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Methods

A strategic performance measurement system for firms across supply and demand chains on the analogy of ecological succession

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ABSTRACT

To answer the call for a new business that integrates economic, biological and human systems, this paper develops a strategic performance measurement system (SPMS) for firms across supply and demand chains (SDC) by analogy with ecological succession. Based on the explanation that SDC can be viewed as community, it develops SDC (monetary value) structure by analogy with community (trophic) structure. As energy flow in ecology follows the first and second laws of thermodynamics, monetary value flow in business follows two laws that are similar to the laws of thermodynamics. Based on these laws, as well as throughput accounting and traditional cost accounting, it puts forward a general monetary value flow model in SDC (i.e. in demand chain and in supply chain respectively). Based on the value flow model in SDC, it conceives an SDC evolution model with a case study on the maturity of Toyota Motor Corporation. Based on these two models, it develops an SPMS for firms across SDC with procedural and structural frameworks. The discussion about monetary value flows in business from nature to the final consumers or converse gives a chance to coordinate business with nature. The SPMS that rationally integrates effective evaluation of tiers in SDC and practical product development plans in firm will help firms create a sustainable commerce (e.g. product–service system).

1. Introduction

The goal of ecological economics of "finding a common language and a set of concepts for the analysis of economies and ecosystems" (Faber et al., 1996, pp. 10) requires a substantial step further into the management of a company. "…commerce and sustainability were antithetical by design, not by intention. …Business will need to integrate economic, biologic, and human systems to create a sustainable method of commerce", (Hawken, 1993, pp. xii, xiv). "… individual businesses no longer compete as solely autonomous entities, but rather as supply chains. …In this emerging competitive environment, the ultimate success of the single business will depend on management's ability to integrate the company's intricate network of business relationships", (Lambert and Cooper, 2000). You cannot manage what you cannot measure. "How to measure performance across supply chains and networks rather than within organizations?" has become a substantial research agenda (Neely, 2005). Accounting systems play a central and crucially constitutive function in the establishment of system/social changes within organizations (Thrane, 2007). A strategic performance measurement system (SPMS) — an innovation in management accounting system — is to present managers with financial and non-financial measures covering different perspectives which, in combination, provide a way of translating strategy into a coherent set of performance measures (Chenhall, 2005). Then, how firms coordinate themselves with (part of) SDC and nature by using SPMS becomes a puzzle for better ecology of commerce. With a focus on developing SPMS for firms across supply and demand chains (SDC), this paper attempts to study redesigning the institutions of sustainable commerce for firm, economic, social and ecologic system as well as a common language.

2. Review

2.1. SPMS related to the supply chain/network (structure)

Balanced scorecard developed for firms by Kaplan and Norton (1992, 1996), a dominant SPMS (Neely, 2005), should be modified pertaining to measuring supply chain performance (Brewer and Speh, 2000). Bullinger et al. (2002), Bititci et al. (2005) and Juan et al. (2007) developed balanced scorecard related to supply chain/network with additional inter-functional, partnership, cross-organizational or inter-enterprise scorecards. However, "…the static and linear nature of strategy maps — key tools for designing and deploying balanced scorecards — are problematic", (Neely, 2005). "The extension of static or simple cybernetic control conceptions to inter-organisational relations is somewhat paradoxical", (Thrane, 2007). Beamon (1999), Gunasekaran et al. (2001), Lambert and Pohlen (2001), Chan (2003),

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Chan and Qi (2003), and Pohlen and Coleman (2005) etc. developed other performance measurement frameworks or systems related to supply chain/network. However, the major defects in this research area remain unsolved, such as lack of a balanced approach, supply chain context, system thinking and connection with strategy etc. (Shepherd and Günter, 2006).

It is the complex coupling structure of supply chain/network that baffles the scholars and managers. For the functional or innovative product, supply chain objectives, performance and structure should focus on efficiency or effectiveness (Fisher, 1997). Furthermore, supply systems can vary on a continuum from lean, pipeline structures (defined as "lean" and focused on efficiency) to fluid and agile networks (defined as "agile" and focused on effectiveness) (Webster, 2002). In most cases, a given supply chain can be decoupled into an upstream chain focused on supply integration (i.e. efficiency) and a downstream chain focused on demand integration (i.e. effectiveness) through a decoupling point (de Treville et al., 2004). Not limiting to seeing the interaction as occurring at the decoupling point only, Rainbird (2004) suggested, "These notions of demand and supply fundamentally overlap and interact and should be seen as constituent, but independent elements of what has been termed the firm's value chain." Not limiting to the value viewpoint and the short range as firm, Liu and Li (2008) suggested supply chain and demand chain is a couple of contradiction as well as harmony aspects of SDC with complex and dynamic coupling structure. Different firms use different measures to deal with efficiency or effectiveness. These measures are difficult to reconcile in a few supply network measures unless they are very fundamental in nature (Morgan, 2007). "Worse still are the measurement inconsistencies that are found in current supply systems", (Morgan, 2007).

Besides this qualitative thinking about supply chain/network structure, quantitative thinking is burgeoning. Three structural dimensions of the network are essential when describing, analyzing, and managing the supply chain. They are the horizontal structure (referring to the number of tiers across the supply chain), the vertical structure (referring to the number of suppliers/customers represented within each tier), and the horizontal position of the focal company within the end points (i.e. the initial source of supply and the ultimate customer) of the supply chain (Lambert and Cooper, 2000). "…an inventory turn improvement by the retailer has a much greater effect on overall supply chain performance than a turn improvement by the supplier, or manufacturer, and a greater impact than a turn improvement by the wholesaler", (Lambert and Pohlen, 2001). It reveals that the supply chain/network structure — here it is the horizontal position — influences the performance of the supply chain/network as a whole and the firms within it.

2.2. Two efforts to integrate the supply chain/network structure with SPMS

To integrate the thinking of the supply chain/network structure with performance measurement, there are two efforts: one is the direct approach based on the full cooperation hypothesis; the other is the indirect approach with the help of study on supply chain maturity.

Lambert and Pohlen (2001) suggested inventory turn metric for the supply chain should be replaced by total inventory carrying costs that considers both the cash value of the inventory at various positions in the supply chain as well as varying opportunity costs for inventory investments for various supply chain members. It can work effectively only if there are full co-operations in the whole supply chain. However, this full co-operation hypothesis fails to face the real and ubiquitous competition in the supply chain. In fact, their group (Lambert and Pohlen, 2001; Pohlen and Coleman, 2005) did not use this unworkable measure. In our opinion, developing metrics in chain/network level by directly integrating the whole supply chain/network structure based on the full cooperation hypothesis is unrealistic. This kind of metrics may be realistic only in a short range, e.g. a short part of supply chain/network.

Studies on supply chain maturity by imitating organizational lifecycle researches have gained much attention by a few leading consulting companies and scholars (see e.g. Cohen and Roussel, 2004; Lockamy and McCormack, 2004). In the successful organizational lifecycle researches, scholars divided lifecycle of firm into several stages by analogy with single organization lifecycle in life science. Similarly, in the studies on supply chain maturity, scholars divided lifecycle of supply chain into several stages by the same analogue. However, this analogue is not suitable. Problems arise if a model appropriate to one type of system is applied to a system of a different type (Ackoff, 1999, pp. 27). There are three basic types of systems (deterministic, animated, and social systems), and a meta-system (i.e. ecological systems) that contains all three types as parts of it (Ackoff, 1999, pp. 27). "Ecological systems contain interacting mechanistic, organismic, and social systems, but unlike social systems have no purposeful of their own", (Ackoff, 1999, pp. 33). Corporations are social systems in which both the parts and the whole are purposeful (Ackoff, 1999, pp. 30). While, the whole supply chain/network with many different kinds of firms caught in complex competition and co-operation hardly achieve any common purpose. Thus, every supply chain/network (now SDC) is an ecological system.

Strictly speaking, SDC can be viewed as community, not population or ecosystem. "A community is an association of interacting species inhabiting some defined area. …A population is a group of individuals of a single species inhabiting a specific area. …An ecosystem is a biological community plus all of the abiotic factors influencing that community", (Molles, 2002, pp. 373, 216, 413). In organizational ecology, "an organizational form (analogue of species) is a blueprint for organizational action, for transforming inputs into outputs"; and "a population of organizations consists of all the organizations within a particular boundary that have a common form", (Hannan and Freeman, 1977; Boone and Witteloostuijn, 1995). Each SDC has different kinds of firms in more than one tier. Thus, one cannot view SDC as population. Study on SDC with many different kinds of firms focuses on interactions among firms, not interactions between firms and the surrounding abiotic environment. Thus, one can view SDC as community. SDC and all of the related abiotic factors in nature compose business ecosystem that can analogize ecosystem. Correspondingly, SDC maturity can analogize ecological/community succession, not single organization lifecycle.

Although the scholars used wrong analogue to study supply chain maturity and only qualitatively analyzed supply chain structure in a few stages, their indirect approach, integrating the thinking of the supply chain/network structure with performance measurement with the help of study on supply chain maturity, is promising. The basic requirements for a successful performance measurement system are two frameworks — a structural framework (specifying a typology for performance measure management) and a procedural framework (i.e. a step-by-step process for developing performance measures from strategy); as well as a number of other performance management tools, such as list of measures, etc. (Folan and Browne, 2005). Study on SDC maturity/evolution might help a firm recognize whether its tier belongs to supply chain or demand chain and whether it should emphasize on efficiency or effectiveness. Besides directing the design of the procedural framework as such, study on SDC evolution may also give a chance to coordinate SDC evolution with ecological succession for better ecology of commerce. It carries out the believing of Odum (1969) that "…successional theory needs to be examined as a basis for resolving man's conflict with nature". Therefore, developing SPMS for firms across SDC should integrate the study on SDC evolution.

2.3. The promising analogy approach

There are certain functional and structural analogues between ecological and socio-economic systems (Matutinović, 2002). In fact, the supply chain/network structure is similar to community structure.