types, we may conclude that courses behave similarly to either one.

Regarding the number of layers, we found that about 50% of the courses were best modeled by 2 hidden layers, while 38% of the courses were best modeled by 3 layers, while about 12% of the courses were modeled by only 1 hidden layer.

Finally, a comparative study was conducted on the total number of neurons of the networks to see how many neurons best fit the courses which are distributed among the hidden layers. Figure 8 shows a histogram of the best number of neurons for the different course models. The average is about 11 neurons ranging from as little as 2 to 20.

These observations suggest that in order to model the performance of a given course, a good start is to build either a feed-forward or a cascade-forward neural network with two hidden layers and a total of 11 neurons distributed randomly between the two layers. Variations

of the model accuracy may then be observed at different configurations.

Analysis of variance

In order to objectively compare the accuracy of the linear and neural network models, we carried out some statistical tests to analyze the standard errors of the two models, namely the F-test (Christensen, 1996) and the Levene test (Levene, 1960). The difference between the two tests is that the F-test assumes both model errors are normally distributed. When the samples are not normally distributed, then the Levene test is a better nonparametric alternative. The F-test however gives more accurate results but when its condition is definitely satisfied.

Our hypothesis is that the error variance of the neural network model, σ_2^2 is less than that of the linear model, σ_1^2. Thus, we set the null and alternative hypotheses as:

$$\begin{aligned} H_0 &: \sigma_1^2 = \sigma_2^2 \\ H_a &: \sigma_1^2 > \sigma_2^2 \end{aligned} \tag{10}$$

The first step is to test the normality of the modeling errors using the widely employed Kolmogorov-Smirnov
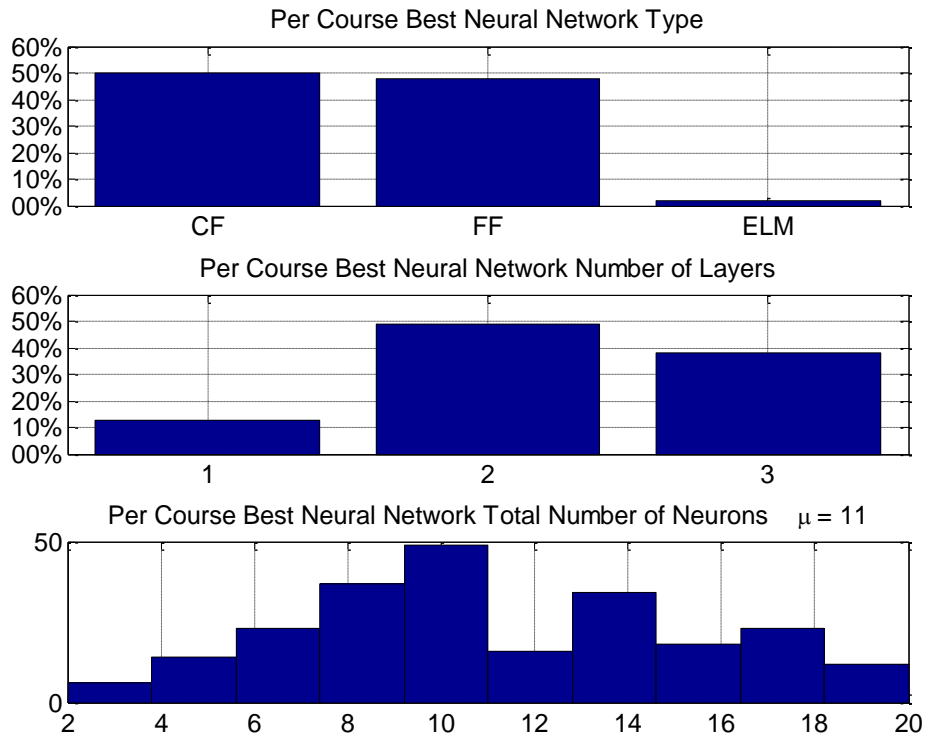
Figure 8. Course neural network analysis.

goodness of fit test (Massey, 1951). To carry out this test, the empirical cumulative distribution function is calculated from the sample data points X_i as follows:

$$F_n(x) = \frac{1}{n}\sum_{i=1}^{n} I(X_i \le x) \tag{11}$$

The Kolmogorov-Smirnov statistics (KS) is then:

$$KS = \sup_{x}|F_n(x) - F(x)| \tag{12}$$

where $F(x)$ in our case is the normal CDF, and $F_n(x)$ is the empirical CDF of the sample.

For the F-test, the F-statistics value is computed as follows:

$$F = \frac{s_1^2}{s_2^2} \tag{13}$$

where s_1^2 and s_2^2 are the linear model and neural network samples variances, respectively. Traditionally, one sets a level of significance, say $\alpha = 0.05$, and finds a Critical Value from the F-distribution tables based on that along with the degrees of freedom of the samples. A com-

parison is then made between the F-statistics and the Critical Value to give a decision whether to reject or accept the null hypothesis. However, modern computing tools are now more efficient to calculate the *p*-value directly from the samples. The *p*-value is simply the probability of the null hypothesis. The lower the *p*-value the more evidence to reject the null hypothesis; and it will be up to the reader to decide on the confidence level.

For the non-parametric Levene-test, the statistics value is calculated as follows:

$$W = \frac{n \cdot (2n-1)}{2 \cdot (n-1)} \frac{(\bar{x}_1 - \bar{x}_2)^2}{s_1^2 + s_2^2} \tag{13}$$

where $\bar{x}_i$ and s_i^2 are the ith sample mean (or preferably the median) and variance, respectively. The p-value of the test is based on tabulated probabilities.

In this work, the course performance modeling was conducted at three levels: the college, the department, and the course level using both the linear and neural network modeling. In carrying out the analysis of variance statistics, the following steps were followed:

1. test the sample normality using Kolmogorov- Smirnov goodness of fit
2. compute the F-statistics if samples are normal at confidence level of 0.05

KS Statistics Boxplots Linear Model

KS Statistics Boxplots NN Model
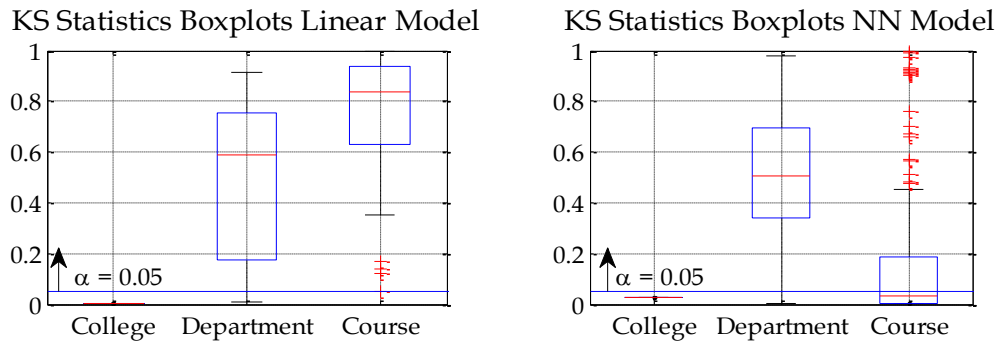
Figure 9. Kolmogorov-Smirnov statistics for normality.

F-Test p-value Boxplots

Levene-Test p-value Boxplots
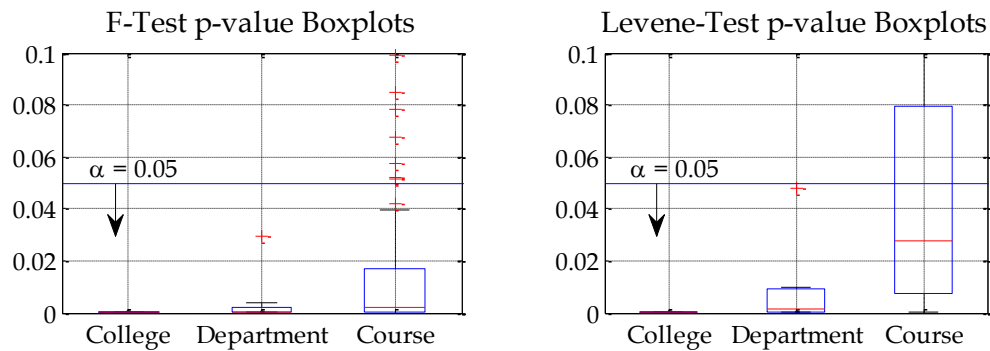
Figure 10. F-test and Levene-test statistics for the different models.

3. calculate the p-value of F-test
4. compute the p-value of Levene-test when either samples are not normal
5. report the decision on the null hypothesis

These steps are carried out for each of the three modeling levels. Figure 9 shows the Kolmogorov-Smirnov statistics calculated on the modeling errors to check for the normality of the model errors. It can be seen that both the linear and neural network the college models are not normally distributed. The *p*-value of the linear college model is 0.0000882, and 0.028 for the neural network model. These values are way below any acceptable confidence level to accept the normality hypothesis. Similarly, 56% of the neural network course model errors are not normally distributed considering a confidence level of 0.05. Thus, it is preferable to use a nonparametric Levene statistical test to compare the modeling errors distributions for both college and course levels, and to use F-test at the department level.

Figure 10 displays the *p*-values of both the F-tests and Levene-tests in boxplots at the different modeling levels:

1. At the college level, the Levene-test is used yielding a *p*-value of 1.42×10^{-7} which indicates a strong rejection of the null hypothesis and accepting the alternative, that is,

the two models having totally different distributions.
2. Similarly at the department level where 9 department models were compared, the *p*-values of the F-tests range from 6.3×10^{-8} to 0.0293, indicating that the linear and neural network models are also different.
3. At the course level, the F-tests and the Levene-tests are used according to the normality tests of the neural network course model errors.

Figure 11 shows the *p*-values boxplots for the course models according to the normality tests, F-test when samples are normal, and Levene-test when samples are not normal. 77% of the normally distributed course models have significant different statistics of the linear and the neural network models, and 71% of the non-normal course models have different distributions for the linear and neural network. These percentages were found at a level confidence of 0.05. For the remaining percentages of course models, there is not enough evidence that the linear and neural network models differ from each other.

Conclusion

In this paper, we presented two modeling methods for an

Course Models Statistical Tests
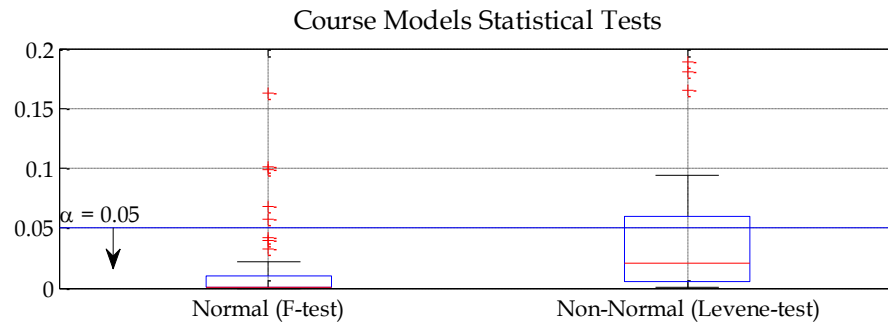
Figure 11. Normal and Non-normal statistical tests at course level.

academic course performance based on a set of factors. The study considered those measurable quantitative factors that have noticeable correlation with the course performance and that of high availability. Results show nonlinear behaviors of the affecting factors when mapped to the course performance, thus modeling with a neural network would be more precise. Modeling improvements are attainable when more inputs factors are considered. The study shows that when adding more factors to the model, accuracy is increased. Thus for a given institution, the more factors considered, the better the modeling will be.

Modeling the course performance was performed at three different levels grouping courses in either indivi-dually, according to their departments or all together as one college model. While the adaptive linear model fitted only 49% of the courses with an error standard deviation of 5.41 grade points, the proposed neural network model was able to fit 83% of the courses with a small error standard deviation of less than one grade point.

Besides the average error observations, statistical tests were employed to objectively compare the accuracy of the linear and neural network models. Utilizing the F-test for normally distributed errors and Levene-test for the non-normal models, results show that the neural network models at the different levels have much lower standard errors than the linear models, confirming the nonlinear behavior of the course performance at all levels.

Although this study was mainly conducted for the courses of the Faculty of Engineering, King Abdulaziz University, other colleges and universities might benefit from similar modeling, especially the advantages of the neural network modeling for performance.

Conflict of Interests

The authors have not declared any conflict of interests.

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Full Length Research Paper

A study of the relationship between carbon emission and tourism development in Maldives

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The scope of this paper is to explore the relationship between tourism development and carbon emission in Maldives. Data used are already published data for Maldives tourism development and carbon emission. Individual Model for tourism development indicators and combined model of all the indicators were used to test the relationship. Unit root test was used to test the stationary status of the data. Empirical tests were performed using Ordinary Least square Method. Unit root results suggest that data are stationary at first differentiation. Regression results show very significant positive correlation between tourism development indicators and carbon emission. The relationship between carbon emission and tourism development shows very directional positive relationship. The results suggest growth of tourism and development of the industry is one major factor driving the carbon emission in Maldives. To reduce the carbon emission to achieve the goal of becoming the first carbon natural country, government could encourage opening of guest houses with more simulative rules by increasing the number of beds without increasing the number of resorts, increasing number of international airports, limiting domestic transfers and developing tourist sites to increase the output of the industry.

Key words: Tourism development, carbon emission, Maldives.

INTRODUCTION

Maldives is an ocean archipelago consisting of 1192 islands in the Indian Ocean. The country is famous for its coral reefs, sandy beaches and luxury resorts. The population of Maldives is estimated to be 336,220 people living in 190 islands (DNP, Maldives at a glance - July, 2013). The Maldives has more territorial sea than land. Marine resources have played a vital role in shaping the contours of economic development with nature-based tourism and fishing being the main drivers of economic growth.

Travel and tourism has have become the powerhouse of the most of the low-lying countries across the globe in the past few decades. Unexploited natural beauty of small nations opened opportunities for economic growth and development. The world tourism growth from 25 million to 1 billion in 60 years has proven tourism hasbecome an important tool for development in many partsof the world. Like any other industry tourism is a "business transection, a commodity for sale in the world market" (Maximiliano et al., 2012). Production of all the

goods and provision of all services have its costs, economic cost, social cost as well as environmental cost.

Fishing was the blood line of the economy prior to introducing tourism in 1972. When Maldives tourism industry started in 1972 with few resorts, people were not aware of the environmental consequences associated with the tourism industry. People still believe that tourism industry is emission free or less emission industry (Salah and John, 2005) because tourism industry is mainly service oriented industry.

Maldives tourism industry accounted for nearly one fourth of the total CO_2 emission (Flora et al., 2010). The total output of the primary, secondary and tertiary sector in 1981 was 312.1, 206.5 and 1159.7 million Rufiyaa respectively. The total Carbon Emission reported for 1981 was 58 matric ton. After 10 years, the reported amount of Carbon Emission increased more than double fold. The growth of Primary and Secondary sectors was slower than that of Tertiary sector. Year before Tsunami hit Asian countries including Maldives, the total emission increased more than five fold than that of 1981. The only industry that grew as fast as the growth of the Carbon Emission was Tertiary sector. All the available information for economic development and carbon emissionshow that carbon emission and tourism development increases in parelel to each other. Lots of researches have been carried out and the broader consession has been made on the positive relationship between economic develop-ment and environmental degradation. Most of these reserch data are from industrial countries. Very less researches have been done using data from small-countries which rely on service based economies. Maldives is chosen for this study because Maldives is one of the smallest fast developing nation driven by its tourism industry in the past few decades.

The main scope of this paper is to analyze the relationship between tourism development and carbon emission in Maldives. Maldives economy started growing at rapid rate with the introduction of tourism in 1972. Over the past 30 years Maldives economy was developing at the rate of 8% per year. Available statistics shows more than one third of the GDP comes from tourism industry. At the same time, carbon emission data for the Maldives also show rapid increase in carbon emission year by year.

LITERATURE AND HYPOTHESIS

Tourism industry across the globe has developed at a very fast rate in the last few decades. The economic activities involved in the industry are numerous. Resent forcast shows that tourism will enjoy an everage growth of 3.8% per year between 2012 and 2020 (UNWTO, 2013). United Natioans World Tourism Organization has observed that tourism is a significant contributor to climate change and global warming. (Bob et al., 2009). A substatial volume of research has identified tourism as a major source of greenhouse gas emissions, primarily (but not exclusively) from air transport. On the other hand, tourism industry is one of the victims of the global climate change. It is estimated that tourism contributes 5% of the total Carbon Dioxide [CO_2] emission and up to 14% of all emission when other greenhouse gase are considered (Scott et al., 2008).

The impact of tourism has been reasonably well researched, particularly from the environmental and economic prospective. However empirical support to show the relationship between the two variables is mainly based either on direct observation of the data or on some parallel based analysis. Such approaches are clearly insufficient to classify the nature of the underlying linkage between carbon emission and tourism development (Zaman et al., 2011).The goal of this study is to use data from a small developing country to study the relationship of carbon emission and economic development and empirically explore the relationship.

Despite the fast increasing carbon emission and environmental degradation, very few studies have been done in Maldives to see the nature of the economic development and carbon emission. One of the researches we published shows positive correlation between economic growth and carbon emission (Ahmed and Laijun, 2012). In that research we found economic growth and carbon emission for Maldives follows Kuznets Curve. Hence there is need to analyze tourism growth and carbon emission to explore their relationships in the Maldives. This will help the policy makers to take timely actions to achieve national goal to achieve world's first nation to become carbon natural.

Environment is one of the most researched and written subject in the twenty first century. Due to the extensive attention given to the environment and global worming warming,primary, secondary and even tertiary sectors ofeconomy were studied by lots of researchers to understand the relationship between economic development and environmental degradation. In many small developing nations travel and tourism or service is the only major industry. As tourism was treated as a discipline of management in the social science, tourism was mainly researched and studied in relation to business management. Till the end of last century tourism researches were dominated by the tourism management, tourism development and other tourism related issues.

Maldives was very unaware of its carbon emission for very long time. On the other hand Maldives was always concerned about environmental problems, especially island erosion problem faced by lots of its islands. Tourism industry was always considered as clean industry in Maldives. Environmental side of the tourism that was given significant important was protecting ecology of the resorts. Even though carbon emission was not addressed separately in tourism related rules and regulation, protecting environment and biosphere of the
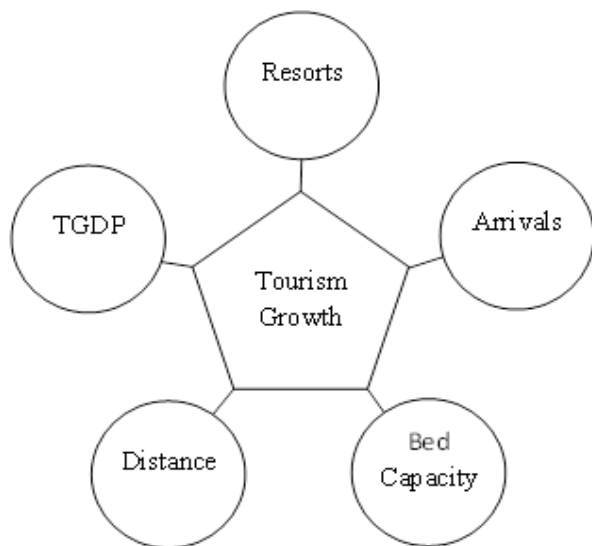
Figure 1. Tourism development indicators.
Source: Self extracted.

country was included in tourism related rules and regulations.

According to the Maldives Carbon Audit, the major environmental pollution of Maldives is the emission of carbon dioxide (Flora et al., 2010)Maldives uses diesel as the main and only fuel to produce energy that is required for the nation.Diesel fuel is burned in almost all the industry including tourism industry.

Before developing the hypothesis the indicators that show the rapid growth of the tourism industry in Maldives were studied. From the information published by Maldives government, there are five indicators that show the growth of the tourism industry. They are 1) Number of tourist resorts, 2) Tourist Arrival, 3) Tourism GDP, 4) Bed Capacity and 5) Tourist Resort Distance. These indicators are chosen because they are the only indicators of tourism development for which data were available. Tourism income is very important indicator to analyze the carbon emission and tourism growth, but data for this variable are very less to use statistical methods to get significant result.These 5 indicators are illustrated in Figure 1.

From the trend of the data sets for tourism develop-ment indicators and carbon emission, it is assumed to have positive relationship between variables. Data distribution graphs of variables and carbon emission used in the statistical tests are shown in Figures 2 and 3 res-pectively. The main hypothesis of the study is that carbon emission and tourism development are positively correlated. Two step approach was used to test the main hypotheses. First step was to explore the individual relationship of the variables to the carbon emission. Separate sub-hypothesis was drawn for each indicator. In the second step, combined relationship of the variables to

carbon emission was tested.

Growth in Tourism Gross Domestic Product (TGDP)

Tourism Gross Domestic Product (TGDP) of the tourism industry is the main indicator of the growth of the tourism industry as well as the overall development of the industry. As we have highlighted before, tourism industry contributesnearly one third of the total GDP of the Maldives(MMA, Monthly Statistics 2014, 2014). First sub hypothesis of this study is that TGDP and carbon emission are positively correlated. Carbon emission increases positively the growth of TGDP.A very high significant level of correlation coefficient was expected with positive sign.

Touristarrivals

Tourist Arrivals (TA) to Maldives have been increasing yearly. In recent years Maldives has been receiving tourist more than its population. In 2013 Maldives has received 1 million tourists achieving the tourism target for 2103 (MMA, Monthly Statistics 2014, 2014). Increase in tourist arrivals increases the overall economic activities vertically and horizontally. This increase in economic activities must increase carbon emission. Therefore second sub-hypothesis was generated as given below. Very significant correlation between these two variables was expected in the test results.

Tourist bed nights

Tourist Bed Nights (TBN) is the number of nights each tourist stayed in Maldives. TBN is always higher than the number of arrivals. Records show in average a tourist spends minimum seven nights and maximum 9 nights in Maldives. When tourists stay in one place it will reduce the commute of the tourists (Scott, et al., 2008). Even though TBNs are higher than the TA, it was assumed that increase in bed nights will not increase the carbon emission at the same rate of Tourist Arrival. But one cannot assume that it will have weaker relationship with the Carbon Emission. The relationship strength might be weaker than that of tourist arrival. Third sub-hypothesis of this paper was drawn based on this assumption.

Number of tourist resorts

Another main visible indicator of tourism development is the increase in the number of Tourist Resorts (TR). Maldives uses very unique model of tourism. This unique model is developed from the unique geographical structure of the Maldives. The island nation of Maldives
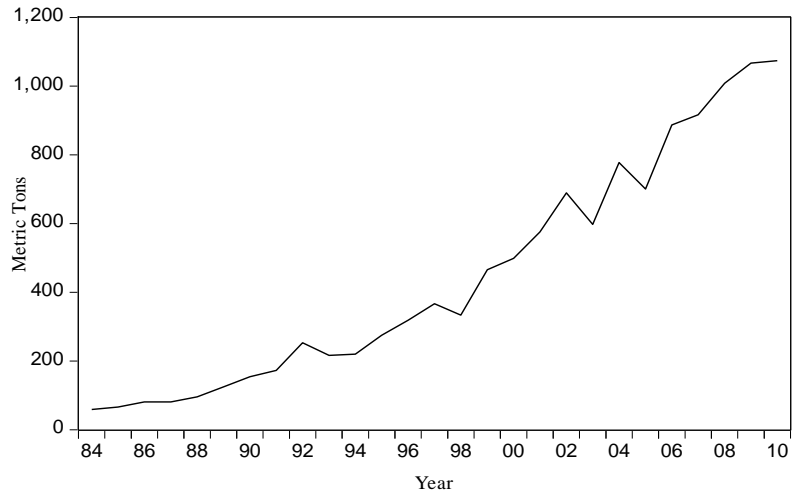
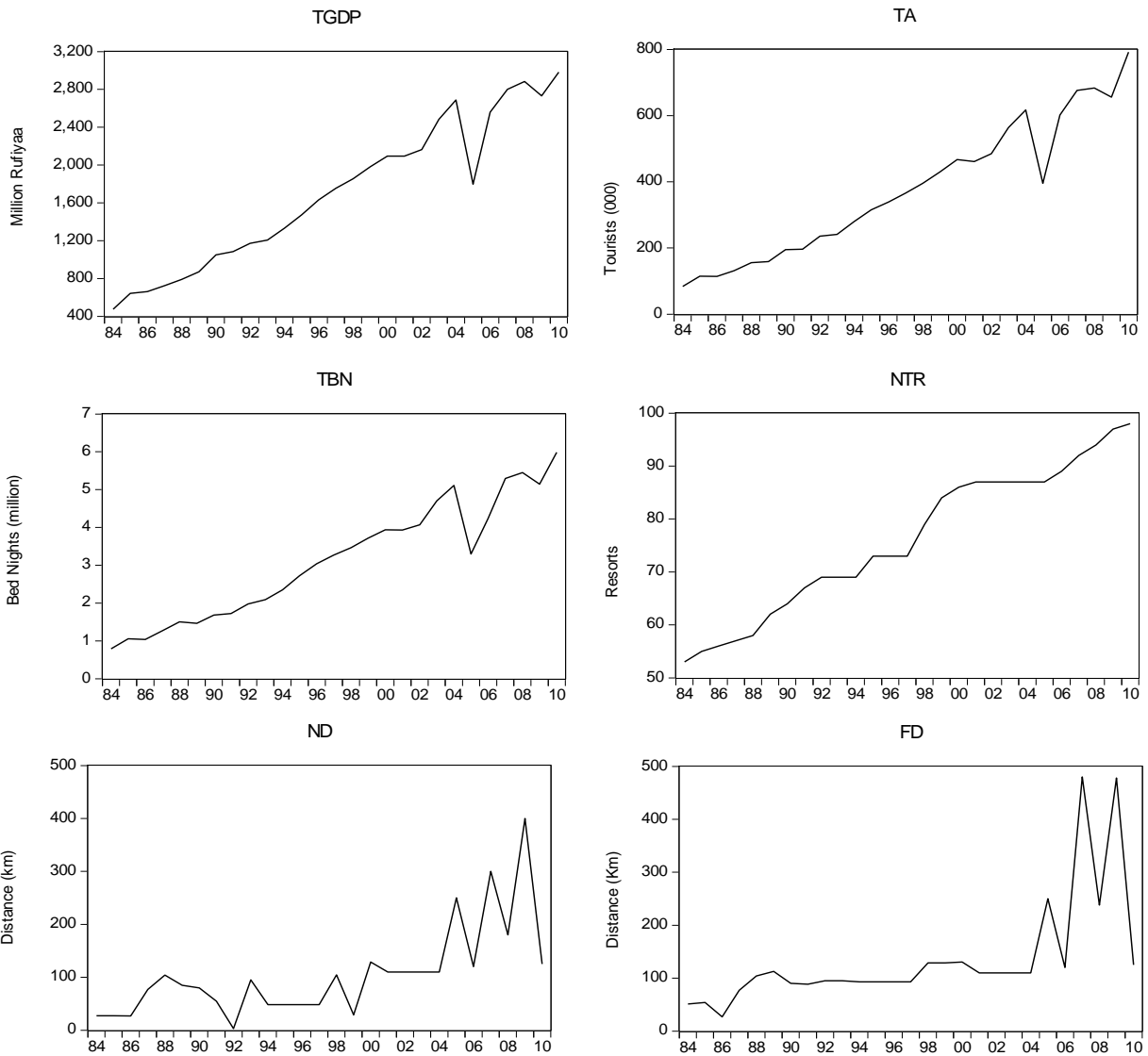**Figure 2.** Data distribution of Carbon Emission (CE).

Figure 3. Data distribution of the variables.

consists of more than 1100 small islands. Out of that only 200 islands are officially inhabited. Maldives uses uninhabited islands to develop tourist resorts. "One-island One-resort" model was createdto give visitors complete privacy and protect general public from any bad influence of the industry.

Over the past three decades nearly 95 resorts were built and in operation. Building more resorts will increase tourist arrivals, tourist bed capacity and will multiply the economic activities. Hence this paper tested below sub-hypothesis as well.

Distance of resorts from airport

Until very recent, Maldives had only one international airport. Most of the tourist arrivals to the country from abroadarevia this one international airport. The special geographical characteristics of the Maldives reduce the land transport within the islands. Tourists arriving Male' international airport are taken to their holiday destination by speed boats or sea planes. To reduce transfer times, lots of resorts were built near the international airport in the first decades of the tourism industry. Any literature to prove that distance from the airport is an indicator of the development of the tourism industry was not found. Study of Scott et al. (2008)suggest that long travel will increase amount of carbon emission.

When tourist resorts are located far away from the international airport more fuel is consumedin transferring tourists to their destinations. In recent years tourism has reached far north and far south of the country.When the resorts are built far from the airport, it will add more to the increase in carbon emission and when resorts are built near the airport, it will add less to the increase in carbon emission. To test this assumption two data sets were used: A- Most far distance (FD) of the resort built in a given year. B- Most near distance (ND) of the resort built in agiven year. Two hypothesis based on our assumption are as follow.

Combined relationship

All the tourism development indicators studied are inter-related to each other to some extent. Increase in number of resorts may not increase the number of tourist arrival to the country. Naturally, tourist arrival increases the tourist bed nights. Tourist arrival also would drive the market to set up more resorts. From Figure 2, data distribution for resort distance ND and FD, it is understood that till 2004 most of the resorts are built in very near location from International Airport. Tourism was spread to the far south and far north in the last 10 years resulting in increase in the number of resorts built far away from International Airport, but still closer to domestic airports. To test their combined relationship with carbon emission, statistical model (7) in Table 2 was used.

VARIABLES, DATA COLLECTION AND ESTIMATION METHODS

Data collection

It was challenging to collect data for carbon emission as well as data for tourism development indicators. Tourism being the most important industry of the economy, government has either not kept clear records of the data or not published the recoded data. This study uses annual observations for the period starting from 1972 to 2010. Observation period for each statistical model is given in Table 2.

Carbon emission data used in this study are taken from the data published by the World Bank (The World Bank, 2014). Tourism development data were taken from the data published by the Department of National Planning (DNP, Publications, 2014). Most of the data were extracted from "25 years of statistics" published online by the Department of National Planning in 2005 (DNP, The 25 Years of Statistics, 2005). This data collection includes data from 1979 to 2004.

Data for 2005 to 2010 were reconciled from year statistical year books of 2005 to 2012. Tourism year book of 2013(Ministry of Tourism, Arts and Culture, 2013) was used to extract the data for resort's distance from the Male' International Airport. Tourism year book was also used to reconcile and cross check the data for other indicators as well.

Variables

Two variables, Independent Variable and Explanatory variable were used to model the non-linear model. According to the Maldives Carbon Audit, the major environmental pollution of Maldives is emission of carbon dioxide (Flora et al., 2010). Maldives uses diesel as main fuel to produce energy that is required for the nation and diesel fuel is burned in the transport industry as well. Carbon emission is used as independent variable in all non-linear to test the hypothesis. Carbon Emission data were used in studies like that of Moomaw and Unruh (1997) and Friedl and Getzner (2003).

The main focus of this study is to examine the relationship of tourism development and carbon emission. Tourism development indicators were used to represent the development of the tourism industry. Zaman et al. (2011) also used tourism development indicators in their study to represent the development of the tourism. Explanatory variables are the tourism development indicators discussed in this paper. Table 1 shows the details of the explanatory variable used in testing each hypothesis.

To examine the relationship between tourism development and carbon emission, non-linear model for each hypothesis was constructed. Table 2 shows the non-linear models estimated for each hypothesis. All the variables seen in Table 1 were expected to have positive contribution to increase carbon emission.

Estimationmethods

Time series properties of the variables were examined before conducting the empirical study. Non-stationary time series data has often been regarded as a problem in empirical analysis. Working with non-stationary variables leads to spurious regression results from which further inference is meaningless when these variables are estimated in their original form. In order to overcome this problem there is a need for testing the stationary of these variables. The unit root tests on all the variables are to determine time series characteristics. Unit root test is important as it shows the number of time the variables have to be differentiated to clear the unit roots and make the data stationary. In general variables which are stationary are called I (0) series. Those data which need to be differenced once in order to obtain stationary are called I (1) series. In testing for stationary, the standard Augmented Dickey-Fuller

Table 1. Variables and theirdescription.

Hypothesis	Explanatory Variable	Description
H_1	TGDP	Tourism Gross Domestic Products of a given year (Million Rufiyya)
H_2	TA	Total Tourist Arrival of a given year(Actual numberof tourists)
H_3	TBN	Total Tourist Bed Nights in a given year(Actual number of bed nights)
H_4	NTR	Total Tourist Resorts built and commenced in a given year (actual number)
H_{5a}	FD	Distance from International Airport to the most far resort opened in a given year (kilometers)
H_{5b}	ND	Distance from International Airport to the most near resort opened in a given year (kilometers)

Table 2. Models and Observation ranges

Hypothesis	Observation	Non-linear Model	
H_1	1984-2010	$\log(CO) = \alpha_1 + \alpha_2 \log(TGDP) + \varepsilon$	(1)
H_2	1979-2010	$\log(CO) = \beta_1 + \beta_2 \log(TA) + \varepsilon$	(2)
H_3	1983-2010	$\log(CO) = \gamma_1 + \gamma_2 \log(TBN) + \varepsilon$	(3)
H_4	1984-2010	$\log(CO) = \theta_1 + \theta_2 \log(NTR) + \varepsilon$	(4)
H_{5a}	1972-2010	$\log(CO) = \mu_1 + \mu_2 \log(FD) + \varepsilon$	(5)
H_{5b}	1972-2010	$\log(CO) = \varphi_1 + \varphi_2 \log(ND) + \varepsilon$	(6)
Combined	1984-2010	$\log(CO) = \Omega_1 + \Omega_2 \log(TGDP) + \Omega_3 \log(TA)$ $+ \Omega_4 \log(TBN) + \Omega_5 \log(NTR)$ $+ \Omega_6 \log(FD) + \Omega_7 \log(ND) + \varepsilon$	(7)

(Dickey and Fuller, 1979)test (ADF) was performed to test whether or not unit root in the data was used to establish the properties of individual series. The regression is estimated by equation (8) as follows:

$$\Delta Y_{t-1} = \alpha + \beta Y_{t-1} + \sum_{j=1}^{k} \gamma_i \Delta Y_{t-k} + \varepsilon_t \qquad (8)$$

Where delta is the difference operator, Y is the series being tested, K is the number of lagged differences and ε is the error term. The null hypothesis is that series has a unit root and the alternative hypothesis is that it is stationary. The number of augmentation terms for the ADF tests wasdetermined by using the Schwarz information criterion(Schwarz, 1978).

The data set of the explanatory variable, Carbon Emission (CO) has four different data observation range. Data ranges of the models were given in second column of the Table 2. We have performed unit root tests for each observation range separately to avoid general conclusion from one observation range. After performing Unit Root tests,correlation tests were performed using the models1 to 7 in Table 2. Ordinary Least Square method was used to carry out the correlation tests.

STATISTICAL TEST RESULTS

Discussion of the results was divided into two sections. At first results of the unit root tests performed to analyze the stationary situation of the data were discussed. Results of

the non-linear models followed after that.

Unit root tests

Economic time-series data are often found to be non-stationary; data might contain unit root in the series. Estimates of the Ordinary Square method are more efficient and significant when variables included in the model are stationary in the same order. Hence we tested all variables for unit root using Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test(Phillips-Perron, 1988).

ADF unit root test shows all the variables are non-stationary at level. Time series data for TBN and TGDP at level in intercept criteria show very significant level of stationary. Results of the ADF tests are given in Table 3. Unit root test of PP results shows time series data of CO from 1994-2010 is significant at level in Trend and Intercept criteria. Data series for variable TGDP and ND also shows very significant stationary status at level in Trend and Intercept criteria. Unit root test results of PP tests are given in Table 4.

ADF test and PP test shows all the variables are stationary at first difference. The results are very significant at critical level of 1%. These results suggest that these

Table 3. Augmented Dickey-Fuller (ADF)Test on the Levels on the First Difference of the variables.

Variables	Period	Level		FirstDifferences		Decision
		Intercept	Trend and Intercept	Intercept	Trend and Intercept	
CE	1972-2010	4.7046	1.3734	-0.6028	-5.0331*	I(1)series
CE	1979-2010	3.6083	-0.1489	-9.6496*	-5.2397*	I(1)series
CE	1983-2010	2.8252**	-1.2322	-9.7359*	-4.7477*	I(1)series
CE	1984-2010	2.6111	-1.2939	-9.7620*	-4.6091*	I(1)series
TGDP	1984-2010	0.1757	-5.1601*	-6.2853	-6.1471*	I(1)series
TA	1979-2010	2.4865	-4.2608	-6.0454*	-7.3325*	I(1)series
TBN	1983-2010	0.3487	-4.4876*	-7.0347*	-6.9724*	I(1)series
NTR	1984-2010	-0.5074	-2.8561*	-3.8326*	-3.7517*	I(1)series
FD	1972-2010	-1.2984	-2.6397	-17.9727*	-17.8522*	I(1)series
ND	1972-2010	0.7046	-0.9294	-18.3587*	-18.6740	I(1)series

Source: Computation fromdata usedin Regression Analysis. The asterisks *,**and *** denote statistical significance at 1%,5% and 10% respectively.Mckinnon(1980)critical valuesareused forrejection ofthe Null unitroot.

Table4. Phillips-Perron (PP)testonthe levelson thefirst differenceof the variables.

Variables	Period	Level		FirstDifferences		Decision
		Intercept	Trend and Intercept	Intercept	Trend and Intercept	
CE	1972-2010	3.5388	-0.6553	-8.6143*	-19.5713*	I(1)series
CE	1979-2010	2.7462	-1.4107	-8.6282*	-44.5467*	I(1)series
CE	1983-2010	1.9481	-2.0457	-8.9871*	-15.4843*	I(1)series
CE	1984-2010	1.7876	-2.2123	-9.0564*	-15.1432*	I(1)series
TGDP	1984-2010	-0.2390	-9.6734*	-16.2873*	-15.7057*	I(1)series
TA	1979-2010	1.9512	-4.1609	-10.8807*	-21.3654*	I(1)series
TBN	1983-2010	0.5255	-4.3387	-11.4898*	-10.9861*	I(1)series
TR	1994-2010	2.7335	-2.0710	-2.7844***	-3.0553	I(1)series
FD	1972-2010	-3.9334*		-18.2519*	-23.4175*	I(1)series
ND	1972-2010	-3.2348	-5.98722*	-18.3213*	-23.1619*	I(1) series

Source: Computation fromdata usedin Regression Analysis. The asterisks *,**and *** denote statistical significance at 1%,5% and 10% respectively.Mckinnon(1980)critical valuesareused forrejection ofthe Null unitroot.

variables are integrated into order I(1); series which are non-stationary at level but stationary at first difference.

Correlation tests

Each hypothesis was tested using Ordinary Least Square method for correlation between variables. Test result for model (1) shows very high correlation between variables. R^2 for correlation between TGDP and CO is 0.96. The t-statistics shows the relationship is significant at 1% critical level. Probability of F-statics is 0 while Durbin-Watson statistics is 1.61. Coefficient of the dependent variable is positive and constant value is negative. Results of this

test are shown in Table 5.

Relationship between TA and CO in model (2) is very significant with positive coefficient of the dependent variable TA. Correlation between two variables is 0.96 while probability of F-statistics is zero. The model seems not very fit to explain the relation with Durbin-Watsan statistics of 0.79. On the other hand t-statistics falls within 1% critical value describing the correlation is very significant and model parameters can be used for estimations. These results are given inTable 5.

As expected the correlation between TBN and CO is slightly lower than the TA. Test result of the model used to test the relationship between TBN and CO indicates that these two variables have very significant correlation.

Table 5. Empirical results ofthe models (1)(2)(3)(4)(5) (6).

Variable	*log*[TGDP]	*log* [TA]	*log* [TBN]	*log* [NTR]	*log* [FD]	*log* [ND]
Constant	-6.74856*	-9.9764*	-16.4698*	-15.0201*	-2.5736*	1.0351**
	(-14.6000)	(-17.7813)	(-17.6656)	(-27.7805)	(-2.9924)	(1.7679)
Coefficient	1.7084*	1.2448*	1.5014*	4.8157*	1.6813*	1.1011*
	(27.1173)	(27.550)	(23.7881)	(38.4577)	(8.7526)	(6.8199)
R-Squared	0.9671	0.9619	0.9560	0.9833	0.6743	0.5569
F-Statisitics	735.34	759.00	565.87	1478.99	76.609	46.511
Prob(F-statisitcs)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Drubin – Watson stat	1.1610	0.7903	1.1249	1.5896	1.0519	0.9508

Adjusted R-squared of the model is 0.95 with zero Probability of F-statistics. Durbin-Watson statistics of 1.12 indicates model is quite fit to explain the dependent variable. Coefficient of the dependent variable is positive and the sign of the constant is negative. T-statistics guarantees the results are significant at 1% critical level. Table 5 shows the results of TBN and CO correlation test.

Observation data from 1984 to 2010for relationship between number of tourist resorts (NT) and carbon emission show highly correlated direct relationship. Correlation coefficient of 0.98 is much expected result with positive coefficient; even though with negative constant probability of F-statistics is favorably zero. Critical value indicates that the results are significant at 1% critical level. Durbin-Watson statistics shown in Table 5suggests that model is significantly fit to describe the dependent variable.

Results in Table 5are the test results of last two hypotheses. Test results relationship between carbon emission and building resorts near to the airport indicate that relationship is not very significant. In Table 5, the adjusted R-squared for model (5) is 0.54 with positive coefficient of independent variable. Durbin-Watson statistics of 0.95 suggest that model is not very good to explain the dependent variable. Over all, the results are significant at 1% level.

On the other hand, the relationship between carbon emission and building resorts away from the airport shows much stronger correlation. The correlation co-efficient of the model is 0.67 while the model shows very good Durbin-Watson statistics. As given in Table 5, the coefficient of the independent variable is positive while the sign of the constant is negative. Results show the estimators are significant at 1% critical level and model is fit to explain dependent variable.

Result of the combined model is given in Table 6. Combined model shows very high correlation between carbon emission and tourism development indicators. Relationship coefficient of 0.98 indicates all the variables together can absolutely explain the carbon emission. F-statistics and Durbin-Watson statistics conclude the model is fit to predict the dependent variable. Tourism

Table 6. Empirical results of the combined model.

Variables	Coefficient	Item	Value
log[TGDP]	0.4455	R-squared	0.9888
log [TA]	1.0526	Adjusted R-squared	0.9855
log [TBN]	-1.000***	F-statistic	296.01
log [NTR]	3.0327*	Prob(F-statistic)	0.000
log [FD]	0.0633	Durbin-Watson stat	1.8406
log [ND]	-0.0251		
C	-9.2902		

Values in parentheses show t-statistics. The statistics significant at 1% (1.7247), 5% (2.0859) and 10% (2.8453) level of significance are indicated by *, ** and *** respectively.

Bed Nights and Number of Tourist Resorts are only indicators that are significant to explain the carbon emission. Other indicators are not statistically significant to explain the carbon emission. Residuals show all the indicators can estimate the carbon emission jointly. Residual graph is given in Figure 4.

DISCUSSION OF RESULTS AND SUGGESTIONS

Our finding reveals that tourism development does enormously contribute to the increase in carbon dioxide. Tourism development indicators are the main key to increase emission in Maldives. High growth rate of the tourism industry in the last three decades not only increased the national receipts but also increased the emission of carbon dioxide and contributed lot to degradation of the fragile nature of the country.

Empirical tests results are very alarming to Maldives. The relationship between tourism development and carbon emission is positively correlated. Even though this result is not a surprise but the correlation of both variable confirms the general understandingof the hypothesis with statistical proof. Six indicators used for the development of the tourism also indicatethe relationships of these two variables are significantly correlated. The degree of the
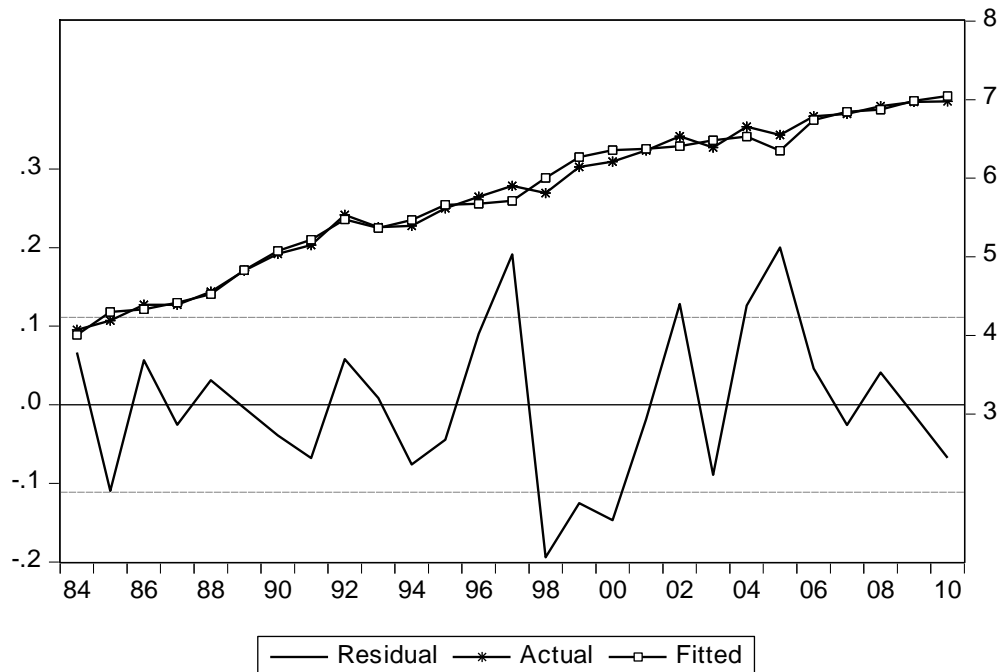
Figure 4. Residual graph for combined model.

correlation differs in each model tested.

Maldives government targets a goal to receive certain amounts of tourism each year. In 2013, the goal was to receive 1 million tourists. The government has achieved this target. The test result shows the carbon emission will increase with an increasing in tourist arrivals. Our results suggest targeting to receive more and more tourists does not add much benefit to the economy, but it does increase environmental pollution across the nation. This result suggests government could increase more tourism related activities through stimulation packages to private sectors. Increase in tourism products will increase the tourism output without increasing the number of receiving tourists.

On the other hand, test results show that if any given tourist spends more time in the country the emission of the carbon dioxide is comparatively less. The relationship between tourist bed nights and carbon emission shows slight weaker relationship than that of the number of tourist arrivals. Almost for the last two decades the average tourist spends average 7 to 8 nights in Maldives. Maldives could reduce its carbon emission by increasing tourist bed nights and reducing number of tourist arrivals. This can be achieved by opening the tourism industry to convention tourism or medical tourism.

The positive relationship between increase in number of tourist resorts and carbon emission is very vivid. The test results confirm building more and more resorts would increase the carbon emission. Maldives government should reconsider the leasing of new islands for tourism development in the future. Government should generate new policies to increase the tourism capacity within the established resorts. Our hypothesis also proved that government should make policies to establish more tourist capacity closer to the international airport. Our finding reveals that when the tourist resorts are established near the international airport, the emission can be reduced. The best solution to this is establishing guest houses near the International airports. Guest house would provide accommodation for low income individual travelers and could limit the transfers to far destinations.

All six indicators show very positive correlation. Degree of correlation strength can be used as a reference to develop the particular indicator. For instant, results indicate the highest degree of correlation is that of Number of Tourist Resort. Policy makers can put restriction on opening of new resorts.According to the correlation coefficient, this study strongly recommends the government to change the policies to allow more tourism capacity in the upcoming tourist resorts and increases tourist related activities to increase the tourist stay in the country.

The correlation figures can be used to understand the behavior of the tourism development indicators tested. Our results suggests that if Maldives relies heavily on the development of the tourism as the main source of developing the economy, then it has to pay a huge price for the increase in carbon emission and degradation of the environment.

Conclusion

The main objective of the study is to empirically test the

relationship of the tourism development and carbon emission in Maldives using tourism development indicators. This study has used different data sets for different models due to unavailability of data for all indicators in a given period of time. Study used six hypotheses to formulate six empirical models to test the relationship. Empirical results strongly disprove the general understanding that tourism is a pollution free environment friendly industry. Results reveal very positive direct relationship between the tourism development indicators and carbon emission. Few indicators show weak correlation, but most of the indicators show significant correlation. This study confirms that tourism development indicators drive carbon emission. On the other hand, this study is insufficient to understand weather carbon emission drives tourism development. This conclusion opens new avenue for future research on causality relationship between tourism development and carbon emission in Maldives.

Conflict of Interests

The authors have not declared any conflict of interests.

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Full Length Research Paper

Leading self, teams and organizations from a female perspective: An exploration of the women leaders' journey

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This paper seeks to capture the characteristics that prevail in the leadership styles of women leaders paying special attention to their individual leaders' journeys. The study reviews the theoretical models of leadership and feminist theory that are particularly pertinent from the discussion of women leadership. A narrative approach is adopted for analyzing two women leaders' journeys –Mary Kay and Mother Teresa– who succeeded in very different contexts. The stories exemplify some of the most important attributes that have been highlighted to play a focal role in current leadership research. The findings suggest that women lead teams and organizations through an authentic leadership and a genuine position of service, once they have become masters in self-leadership.

Key words: Leadership, gender, women, transformational leadership, servant leadership, self-leadership.

INTRODUCTION

As Drucker put it (1999, p.11), "organization is a tool for making people productive in working together". For the 21st century the author foresaw that the productivity of the knowledge worker was probably to become the center of management of people. Yet, Drucker also realized that in the organizations of the 21st century one would need to lead teams, rather than managing people (Drucker, 1999). During the past decade, it has become clear that his forecasts were not wrong. The countless interrelations that globalization has brought in the business arena have not only changed the focus from managing people to leading teams, but also the scope of what is led and, accordingly, the responsibilities of the leaders as well

(Carter and Greer, 2013; Charan et al., 2011, Groves, 2014).

On the one hand, there is a need for leading global organizations operating in international markets (Gundersen et al., 2012; Kuratko, 2007). Being competitive means now being global; therefore, companies need to face the challenges that come with the internationalization, particularly, the complex interconnectedness that takes place (Yates, 2005), the fact of supporting higher uncertainties as a consequence of entering into culturally distant societies (Harvey et al., 2012), and the multiple stakeholders, interests and values that come in conflict (Hughes, 2012). From this it

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follows that leaders and managers have to deal not only with organizational behaviors but also with ethical ones (Copeland, 2014; Philipp and Lopez, 2013).

On the other hand, as a consequence of the global scope of the organizations, leaders' traditional responsibilities such as risk-taking, foresight, conceptualization, and critical thought (Spears and Lawrence, 2002), mostly embedded in a rational and male role, arise no longer as the only key to lead as they used to be, while moral and emotional qualities, both considered much more close to a female style, acquire a significant role (Barbuto et al., 2014; Hayes, 1999). In fact, the most recent literature indicates a tendency to lead with a much more female style (Arar, 2012; Brandt and Laiho, 2013), which have renewed the interest among scholars for studying gender principles and how they may influence the approaches of leadership (Andersen and Hasson, 2011; Mavin and Grandy, 2012; Mensi-Klarbach, 2014: Trinidad and Normore, 2006) This, put in a neutral language, is explained in terms of adopting approaches more concerned with the person of the leader –self-leadership or authentic leadership (D'Intino et al., 2007; Yagil and Medler-Liraz, 2014)–, and the emotional processes that she or he drives to the creation of las relations within and outside the organizations –transformational or servant-leadership (Barbuto et al., 2014; Greenleaf, 1970; Lord and Brown, 2004; Schneider and George, 2011; Smith et al., 2004). Nonetheless, inspite of the recommendations about the current importance of female qualities to lead teams and organizations, there is still a considerable gap in organizations led by women as in leadership literature addressing issues of gender (Kezar and Lester, 2009; O'Connor, 2010; Sandberg, 2013; Werhane and Painter-Morland, 2011).

In the business world, although the definitive ranking of America's biggest companies boasted some 24 female CEOs for the end of August 2014, which means an increase from 20 a year ago and more than at any point since Fortune started compiling executive gender in 1998[1], they still represent a small percentage –4.8%– of the overall CEOs on the list (Fortune, 2014). In politics, the situation is similar. Of the 195 independent countries in the world, women lead only 17 and hold just 20% of seats in parliaments globally. The gap is even more for women of color, who hold just 4% of top corporate jobs, 3% of board seats, and 5% of congressional seats (Sandberg, 2013, p.5).

From the academic side, it has been recognized that some classic leadership models might appear unhelpful in relevance and application to practicing leaders, especially, when the focus of analysis lies on women leaders (Barbuto and Gifford, 2010; Billing and Alvesson, 2000). Researchers have questioned earlier attempts to study the issue of women in leadership and methodological approaches in particular (Appelbaum and Shapiro, 1993). Trinidad and Normore (2006, p.574), for instance, made the observation that "the integration of women in leadership roles is not a matter of 'fitting in' the traditional models, but 'giving in' the opportunities for them to practice their own leadership styles". Turner and Mavin (2008, p.376), specifically, pointed out that, "leadership research has tended to neglect subjective realities of 'becoming' a leader by failing to consider individual leaders' journeys". It is in this context that narrative enquiry has been acknowledged as valuable in addressing some of the limitations of leadership's traditional approaches. Particularly, it has been stressed about its advantages in providing multi-level perspectives on the relational processes among leaders and followers (Riesman and Quinney, 2005), in accounting for learning experiences (Fletcher and Watson, 2007) and, in general, in exploring what leaders –or others– say about what they do (Czarniawska, 2004). Moreover, it is analysing the discourses and stories related to women leaders where the power of narratives, with its teachings in the social formation of the leader-woman identity and style has become more evident (Hamilton, 2006).

Therefore, taking into account the need for considering the subjective experience of women as leaders, this paper aims to obtain a better understanding of the phenomenon by paying special attention to the personal stories of two acknowledged leaders: Mary Kay and Teresa of Calcuta. In spite of their lives and leadership were developed in two completely different environments –the secular business world and the religious congregations, respectively– both share the features of authentic and servant leadership distinctive of women. Moreover, during their lives they were highly rewarded[2] by the significance that they achieved through their long-life projects –where the personal side was intertwined with the professional/vocational one– and their approach to lead as servant and authentic leaders –based on the application of genuine love (Bryant, 2009). While Mary Kay provided an open-ended opportunity for empowering women at a time when most women did not hold full-time jobs (Kreydatus, 2005), Teresa of Calcutta –commonly known as Mother Teresa– ran and led hospices, homes and schools through a life and leadership built through the maxim of treating the poor with total love (Muggeridge, 1971). By exploring retrospectively the individual journeys that addressed them to lead teams and international organizations, we can gain new insights about the phenomenon of women leadership and extend the existent literature in the topic.

Structurally, after this introduction, this paper begins with a brief review of the models of leadership that have been highlighted in literature, and are particularly pertinent for its discussion from a female perspective. Subsequently, a general account of feminist theory and its link with the research of women leadership is presented. This is followed by an explanation of the narrative approach and the presentation of the women leaders' stories. Then, their main aspects in terms of their leadership style are discussed. Finally, the paper ends

highlighting the main conclusions, implications, and future research lines.

Leadership approaches

There is a huge literature on leadership that deals with different models or styles of leading teams, organizations as well as the 'own person' of the leader –self-leadership (Carter and Greer, 2013; DePree, 2004;D'Intino et al., 2007;Lord and Brown, 2004; Kuratko, 2007). Generally, it has been admitted that leadership involves a relational of mutual commitment between a leader and a group of followers in pursuit of a collective goal (Gupta et al., 2004). According to this view, a great bulk of studies have put the interest on the relations between leaders and followers and, in this sense, leadership has mainly been seen from the perspective of leading teams within an organizational context (Carter and Greer, 2013; Charan et al., 2011). The traditional explanations about how to succeed doing this could be divided into two main groups: those that defend the relations in terms of transaction, that is, as an exchange process, and those who consider it from a perspective of transformation, that is, as a medium for promoting personal and professional changes (Kotlyar and Karakowsky, 2007; Rafferty and Griffin, 2004).

Introduced in the 1970s (Burns, 1978), the concept of transformational leadership gained popularity at the end of the past century, not just in business contexts but in religions circles as well (Blanchard and Hodges, 2005; Ford, 1991). References to transformational leadership consistently attribute such leaders with the ability to communicate a vision and motivate followers to embrace this vision (Rafferty and Griffin, 2004; Stelzer and Bass, 1990).In fact, as Chakraborty and Chakraborty (2004, p. 194) noted,"relations between leaders and followers involve the mutual 'raising' of both sides to higher levels of motivation and morality". Under the model of transformational leadershiptwo different typologies can be distinguished, "servant leadership" and "entrepreneurial leadership", which mainly promote changes in teams and organizations, respectively.

Servant leadership puts the focus on motivating, guiding followers, offering hope, and providing a more caring experience through established quality relationships (Sendjaya et al., 2008). DePree (2004, p.xvi) further noted that,"servant leaders are conducted by the rule of abandoning oneself to the strengths of others", whileSchneider and George (2011, p. 63)expressed it quantitatively by saying that, "servant leaders make the service to their followers their first priority". For these reasons, some authors have argued that servant leadership is an appropriate and effective style of leadership for non-profit organizations (Sendjaya et al., 2008; Spears, 1998). In fact, it has been considered the prototype of leadership style in religious institutions, and the person of

Jesus Christ its maximum exponent (Blanchard and Hodges, 2005; Ford, 1991).

While the studies under the typology of servant leadership have advanced the notion of transformational leadership in the framework of leading teams, the idea of "entrepreneurial leadership" has emerged as the key style for leading change within the organizational context (Kuratko and Hornsby, 1999; Kuratko, 2007). This approach is often referred to as "corporate entrepreneurship" or "intrapreneurship" (Guth and Ginsberg, 1990) and realizes the need for infusion of innovation and entrepreneurial thinking into large bureaucratic structures. It has also been seen as the model of leadership able to return the health to the big international organizations by allowing corporations to tap the innovative talents of its own workers and managers (Kuratko and Hornsby, 1999; Sarros et al., 2008). Leaders, from this view, are identified as entrepreneurs –*intrapreneurs*– or builders of new businesses.

Besides, more recently the model of self-leadership has grown in prominence among scholars(D'Intino et al., 2007; Neck and Houghton, 2006; Yagil and Medler-Liraz, 2014).Although the notion of self-leadership is not new (Neck and Houghton, 2006), it seems to be living a new revivalgiven the latest organizational scandals suffered by unethical leaders' behaviors and thelongings of finding an "authentic leader"(Yagil and Medler-Liraz, 2014). Authentic leaders are identified with those who are able to express their inner beliefs and personal convictions through their leadership practices (Turner and Mavin, 2008). This means that, mind, heart and actions become harmonious, and therefore, it might be understood as a call to reconcile the spiritual part of the person of the leader with the emotional and intellectual ones (Chakraborty and Chakraborty, 2004; Sanders et al., 2003; Spears, 1998).

In the current organizational practice, it is possible to find leaders that become a mix of the styles pointed outearlier. Then, during their journeys, transforming leaders,for instance, mayactmore as leading themselves, or as leading teamsand organizations. Additionally, it is important to note that the conception of transforming leaders, with an accent in the emotional and spiritual consciousness of the self –as authentic leader-,is often associated with issues of gender in leadership and how women develop their role as leaders (Andersen and Hasson, 2011). This explains, in part, the growing interest among scholars for linking the studies of gender with leadership literature (Brandt and Laiho, 2013; Mensi-Klarbach, 2014: Trinidad and Normore, 2006). To this issue we turn now.

Women leadership: connecting feminist theory and leadership literature

Leadership of both men and women is gendered (Greer

and Greene, 2003; Mavin and Grandy, 2012; Mensi-Klarbach, 2014; Trinidad and Normore, 2006). Gender is a basic element of human social interaction, and since leadership involves a relational commitment both elements could be considered together (Arar, 2012; Batliwala, 2011; Hayes, 1999). While research on women leaders is not consistently organized according to any particular feminist framework (Kark, 2004), much of leadership literature could be understood in a different manner if one adopts a female perspective or, in other words, if leadership is seen from a woman's eyes.

Feminist approaches are mainly developed around the differences or similarities existent between the genders, and the positive or negative view maintained regarding the feminine traits (Calàs and Smircich, 1996).The different positions adopted with respect to these two aspects lead to classify feminist theories into three main groups (Harding, 1987).In the first group, which is supported by what is known by liberal theory or gender reform feminism, men and women are seen as essentially similar (Greer and Greene, 2003). Their advocates hold that women would behave, and achieve, as do men if they had had the same opportunities than men to be skilled to compete in the business world (Calás et al., 2013; Lorber, 2001). The second group's ideas, developed under the radical theory or what is called "gender resistance feminism" (Greer and Greene, 2003), brings an image of men and women as essentially different, although equal, while feminine traits are perceived as benefits rather than as drawbacks. This approach affirms and defends a complementary female norm of behavior (Ahl, 2006) and portrays each gender as having "an effective and valid, but distinct, way of thinking and rationalizing" (Johnsen and McMahon, 2005, p. 117). Differences in gender are considered innate, psychological, emotional, and typical attributed at least to some degree to basic distinctions in reproduction of the species (Greer and Greene, 2003). In addition, this perspective propones that these differences should not be eliminated, but rather, celebrated, as they could bring a positive impact in the leadership style adopted by women. Finally, a third group of thought is established by what is acknowledged as social constructionist and poststructuralist feminist theory (Greer and Greene, 2003). This group is not concerned with what men or women are but with how masculinity and femininity is constructed and what effects this construction has on the social order (Ahl, 2006).

The works that connect feminist theory with leadership emerged in the framework of an ideology that shared principles of liberal theory (Greer and Greene, 2003). They came out of larger discussions of power, and of alternative, non-patriarchal, non-hierarchical structures and organizations (Pace, 2010). Indeed, the first approaches to and definitions of women leadership became, in part, products of their struggles to advance gender equality in positions of power, to create structures that would not reproduce the patriarchal models

(Batliwala, 2011), and to denounce the social injustice and discrimination suffered by women throughout the whole history (Andersen and Hasson, 2011). None-theless, the sociological approach, with the basic ideas of "socialization" and "expectations",has influenced further the arguments held in women leadership literature. From this perspective, people behave according to societal expectations about their learned gender role (Werhane and Painter-Morland, 2011). In fact,it is, precisely, the expectation that women will be more caring and relationship oriented than men –due to her biological possibility to give life–, the basic idea that accounts for approaches to women leadership that differ from those traditionally established for and by men –normally more competitive and controlling aggressive (Andersen and Hasson, 2011). In addition, the dominant male culture has projected onto the subordinate female culture all aspects of life that are psychologically unpleasant, with the result that women have developed a foundation of extremely valuable psychological qualities that are particularly relevant to leadership based on relationships encouragement and support (Helgesen, 1990). Recently, the research on women leadership is frequently approached under the principles of radical feminist theory (Greer and Greene, 2003; Kezar and Lester, 2009). However, the assumption underlined is that certain styles of leadership are more readily available to a woman than others (O´Connor, 2010), which reaffirms, in some sense, the sociological approach.

In sum, according to the most recent literature some styles of leadingwould bemore compatible with an identity as "woman" while others are not. Women would be able to lead self, teams and organizations successfully, but they surely would do in a different way than men do. Some studies, moreover, have emphasized thewomen's style of leadingas advantages for teams and corporation's outcomes, founded on women'sespecial relational skills to help their followers, to create truthful contacts, as well as to introduce a more emotionaland intuitive mode of thinking (Arar, 2012; Sandberg, 2013). Then, the conclusions of the current existent literature seem to indicate a tendency for women to be rated as slightly more transformational and authentic than men (Mensi-Klarbach, 2014; Mavin and Grandy, 2012; Sandberg, 2013).

Narrative as a research method

The field of narrative studies is acknowledged for being multivocal, cross-disciplinary, and extremely diverse theoretically and methodologically (Andrew et al., 2008). Narratives have been widely defined as "forms of discourses that connect events in a meaningful way, offering insights about the world and/or people's experiences of it" (Hinchman and Hinchman 1997, p. xv). In this sense, narratives might be considered a solution to the problem of how to translate knowing of events or actions, experienced or imagined, into an understandable telling (Linde, 2001). On the one hand, the person's experiences about a particular event and/or action are analyzed (auto) reflexively to obtain a conscious

knowledge of them. On the other, that knowledge of personal experiences, through a translation process, is transformed in the form of stories in an understandable telling that is told and re-told to a definite audience.

Important features of narratives have to do with its particular temporal dimension and its peculiar causality. For one thing, stories generally rely on the presumption that time has a uni-linear direction moving from past to present to future. But, nonetheless, as Bruner (1991, p. 6) has noted, "it may be characterizable in seemingly non-temporal terms (as a tragedy or a farce)". Then, its temporal essentiality lies in the meaning-preserving sequence of clauses in narrative discourse itself. As far as its causality is concerned, a story normally involves a change in situations with a certain causative connectedness. Although narratives do not provide causal explanations (Bruner, 1986, 1991; Hinchman and Hinchman 1997) they offer accounts of how one event followed, or will follow, another under a specific set of circumstances (Elliot, 2005). In other words, narrative supplies the basis for interpreting the person's behaviours; therefore, it provides us with reasons but not with causes.

In social sciences, the interest in the use of narratives as a research approach has outstandingly grown during the past decades (Czarniawska, 2004; Elliot, 2005; Rhodes and Brown, 2005). In the organizational context, the conception of narrative is commonly linked with the meaning-making of leaders' experiences in the relationships generated with their employees and its interpretative process into an understanding telling (Czarniwaska, 2004; Rhodes and Brown, 2005). Moreover, in the daily organi-zational life, participants not only make sense of their relationships in narrative terms, but they proactively enact narratives that are coherent with their system of values (Czarniwaska, 2004; Gergen and Gergen, 1988), providing, in this way, valuable opportunities toappreciate their personal character and personal style (Andrews et al., 2008). In fact, narrative purposefully sets out to make sense of the experiences of the self in social organizations becoming a device through which the self-identity is shaped and performed (Czarniwaska, 2004; Muncey, 2010). Narratives thus carry personal as well as contextualized meanings.Moreover, there has also been a growing interest in narratives or stories as a vehicle for organizational growth and transformation. They have been used to rally leaders and followers around a specific issue or cause, being able to be placed in the service of change and social progress (Czarniawska, 2004). To this perspective of narrative we turn now, while we focus on the story of two women whose personal initiatives and leadership contributed to change the world for women and the poor: Mary Kay and Mother Teresa.

Narrating personal stories of women leaders

In terms of narratives that consider the women leaders' journey within a framework that embraces the leadership of the self, people and international organizations, few stories, over the last century, might be noted more significant than the one of Mary Kay and Mother Teresa. In spite of the fact that both developed their vocation in organizations that may be seen as "traditional sectors" – cosmetics and care taking–they left –both have passed away– a written legacy that continues being used as valuable leadership lessons tothe current generations (Bose and Faust, 2011; Kay Ash and Pendleton, 2008). Moreover,it becomes remarkable that both received international rewards for the innovative approacheswith which they lead traditional sectors in different areas –secular and religious. Their approaches to leadership, based on the Golden Rule (Mary Kay) and the Love Law (Mother Teresa), are object of a renewed revival not only among scholars but also among practitioners (Bryant, 2009). We present in the following paragraphs a summary of the most significant facts that marked their stories.

Mary Kay Ash:authenticand servant leadership in the secular context

Mary Kay Ash (1918-2001) was an American businesswoman internationally renowned. Founder of Mary Kay Inc., she built a profitable business from scratch that created new opportunities for women to achieve financial success (Ash and Pendleton, 2008, p.xvi).

From her personal life, it is known that she was once divorced and twice widowed. After her first husband left her, she dropped out of pre med courses she was taking at the University of Houston and began selling full-time, so supporting her children (Ash, 1981).

In 1963, when she was forty-five, Mary Kay started her business with $5,000. Mary Kay had had a vision based on the emerging needs of women in the 1960s and 1970s and decided to follow it by offering women opportunities that did not exist anywhere else. From a dream, Mary Kay Cosmetics grew into a vertically integrated corporation with annual sales over $950 million. In 1976 it became the first company chaired by a woman to be listed on the New York Stock Exchange (Gross 1996, p. 232).Today, Mary Kay beauty consultants are found all over the world.Worldwide, the company prides itself in having more women earning more than $50,000 per year than any other organization (Kay Ash and Pendleton, 2008).

Mary Kay's rapid successwas due,in great part, to her original approach in terms of marketplaceand corporate structure – independent consultants. However, she herself recognized that her biggest secret laid on her leadership style, which was based on the Golden Rule:"Do unto others as you would have them do unto you" (Ash and Pendleton, 2008, p.xxi). The Golden Rule in the world of business is translated in developing an extreme sensitivity for the needs of others, whether employees or customers. In both, she became exceptional. On the one hand, she had strong ideas about women's roles in the workforce so that she gained a national reputation as a forceful supporter of women's rights and of radical feminism. Yet, because Mary Kay defined consultants' participation in the business world as progressive and liberating, her company ideology allowed consultants to view themselves as empowered women who simultaneously conformed to "traditional" gender roles (Kreydatus, 2005, p.2). On the other hand, Mary Kay's leadership rested on a strong commitment to customer satisfaction, a pillar that was built through quality, value, convenience, innovations and personal service (Ash, 1981).

Mother Theresa: authentic and servant leadership in the religious context

Mother Teresa of Calcutta (1910-1997) founded a traditional Catholic religious community called the Missionaries of charity; through it, she helped turn the world's attention to some of the most neglected members of the global village: the poorest of the poor (Spink, 1997).

Personally, she described herself in this way: "By blood, I am Albanian. By citizenship I am an Indian. By faith, I am a Catholic nun. As to my calling, I belong to the world. As to my heart, I belong entirely to the heart of Jesus" (Independent, 1997, p.11). Born Agnes Gonxha Bojaxhiu in Skopje, she entered the Irish Branch of the Institute of the Blessed Virgin Mary in Dublin (the Loreto Sisters) at age eighteen. She professed her final vows in 1937. For eighteen years, Mother Teresa served in India at St Mar's School as a teacher and principal, but she was very moved by the presence of the sick, begging, and dying people on the streets of Calcutta (Muggeridge, 1971). On September 10, 1946, she received her foundational inspiration;something to which she referred to as a "call within a call" (Muggeridge, 1971, p 19). Although she could never fully articulate this experience, it inspired her to be Christ's light for the world by following him "into the slums" (Kolodiejchuk,

2007, p.10). Flowing from this initial experience, she left Loreto convent on August 16, 1948, and initiated her work among the poor. On October 7, 1950, the Missionaries of Charity were born, whose apostolate is "to give wholehearted and free service to the poorest of the poor" (Muggeridge, 1971, p. 105).

Mother Teresa transformed the Missionaries of Charity to an organization with a full-time staff of 4,000 employees in over 100 countries, as well as over 1 million of volunteers. Over 47 years she was helping millions of people, making decisions for which she initially had been highly criticized (Spink, 1997). She believed that "it is how much love we put in the doing that makes our offering something beautiful for God" (Muggeridge, 1971, pp.67-68).Her personal belief became embedded in a leadership style characterized by the simplicity and strength in the vision as well as by the way of how it was communicated. Her way of leading turned to be essential for the growth of the organization (Bose and Faust, 2011).

ANALYSIS AND FINDINGS

As it was noted before, the two women leaders chosenin this paper exercised their leadership in two considerable different contexts: Mary Kay in the secular world as a woman entrepreneur, and Mother Teresa in the religious environment as a nun.Nevertheless, beyond these differences, Kay's and Mother Theresa's stories reveal insights into the style of women leaders for big international organizations in a global world, which, in both cases, is identified with what leadership literature appeal as authentic transformers leaders(Yagil and Medler-Liraz, 2014) and gender scholars include under a radical theory (Greer and Greene, 2003).

Transformational Leaders- Interestingly, in the early formation of the organizations, there are similarities reflecting the features of transformational leaders. Firstly, for both leaders, the point of departure was a strong sense of call or, in entrepreneurial words, an unmistakable vision about the aim of the organizations (Chakraborty and Chakraborty 2004; Rafferty and Griffin, 2004). Mary Kay's vision grew out of a sense of discontent with her previous professional career, in which though she had obtained important achievements she felt that she had been denied opportunities to fulfill her potential for being a woman (Ash and Pendleton, 2008, p. xxii). Once she decided to make this disappointment the reason to fight in her life, she set off with a clear objective in mind: "establishing a company that would give unlimited opportunity to women" (Ash and Pendleton, 2008, p. xxiv). In Mother Theresa's case, biographers tell the story of her confessions, in which she affirmed she had listened directly to God's voice, and confessors came to confirm that that call came truly from God (Kolodiejchuk, 2007, p.32). In addition, in several interviews she personally told how their sense of mission with the poorest of poorest had come several times during her prayers (Desmond, 1989). Secondly, in the two leaders there was a combination of accumulation of hard skills or professional competency along with softer or relational

aspects of leadership. For both not only had enough competence for overcoming the ambiguity of new and challenge situations, but also had the abilities to inspire others to embrace their visions (Rafferty and Griffin, 2004; Stelzer and Bass, 1990). This capacity to build confidence in their teams is, precisely, what allows us to consider them as the kind of transformational leaders known as servants.

Servant Leaders.-As discussed by Schneider and George (2011), when followers turn out to be the reason for existence of the leader, and leaders place the growth of their followers among their first priorities, they may be distinguished as servant leaders. In the case of Mary Kay, she defended a servant leadership style throughout her life through her "Golden Rule", which she recognized as one of the most important elements to explain her success. Additionally, her caring experience with employees becomes clearer when her perspective about person is known; such perspective can be summarized in these words, "I believe every person has the ability to achieve something important, and with that in mind, I regard everyone as special" (Ash and Pendleton, 2008, p. 23). In the case of Mother Teresa, it is documented how she was able to create and nurture a close and long-term relationship with the nuns through her compassion and faith (Kolodiejchuk, 2007). She earnestly encouraged other nuns to a total deliverance to Jesus Christ as a way of attaining a full potential, and this attitude goes on characterizing the spirit of her organization even today (Bose and Faust, 2011).

Authentic Leaders.-Previous research has suggested that the individual leaders' journeys is key to under-standing the style of leadership that each one puts into practice (Turner and Mavin, 2008). The two narratives considered in this paper show that leadership itself is not a state or job that someone exercises. Rather, it is part of a personal journey that is built through different pipeline turns. Moreover, from the Mary Kay's and Mother Teresa's stories is derived that their leadership grew from their daily commitments with their personal convictions – the importance of helping women and the poor, respectively–, which, in turn, had been fruit of their personal journeys. In other words, their lives as worker woman and a nun determined and shaped their public leadership style, rather than that the leadership style was a choice made previously for applying in the work place. Leadership became, then an expression of their more authentic self rather than expressions of a theoretical style of leadership. Put it differently, only once they were masters in self-leadership –in their personal and private lives– they turned to be successful leaders of teams and organizations in the public arena.

Radical Feminism Leaders.-As it was noted previously, an adequate acceptation of differences between man and

woman is proclaimed by what scholars of gender denominate "gender resistance feminism" or "radical feminism" (Greer and Greene, 2003). Beyond the stereotypes that could suggest these labels –the term "radical" is often associated with something extreme or revolutionary in a violent way[3]– this approach combines an equality view of men and women –as human beings– with a defense of the feminine qualities as complementary of the men (Ahl, 2006; Johnsen and McMahon, 2005). From Mary Kay's story it becomes clear that her whole organization was an expression of radical feminism's ideology. Moreover, she manifested explicitly her ideals by writing her feminism view and highlighting the specific ways in which women do think differently from men. In this sense, she promoted what she labeled as "women's intuition" as special talents and sensitivities to lead (Ash and Pendleton, 2008, p. xxiv). In the case of Mother Teresa's view of women, although it was not as evident as Mary Kay, also may be identified with the radical approach. In an interview where she was asked the question of feminism, she concluded by saying that what a woman can give, no man can give. From her perspective, that is why God has created them separately. Additionally, she stressed that women are created to be the heart of love, which they give in the family or in service (Desmond, 1989).

Conclusions

In this paper we help to address the recent call for scholars to pay greater attention to the women leadership topic (O'Connor, 2010; Sandberg, 2013) as well as to use the narrative genre for improving our understanding of the leaders' subjective journeys (Turner and Mavin, 2008). We reviewed the literature of both models of leadership and female theory in order to consider how they fitted in the practical experiences of women leaders. Moreover, using a narrative approach we focused on two stories of two women leaders –Mary Kay and Mother Teresa– with the aim of recognizing and understanding better the peculiarities of leadership from a female perspective.

According to the two stories analyzed the women's leadership style becomes an expression of their own persons, lived in a public role as leaders. Therearenot two different stories–personal and professional as leaders– because there are no two persons separated in oneself –one populated by actions and the other only by theories. In contrast, every action as leaders isshaped previously "privately", in a scheme in which their purposes as women were to connect, improve and educate that human nature implicit in every human being. They were women first, then leaders of teams and international organizations. There was no "leadership fiction" or theoretical model of leadership embodied in the person of the leader, but authentic leadership. Moreover, in the light of the previous narratives, a new "rule" may be

identified about the way of leading teams and organizations. In particular, from their stories we can realize how the love for others contributed to shape their leadership style with the highest level of commitment for other's good. Kay and Mother Teresa expressed an inner motivation to lead their organizations that came from their heart more than from external rewards or a traditional rationality of businessmen. In fact, their stories demonstrate that in spite of having been initiated during the past century, they are closer to the new approaches of leadership, which place more emphasis in leaders' emotional health, values, servant hood, authenticity, and self-awareness (Chakraborty and Chakraborty, 2004; Sanders et al., 2003; Spears, 1998). Therefore, Kay and Mother Teresa's style of leadership may fit well in the new trends for leading the global organizations of the 21st century.

Finally, although our focus on the narratives of two women leaders advises us to interpret the conclusions modestly, they can also encourage researchers to broaden their thinking about how to approach the topic of women leadership taking into account subjective realities. Nevertheless, much more effort in this research field would be necessary. Some possible directions for future research could be focused on the leadership practices of current women entrepreneurs who lead in different organizational settings, whether SMEs, new enterprises, or big secular or religious institutions. Furthermore, future investigations based on ethnographies have the potential to make significant contributions in this field.

Conflict of Interests

The authors have not declared any conflict of interests.

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[1] While just one woman led a Fortune 500 company in 1998, that number slowly rose to 15 in 2009 before declining to 12 women by 2011 (Fortune 2014).

[2] About Mary Kay is remarkable the fact that she was the first NYSE (New York Stock Exchange) listed firm chaired by a woman in 1976; In 1984 she appeared in the first edition of Fortune among the 100 best companies to work for in America. In 2000 she received the acknowledgment for being the best businesswoman of the century. About Mother Teresa the biggest reward was the Nobel Prize of the peace, which she received in 1979.

[3] Among the Oxford Dictionary's definitions, radical is identified with "an adjective

relating to or affecting the fundamental nature of something", and is also characterized "by departure of tradition; something innovative and progressive" (Oxford, 2014). Available at: http://www.oxforddictionaries.com/definition/english/radical

Full Length Research Paper

Effect of family control and internal auditor on conservatism behaviour

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In this study, we deal with the effect of internal auditor and family control on operational accrual items measurements across the Tehran Stock Exchange registered firms. The operational accrual items of the Giuli and Hin Model have been used to measure the conservatism level. In comparison with other models, including Basu's model, the above-mentioned model is more reliable. "Herfindal-Hirschman Model" has been used to measure the family control. A total of 125 corporations were selected randomly in 2009 - 2011 for this study. Both regression and Pearson methods were used as the statistical methods of the study. Our findings approved the very intensive relationship between the internal auditor and the operational accrual measurement item. The impact of the family control over corporations on their conservatism level has been verified, as well; there was a positive and direct relation between the two mentioned variables. Also, the effects of firm size and financial leverage on the operational accrual items have been approved; the relation between these variables was more intense.

Key words: Conservatism, family control, internal auditor.

INTRODUCTION

According to the International Accounting Standard manifesto (SFAC No. 95), conservatism is a warily response to any type of ambiguity caused by the environmental hazards across the firm. Therefore, if there is an equal probability for estimating a sum which would be paid or received in the future, the conservatism allows estimation with lower optimism. Moreover, in the case of an unequal probability, using the pessimistic sum will not be allowed by the conservatism theory. Basu (1997) has examined the conservatism concept in the on-time reflection of accounting earnings in stocks and effect of both good and bad news and also has formulated a model for measuring. Watts (2003) has offered three overall criteria for measuring the conservatism as net assets,

earnings and accrual items and earnings to stock return. He also posed four interpretations for conservatism and scrutinized them through contractual, legislative, fiscal and legal aspects.

According to the Iranian accounting standards (2009), the financial statement providers are bound to urge caution when disclosing nature and amount of uncertainties. From Iranian accounting standards point of view, conservatism is a degree of surveillance in which adjudication is necessary to make estimation when uncertainty is dominant, as revenues and assets should not be exaggerated and expenses or liabilities should not be understated. It will be explained that using the conservatism should not be led to recognition of the

unnecessary reserves, because it violates the neutrality of the financial reporting.

Given the definition broadcasted by the organization for Economic Co-operation and Development (OECD) in 2001and Ghirmai (2011), the corporate governance is the structure of relations and responsibilities among a major group including stockholders, board members and managing director to promote the necessary competitive performance to achieve the initial participation objectives (judge, 2010). Some other definitions stress the legal aspect of the corporate governance, e.g. IFAC which has considered the corporate governance fundamentally a proper measure to compare various countries and it believes that rules of each country play a key role in the corporate governance system; others emphasize keeping broader groups' interests and deem corporate as responsible for any damages over the society, upcoming generation, natural resources and the environment (Young et al., 2011; Judge, 2010 ; Piot and Janin , 2007) Hasaasyegane (2009), Hesiang and Li-Jen (2010) and Nicolae et al. (2010) define corporate governance as a set of rules, regulations, structures and processes and cultures which make us able to achieve transparency and accountability necessary for observing stockholders' rights. Some authors (Wang et al., 2009; Mohamad et al., 2010; Mehrani et al., 2009) have used conditional and unconditional conservatism terms. The conditional conservatism includes imperative accounting standards such as application of the minimum prime cost or market price apart from their good or bad consequences; usually, it is called income statements conservatism. However, the unconditional conservatism covers the financial behaviors which are not considered imperative according to the accounting standards and the book values of net assets are shown lower than the actual amount. This kind of book value is called balance sheet book value.

Accordingly, we will deal with the conducted studies in Iran and other countries with different accounting, legislative and legal conditions aiming to elicit our study hypotheses (Hasasyegane, 2009; Annelies et al., 2010; Midary, 2006; Renders et al., 2010).

Prior research and hypothesis development

Lara and Osama (2009) embarked on analyzing the relation between conservatism and the corporate governance. They examined corporate governance through either internal or external aspects and used market and book values for conservatism. They found that there is a direct relationship between firms with stronger corporate governance and conservatism level. They also came to a conclusion that firms with stronger corporate governance use discretionary accrual items to inform investors about bad news.

Rahmani and Gholamzadeh (2009) have analyzed the relation between the public ownership in the capital market and conservatism in the financial reporting. They consider conservatism as an index to improve the quality of the financial reporting. They have examined different conservatisms across financial reporting of 40 firms before and after their enrollment in TSE. Their results showed that the conservatism of financial reporting grew pale after enrolment in TSE.

Mashayekh et al. (2009) have begun to analyze the impact of the accounting conservatism on income stability and have concluded that income dividends decrease through increasing conservatism across the Iranian firms. Karami et al. (2010) have analyzed the relationship between corporate governance mechanisms and conservatism across the TSE registered firms. They believe firms' boards can act as the supervisor of the CEOs' performance and prevent them from divulging income information and postponing losses. Basu model has been used for conservatism. Their results approve the meaningful and positive relationship between ownership percentage of the executive board members ad holding investors with conservatism and the negative relationship between non-executive board members and conservatism of firms.

Mohamad et al. (2010) found that bad news consequences act quicker than good news; moreover, the correlation coefficients of audit committee, size of directors and independence of directors are stronger and conservatism has grown in such firms. They also found the trivial effect of the political condition on price alterations caused by good and bad news. There was a negative relation between them while the government ownership has a positive effect.

Kung et al. (2010) have fathomed impact of the capital structure on conservatism of accounting digits in China. They used either Basu model or its refined version, "Ball and Shivakumar", to measure conservatism. They found that firms whose stocks turnover is low have lower conservatism rate as well. In confirmation of their previous studies, they discovered that there is a direct relationship between ownership concentration and asymmetry of information and hence agency expenses in firms; thus demands for conservative profits will be dropped in such firms.

Chi et al. (2009) have analyzed the effective factors of the conservative behavior occurrence across firms. To do so, they studied corporate governance factor. They believed that firms which face agency expenses problem often prefer to be conservative. Therefore, any weak corporate governance system in such firms may end to more accounting conservative behavior. They also came to the conclusion that firms whose corporate governance is weaker are more inclined to conduct accounting conservative behavior.

Relying on Giuli and Hin Model, Banimahd and Baghbani (2009) measured conservatism rate across TSE registered firms. They analyzed the effect of corporate ownership type, firm size and financial

leverage/unprofitability ratio across firms. They found a strong relationship between unprofitability and conservatism rate of firms, so, conservatism enhances value of unprofitable firms in the long term.

Given the results gained from both Iranian and foreign studies, the following hypotheses are set down:

H1: There is a meaningful and positive relationship between accounting conservatism and an internal auditor in a firm.
H2: There is a meaningful and positive relation between accounting conservatism and family control in a firm.

METHODOLOGY

All variables and the procedure used to measure them are explained as the first step to fulfill the study and then the model used for the study is described considering the theoretical concepts and the results of other studies.

Internal auditor

According to the Iranian Corporate Governance Law, the commercial firms must be equipped with an internal audit department which is monitored and controlled by their managing director or board of directors. The internal auditor can act and make report from all operational and financial fields of accounting. There is no audit committee in Iran; instead the internal audit plays this role in a more limited framework. Aiming to analyze hypotheses of our study, we marked firms with internal audit and without internal audit as 1 and 0, respectively.

Family ownership

Major shareholders of Iranian firms typically select the directors and minor stockholders are not allowed to select either directors or managing director. It is expected that the major stockholders maintain their own interests in this issue and disregard minor and dispersed stockholders. The Iranian Corporate Governance Law has not posed any certain controlling mechanism for this problem (Abdoli, 2011). In order to measure this variable across all questioned firms the corporate governance concentration rank is measured. The higher the index obtained, the more concentrated stockholders will be (Yu, 2010).

Ownership concentration is the manner in which stocks are distributed across stockholders of different firms. The less the number of stockholders is, the more concentrated ownership will be. In this study, Herfindal-Hirschman Index (HHI) has been used to qualify ownership concentration ratio. The index is the sum square of stocks percent belonging to stockholders. As the index increases, ownership concentration rate will be increased

too and whenever the whole shares belong to an individual, then it will obtain the highest value, i.e. 10,000 units. If the ownership structure is dispersed and all stockholders have equal ratios, then the "HHI "will have the lowest value, i.e. N/10000.

$$HHI = \sum (p_i /p *100)^2$$

Conservatism

With regard to shortages of Basu model and other relevant models as well as the weak efficient capital market of Iran and relying on a model independent from market prices, we have decided to employ Giuli and Hin model (2000), to measure conservative index; the conservative index is measured here as:

Conservative index = Total Accruals x (-1)/ Total Asset
and
Total accruals = (Net Income – Net Operating Cash Flow) + Depreciation of Assets

The total assets are equal to book value of assets for 2011. Giuli and Hin (2000) believed, "Increased accrual items can be an index of any change in the accounting conservatism degree in the long term". In other words, if accrual items increase, then the conservatism drops and vice versa. Therefore, in order to specify direction of the conservatism alterations, the accrual items have been multiplied by -1 which homogenizes information across firms with different sizes; so, total accrual items have been divided by total assets.

Control variable – firm size and leverage ratio

Sizes of firms have been calculated using total assets logarithm, as large as book value recorded for the end of 2011. The leverage ratio has been obtained through dividing total liability by total assets of each firm.
Given the theoretical concepts of the study, relations among variables are evaluated and modeled as follows:

TOTAL ACCRUAL *-1 /TOTAL ASSET = α0 + + α1 * INT AUD +α2 *OWN CONC +α3 * SIZE + α4* LEVE+ ₃

Where, Total accrual x -1/ total asset is considered as the dependent variable while INT AUD and OWN CONC which show internal auditor and ownership concentration rank in firms respectively are independent variables of the study and SIZE and LEVE show leverage ratio of firms.

Now, we analyze the results of the descriptive statistics of the firms; the results of presumptions of the regression test are presented which are accompanied with the results of our hypotheses.

Table 1. Results of the descriptive statistics of each variable.

	Minimum	Maximum	Mean	Std. Deviation
Conservatism Index	O.42	.77	.667	.092
Rank of Concentration	2395	7639	4537	1279
Internal Auditor	.00	1.00	.617	.080
Size of Corporation	7.28	16.82	12.762	2.763
Leverage Ratio	.00	.846	.594	.118

Table 2. Results of Durbin-Watson Test.

Model	R	R Square	Adjusted R Square	Durbin-Watson
1	o.641	.520	.472	1.532

Table 3. Regression results of the first hypothesis.

Model	Non-standardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.378	.029		3.020	.000
Internal Auditor	.322	.040	.210	2.193	.047

Statistical population and sample

In order to analyze the model and to test the hypotheses, the TSE registered firms have been examined. End of fiscal year of the selected firms, excluding investment and brokerage firms, should be March 20 and their financial data for 2009 - 2011 period should be available. As mentioned previously, a total of 125 firms active in different industries were selected randomly. The information is summarized in Table 1.

As seen in the table, most firms have applied the conservative behavior in their financial report and have reported high optional accrual items. 62% of firms have internal audit, their sizes are relatively equal and most of them suffer from high rates of liability and financial leverage and their average leverage ratio is 60%, which is very high.

The statistic of this test is 1.532 (table 2). Standing 1.5 and 2.5 makes it appropriate. Therefore, it can be concluded that errors are independent of each other, so a regression model can be used to test the hypotheses. Now all results obtained for our hypotheses are analyzed statistically.

1. There is a meaningful and positive relationship between accounting conservatism and internal audit in the firm.

This hypothesis develops the expectation that despite an internal auditor in the firm, the possibility of financial behaviors leading to development of an accounting conservative report is very rare. Results are shown in Table 3.

As the table represents, sign value is lower than alpha 5%; hence, the hypothesis is approved. In other words, there is a meaningful relationship between internal auditor and conservatism level in the firm. Beta coefficient value confirms the relation too; however, the relation type between them is determined as positive.

2. There is a meaningful and positive relationship between accounting and ownership concentration rank of a firm

According to the theoretical concepts, it is expected that firms whose ownership concentration rank is higher (~10000) have higher conservatism which is because of the higher monitoring possibility by the major stockholder as well as higher family control. The related results are shown in Table 4.

This table shows that Sign value is lower than Alpha 5% level; therefore, our hypothesis is confirmed and there is a relationship between percent of the major shareholders and family control across firms and conservatism level of financial behavior of directors.

The Forward model has been employed to analyze control variables. The seven variables used as the corporate governance specifications to predict conservatism have been selected out of many corporate governance specifications. As normal issues some specifications (variables) may not be good predictors. Therefore, when the irrelevant variables are used in this model, the criterion error is raised without improvement of prediction. Separate application of each of two control

Table 4. Regression results of the second hypothesis.

Model	Non-standardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.206	.063		2.217	.000
Rank of Concentration	.643	.054	.489	2.784	.015

variables including firm size and financial leverage ratio for each of the above-mentioned hypotheses changed (increased) their correlation value and this level is meaningful given the "alpha" value. R2 rate for firm size and financial leverage were 35% and 39%, respectively.

DISCUSSION AND CONCLUSION

According to the theoretical concepts, the results of otherstudies on the conservatism, the hypothesis about the effect of political behaviors and agency theory it is expected that directors of larger firms suffering from external pressures embark on taking more conservative behaviors and recognize their profits later and understate interest rates through identifying expenses and various reserves. It is the case for firms whose leverage ratio is higher.

Our findings indicated that both family control and major stockholders who assume themselves as the main owners of firms, select executive directors and do not consider interests of minor stockholders, emphasize and support conservative behavior in firms. Directors can meet expectations and requirements of major stockholders on paying profits and withdrawing cash from the firms through submitting delayed reports on incomes and quicker identification of expenses; they also can postpone taxpaying. Tax issue is one of the most important effective factors of the financial behavior of the Iranian firms who consider this goal and issue in their financial reports.

Internal audit in firms has not prevented them from fulfilling conservative behavior and they have emphasized the delayed recognition of interests and have tried to recognize liabilities sooner. It can be explained by their dependency to executive director and particularly managing director of the Iranian firms. The dependency of the internal auditors is due to lack of precise definition of their position in firms and also lack of corporate governance law of Iran.

Like other studies, in this study the effect of firm size and their financial leverage ratio on conservatism of firms was positive. In other words, these components increase conservatism level imposed by the executive directors of firms. Such increase is justified by keeping interest and escaping from surveillance of others such as financers, the government and policy makers (according to politic and agency theory).

Conflict of Interests

The author has not declared any conflict of interests.

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