Associating Risk Management with a Performance Measurement System: Case of Academic Libraries

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Abstract—Risk management and performance measurement should be linked together to enable, to each supply chain partner, to define and guide its overall risk profile, as well as to shape its strategic direction. In this frame, the aim of this paper is to propose and to validate an integrated approach for relating risk management into supply chain performance measurement system. The proposed approach is carried out in two sequential phases. After identifying flow, missions and goals of an organization, the first phase focuses on the application of the Supply chain operations reference (SCOR) model and the Activity Breakdown Structure (ABS) to identify supply chain processes and activities. After that, Risk Breakdown Structure (RBS) and Risk Breakdown Matrix (RBM) are applied to identify critical risks and to give a set of performance metrics that is based on those risks. Finally, the second phase completes this set by using the Balanced Scorecard (BSC) framework. For a validation purpose, the proposed approach is applied to the Higher Institute of Industrial Management (ISGI, Sfax-Tunisia) library. A comparative analysis between the identified metrics and those required by the standard ISO 11620 (version 2008) shows the significance and the importance of the proposed approach.

Keywords—supply chain risk management; performance measurement system; SCOR model; Balanced Scorecard; Academic library

I. INTRODUCTION

Over the years, the Balanced Scorecard (BSC) has evolved, from the performance measurement tool originally introduced by Kaplan and Norton [1], to a tool for implementing strategies [2, 3] and a framework for determining the alignment of an organization’s human, information and organization capital with its strategy [4, 5]. Since its introduction the BSC has proven to be a remarkably comprehensive and adaptable performance measurement tool. The management of risk is often instrumental in achieving organizational objectives, it makes sense to consider how risk management may be incorporated into the BSC to help with the identity, measurement, management and reporting of key risks. Consequently, BSC is an integrating framework; it lends itself well to initiatives such as risk management. Indeed, for many firms measuring risk can be just as important as measuring performance. Although the application of the BSC in the business sector is well documented, very little research has been reported regarding the risk management. There are only a few studies have considered how Enterprise Risk Management (ERM) and BSC can be linked.

In this frame of risk management and performance measurement integration, the aim of this paper is to propose and to validate a new approach for associating supply chain risk management (SCRM) with a performance measurement system using a BSC framework. The proposed approach is carried out in two phases. After identifying flows, missions and goals of an organization, the first phase focuses on the application of the SCOR model and the ABS to identify supply chain processes and activities. After that, RBS and RBM are applied to identify critical risks and to give a set of performance measures that is based on those risks. Finally, the second phase completes this set by using the BSC method.

The remainder of this paper will proceed as follows. The second section of the paper develops ERM and SCRM. The third section present the BSC and SCOR model as performance measurement system (PMS) is utilized by organizations. The possible linkages of BSC and SCRM are discussed in the fourth section of the paper. The fifth section presents the proposed approach that is applied to an academic library. The sixth section of the paper provides some concluding comments and future research.
of the Treadway Commission COSO 2004” [9]. COSO 2004 ERM framework is built upon the earlier COSO’s Internal Control-Integrated framework 1992. This new framework comprises of eight interrelated components of risk management and internal controls: (i) internal environment; (ii) objective setting; (iii) event identification; (iv) risk assessment; (v) risk response; (vi) control activities; (vii) information and communication and (viii) monitoring.

SCRM is a crucial and fundamental element of ERM [10]. According to [12], SCRM is to collaborate with partners in a supply chain apply risk management process tools to deal with risks and uncertainties caused by, or impacting on, logistics related activities or resources. SCRM is the identification and management of risks within the supply chain and risks external to it through a coordinated approach amongst supply chain members in order to reduce supply chain vulnerability as a whole [13]. Both definitions emphasize that the SCRM is a collective action that requires coordination between the different members of the supply chain with the aim to reduce the vulnerability of the chain. SCRM process consists of four components: (1) Risk identification; (2) Risk assessment; (3) Risk management decisions and implementation; and (4) Risk monitoring [14].

III. PERFORMANCE MEASUREMENT SYSTEM

The performance of an organization is apprehended through the satisfaction of a set of objectives inherent in the chosen strategy. To assess the degree of achievement of each objective, company must have systems to measure its performance. So, the ultimate objective of implementing this system in an organisation is to better its performance. PMS are vital tools, which assist organizations to translate their strategy in terms of desired behavior and results [6].

The literature offers many tools and techniques to develop a system for measuring performance in an organization. In this section, the presentation is limited to the fundamental tools of the proposed approach, the BSC and SCOR model.

A. SCOR model

The SCOR model, is a reference model, was initialize in 1996 by the Supply Chain Council (SCC) [15], an independent, not-for-profit, global corporation interested in applying and advancing the state-of-the-art in supply chain management systems and practices.

The SCOR model is based on five distinct management processes, as it shown in figure 1: “Plan” is the process that set adequacy capacity with demand; “Source” is the process that includes all actions which contribute to the provision of raw materials or services in accordance with schedules; “Make” contains all the actions of product processing; “Deliver”, corresponds to all the stages allowing delivering a finished product or service as requested; “Return” this process is associated with the returning product to suppliers and receiving returned products from customer. The following five performances attributes can be used to evaluate the performances of an organization into five performance criteria that gaps in two categories: customer facing metrics that include reliability, responsiveness, and flexibility, and the internal-facing metrics that include cost and assets. The base metrics proposed by the model may allow companies to select relevant key performance metrics to assess and monitor the level of risk [16].

![SCOR model for supply chain linkage](image)

The SCOR model defines processes, at less, in three levels [17]. Level 1 is the top level that deals with process types and consists of the five different process types: Plan, Source, Make, Deliver, and Return. Level 2 is the categorization of core processes; each level 1 process is divided into sub-categories depending on the product. As an example, the Source process (S) is divided into: Source Stocked Product (S1), Source Make-to-Order Product (S2), and Source Engineer-to-Order Product (S3). Level 3 defines the sub-processes of level 2 that describe every activity clearly. As an example, the level 2 process Source stocked product (S1) consists of the sub-processes: Schedule product deliveries (S1.1), Receive product (S1.2), Verify product (S1.3), Transfer product (S1.4), and Authorize supplier payment (S1.5).

B. Balanced Scorecard

The BSC was introduced by Drs. Robert Kaplan and David Norton in 1992, as a conceptual framework for designing, evaluating and measuring multiple factors that drive a firm’s performance [18]. According to the BSC framework, the performance in the organization is closely linked to the concept of strategic management. A generic BSC translated organization’s mission and objective into specific and measurable operational and performance metrics across four perspectives: “Financial perspective”, measuring classically the level and evolution of the financial performance of the company, “Customer perspective”, includes metrics that assess the present or future customer satisfaction, “Internal Business Processes perspective”, measuring classically the level and evolution of the financial performance of the company, “Customer perspective”, includes metrics that assess the present or future customer satisfaction, “Internal Business Processes perspective”, it is to consider how management operations and processes can help to provide a competitive advantage to the company, “Learning and Growth perspective”, it concerns essentially how we manage human resources and knowledge to achieve the strategic objectives set previously. As it is shown in figure 2, these four areas are not simply a collection of independent perspectives; there is a logical connection between them [2]. In other words, “Learning and Growth” leads to better “Internal Business

![Balanced Scorecard](image)
Processes”, which in turn leads to increase “Customer” value which ultimately leads to improved “Financial” performance.

One of the greatest benefits of the BSC lies in its potential to overcome the remoteness of strategy from day to day activity [19], and this is one of the challenges faced to introduce risk management into an organisation. Risks of various types may threaten the achievement of strategic objectives, and systems need to be devised to create a culture or consciousness of how to manage those risks at all levels within the organization [20].

IV. RELATED LITERATURE OVERVIEW

Managing risk is all about achieving objectives [21]. All organizations need to take risk into account in determining strategy, otherwise they cannot assess how likely they are to achieve their objectives [22]. Organizations should understand that a strategy, which lacks alignment with risk management, is not only insufficient but also risky [6]. Incorporating risk into performance management processes can foster a better understanding of the overall organizational risk exposure and improve business results [21]. So it remains important to take risks into account when setting goals and thereafter during the performance management.

A significant weakness of most performance measurement frameworks, including the Performance Prism and the BSC, is insufficient emphasis on risk management [22]. Therefore ensure that the objectives are achieved by customers, people and process terms do not necessarily mean that the risk is managed. Consequently, the integration of risk management in the BSC expands the use of the BSC to cover risks that may arise during the execution of the strategy. The balanced scorecard’s focus on measuring progress toward achieving strategic objectives and ERM’s emphasis on addressing positive and negative factors potentially affecting the accomplishment of those objectives make their combination a natural fit for success [23]. The information generated by integrating ERM in BSC, provide a balanced view of a company’s activities that managers can use to create value at acceptable levels of risk over time. The combination of the BSC and ERM will increase the probability of achieving goals and objectives. Despite this advantage there are only a few studies have considered how ERM (or SCRM) and BSC can be linked.

Reference [22] describes the structure, methodology and application of the Public Sector Scorecard, a variant of the BSC with more emphasis on stakeholder involvement and contribution, process mapping and risk management, specially designed for the public and voluntary sectors. The author showed how the risk should be incorporated in each perspective of the Public Sector Scorecard. This study presents an innovative attempt for the integration of risk management in the BSC.

Reference [24] presents how Bank of Tokyo-Mitsubishi undertook the integration of BSC and ERM. He present BSC–COSO ERM Mapping Chart, which is the key to the integration of two concepts into one; By mapping the COSO ERM model to the BSC according to its eight components of risk management and internal control. The author reported that when ERM and BSC are used correctly together, management improves the potential to achieve the goals and objectives of the organization. In addition, when BSC and the COSO ERM model are used as a “package” rather than separately, the organization achieves simplicity in governance, with minimizing confusion.

Reference [25] introduces the concept of an Enterprise Risk Scorecard. They design a risk scorecard based on Kaplan and Norton’s BSC. The findings suggest that a scorecard framework could be an effective risk measurement, management and communication tool. For both design and organizational reasons, they recommended that risk scorecards have to be separate from performance scorecards. And they presented their reasons in support of this recommendation.

The main idea which [23] defend is that the BSC can be leveraged to support a point of view ERM. They presented the common elements shared by the BSC and ERM; focus on strategy, holistic perspective, emphasis on interrelationships, top-down emphasis, desire for consistency, focus on accountabilities, and continuous nature. They presented an example of an integrated framework of a balanced scorecard and ERM for supply chain management.

Reference [20] shows, the extent of overlap between ERM and BSC. A case study of one of the UK’s largest retailers, Tesco plc, is used to show how ERM can be introduced as part of an existing strategic control system BSC. The case demonstrates that, despite some differences in lines of communications, the strategic controls and risk controls can be used to achieve a common objective. Adoption of such an integrated approach, however, has implications for the profile of risk and the overall risk culture within an organisation.

Reference [6] examines the link between risk management and PMS. They indicate that both ERM and BSC are two types of control systems, having many similarities and should be considered simultaneously. In addition, they discuss the impacts of these two systems on organizational performance. Finally, they proposed a conceptual model for integrating risk management and performance measurement.
V. PROCEDURE OF THE PROPOSED APPROACH

Scientific works which are related to the problem of performance management and risk management in the supply chain are limited. The aim of this paper is to present an integrated and coherent approach to manage organizational performance, taking into account all risks that may affect the achievement of objectives and implementation strategy. The process of the proposed approach involves two basic phases, as it is shown in figure 3.

In the first phase, SCOR model is used to map processes and allocate activities. The proposed approach suggests using the ABS because it decomposes activities in a clear way and it is also able to properly represent the SCOR Model structure. The ABS is a hierarchical grouping of activities that organises and defines the scope of a process [26]. Each descending level constitutes a more detailed decomposition of process tasks. This mapping allow to better understand what part of the supply chain, the risks may occur. Then these activities was linked to the sources of uncertainty associated, found it in the literature. To facilitate understanding and to provide a standard representation of the risk exposure, we are based on the RBS. The RBS is a hierarchical, source-oriented grouping of risks that organises and defines the total risk exposure [26]. Each descending level represents an increasingly detailed definition of sources of risk. At the end of this phase, the RBM was generated, a presentation for connecting sources risks, detailed by RBS, with elementary activities corresponding to the process of the supply chain, and presented by ABS.

As it is shown in the figure 4, activities at the lowest ABS level are the rows of a matrix, whose columns represent risk sources at the lowest RBS level, and their intersections, the cells, represent the impact of risk sources on activities (represented by coloring the corresponding cells). Based on the SCOR model (version 9), performance metrics allowing measuring the degree of the effects of the occurrence of risk events on activities, was generated.

In the second phase, BSC is used to integrate performance metrics of supply chains, generated from literature of performance metrics, essentially from the study of [27], and performance metrics adapted to the risks that are generated in the first phase, to have a holistic and coherent view of performance in case of risks exposure, through 4 perspectives: “Financial”, “Customer”, “Internal Business Processes”, “Learning and Growth”. To validate the proposed approach, it is applied to an academic library ISGIS.

VI. CASE STUDY OF AN ACADEMY LIBRARY

The evaluation of library services is an important topic in all countries with established library services. In fact, academic libraries are the resource centers for permanent learning and scientific research. The traditional manner of assessing performance metrics is being questioned and assessment activities in academic libraries are increasingly important. Reference [28] reviews the literature related to quality assessment and performance evaluation in academic libraries. Moreover, one international standard compiled by ISO, which has been considered by academic libraries, is ISO 11620 (version 2008) [29], which it deals with performance indicators for libraries.

The present section describes the application of the proposed approach to the university library ISGI. The SCOR model, as it was previously describe, gives an end-to-end visibility of the supply chain and presumed that the supply chain can be divided into five types of processes: “Plan”, “Source”, “Make”, “Deliver”, and “Return”. To apply SCOR model in the case study of a university library (ISGI, Sfax), publishers are considered as suppliers, the library as the company and the students and teachers are considered as customer. It should be noted that the Source process is not limited to the conventional Source (supplier), but it also concern the entry of books returned by the users, Source (user).
A. Risk Analysis

The analysis of the supply chain activities is based on the SCOR model, risk sources are drawn from literature and performance metrics are selected from the SCOR model catalogue. Source, Make and Deliver processes of the SCOR model are studied. For each of them, most relevant sub-processes (Level 2) are considered. In turn, most significant elementary activities (Level 3) for each of these sub-processes are selected. As an example, the ABS for the Source process is detailed in the Table 1. P2 Plan Source, S1 Source Stocked Product and SR1 Source Return Defective Product are the SCOR Level 2 sub-processes that are taken into account. The ABSs for Make and Deliver processes have been developed in the same way.

The RBS that identifies the risk sources impacting on the Source process is shown in Table 2. Sources of supply chain risks are first categorized as external and internal ones. External risk sources cannot be controlled by a company, being exposed to its external environment. On the contrary, internal risk sources can be better handled because they are associated with decisions made and actions undertaken within the company [26]. RBS Level 3 represents the most determinants risk which may affect the University library. The RBSs classifying the risk sources affecting the Make and Deliver processes have been developed in a similar way.

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
</tr>
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<tbody>
<tr>
<td>Source (supplier)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>P2 Plan source</td>
<td>P2.1: Identify, prioritize, and aggregate books requirements</td>
</tr>
<tr>
<td></td>
<td>S1 Source Stocked Product</td>
<td>S1.1: Receive books</td>
</tr>
<tr>
<td></td>
<td>SR1 Source Return Defective Product</td>
<td>SR1.5: Return defective books</td>
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</tbody>
</table>

B. BSC application

In the first step, the reference [27] was adapted for the implementation of BSC for performance management of academic libraries. The most relevant performance metrics that can be used for library are choosing. In a second step, the metrics found it in the previous step was incorporated, with those reflecting aspects of risk (phase 1), found it in the phase of Risk Analysis, in order to release a BSC allowing to monitor the performance evolution when it exposed to risks. As result, the following table (4) presents the “Internal Processes”. The “Financial”, “Customer”, and “Learning and Growth” perspectives are developed in the same manner.

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
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<tbody>
<tr>
<td>Source (supplier)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>External</td>
<td>EXS.1 Nature disasters</td>
</tr>
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<td></td>
<td></td>
<td>EXS.2 Man-made accidents</td>
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<td>EXS.3 Labor strikes</td>
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<td></td>
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<td>EXS.4 Supplier behavior</td>
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<td></td>
<td></td>
<td>EXS.5 Quality of books</td>
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<tr>
<td></td>
<td>Internal</td>
<td>INS.1 Attitude about information sharing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>INS.2 Operator’s operations during transiting books</td>
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</tbody>
</table>

For the realization of RBM, the ABSs for the Source, Make and Delivery, are related to the associated RBSs. For an RBM, activities at the lowest ABS level are the rows of a matrix, whose columns represent risk sources at the lowest RBS level, and their intersections, the cells, represent the impact of risk sources on activities. As an example, Table 3 presents the complete RBM for the Source process with the identification of the impacts of risk sources on activities (cells). According to the nature of both the risky events that may happen and their effects, the performance metrics enabling to measure the degree of such effects are selected from SCOR model. For example the metric: RL.3.24 % Orders/lines received damage free can measure the performance of the activity S1.2: Receive books, in case of occurrence of the risk INS.2: Operator’s operations during transiting books. The RBMs corresponding to the Make and Deliver processes have been developed in a similar way.
The objective of this study is to perform a conceptual performance measurement system. Indeed, the first perspective of this research is to apply the founded metrics to lead projects improvement in ISGI library. Multiple other perspectives can be also interesting. For instance, it is necessary to apply the proposed approach to other supply chains types to prove its applicability.

REFERENCES