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Organizational alignment and supply chain governance structure: Introduction and construct validation

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Abstract

Purpose

The purpose of this paper is to introduce and validate two new constructs with the potential to sharpen our understanding of how and why firms integrate their internal supply chains and assess the governance structure of their supply chains. The first construct, organizational alignment (OA), is a reflective scale measuring the extent to which upper management attempts to foster integration between internal supply chain functions. The second, supply chain governance structure (SCGS), is a formative index, and is a first attempt at developing a measurement instrument to assess SCGS along multiple dimensions.

Design/methodology/approach

Following a literature review, measures of OA and SCGS are conceptualized. These instruments are used to collect data, after which they are refined and validated through parallel scale development (OA) and index construction (SCGS) processes.

Findings

OA shows acceptable content and construct validity, and SCGS shows acceptable results for content and item specification, as well as multicollinearity.

Practical implications

OA and SCGS may provide some insight into how to promote better internal supply chain integration within the firm, and may allow for an assessment of the governance structure of the firm's supply chain. In different industries and at different times, this knowledge may prove useful in supply chain design and supply base optimization decisions.

Originality/value

These scales have considerable applicability in logistics and supply chain management research. Together, they represent initial attempts to assess upper management influence on internal supply chain alignment (OA), and to assess the governance structure of a firm's supply chain.

Keywords

Supply chain management, Integration, Strategic alignment, Purchasing

1 Introduction

Research in logistics and supply chain management benefits from the introduction of new constructs that help to explain relationships between phenomena of interest (Colquitt and Zapata-Phelan, 2007). Such new constructs must be both conceptually and psychometrically sound (Menor and Roth, 2007). As is periodically mentioned in the academic literature, research in the various business disciplines is often hindered by a lack of attention to the construct validation process that generates psychometrically sound measures (Churchill, 1979; Dunn et al., 1994; Garver and Mentzer, 1999; Menor and Roth, 2007; O'Leary-Kelly and Vokurka, 1998; Peter, 1979, 1981).

This paper presents the conceptualization and validation of two new constructs relating to internal supply chain integration and supply chain governance structure (SCGS). The objective of this paper is to present these constructs as new and useful measures for furthering research within the supply chain management and logistics field, and to describe their conceptualization, operationalization, and psychometric validation. These two constructs are:

1. *Organizational alignment* (*OA*). This construct is designed to measure upper management efforts to foster internal supply chain integration (i.e. that between purchasing and logistics). Scale items draw on the literature to provide an overlooked linkage by attempting to measure the use of joint rewards systems, integrating personnel, and spatial proximity.
2. *SCGS*. This construct is designed to assess the governance structure of a firm's supply chain by measuring three dimensions: information complexity in knowledge transfer transactions, the codifiability of such transactions, and supply base capabilities. These three dimensions are put forth in the conceptual work of Gereffi *et al.* (2005).

The OA scale elements appear consistently, but separately, throughout the integration and supply chain literature. This article proposes that OA is a unifying construct that underlies these elements, reflecting the integrative efforts of upper management. These integration efforts are formalized in the design of performance evaluation, the creation of integrative roles, and decisions regarding the physical location of personnel. The SCGS index is derived from the conceptual work of Gereffi et al. (2005), who suggest that supply chains fall into one of five different governance types, depending on the relative levels of three key dimensions (see above). The SCGS index is a first attempt to operationalize these three dimensions, and so provide a way to assess the existing governance structure of a given supply chain.

In addition to capturing “upper management efforts,” OA is also defined by a focus on internal supply chain integration. The key internal supply chain functions are purchasing and logistics, which are jointly responsible for the successful delivery of supplies and services to the operational centers of their firm. The OA and SCGS constructs were therefore validated against data collected from matched samples of purchasing and logistics respondents, under the assumption that this would provide the most reasonable snapshot of internal supply chain integration. In addition, respondents in these functions are most likely to be able to assess the nature of the firm's relationship with its supply base, and are thus also an ideal sample for the SCGS construct.

The introduction of these new constructs is a timely and valuable contribution given the modern business environment. Increased globalization and outsourcing have heightened the need for purchasing and logistics functions to accurately assess the structure of their supply base and to successfully integrate with one another (Bozarth et al., 1998; Sturgeon, 2002; Daugherty et al., 1996; Fawcett and Magnan, 2002; McGinnis and Kohn, 2002Petersen et al., 2000). It is hoped that these constructs will be useful in sharpening our understanding of these phenomena.

The remainder of this paper is structured as follows. Section 2 describes the literature-based conceptualization and operationalization of each construct, and Section 3 describes the data collection and non-response bias methodologies. Section 4 contains a brief discussion of the differences between latent and composite variables, and a description of the validity testing of the measurement instruments using a three-step framework that unifies the construct validation processes for latent variables (O'Leary-Kelly and Vokurka, 1998) and composite variables (Diamantopoulos and Winklhofer, 2001). The paper ends with a discussion of research contributions in Section 5.

2 Construct conceptualization and operationalization

2.1 Organizational alignment

“Integration” as a testable construct has a number of actualizations. In the literature focusing on inter-functional integration, it has been formally conceptualized as the sharing of information and/or the engagement in collaborative behaviors (Kahn, 1996). However, a significant number of integrating mechanisms have been empirically examined that cannot be neatly categorized as "information-sharing" or "collaboration" activities (Droge and Germain, 1998; Germain and Droge, 1997; Germain et al., 1994; Stank et al., 2001). These mechanisms can be classified into three categories: joint reward systems, the use of integrating personnel, and spatial proximity.

Joint reward systems are set up so that individual performance evaluations and promotions are linked to working with people from other functions. Joint reward systems are consistently mentioned in the literature as an important integrating mechanism (Gupta and Wilemon, 1988; Lim and Reid, 1992; Griffin and Hauser, 1996; Souder and Chakrabarti, 1978; Murphy and Poist, 1992; Lynagh and Poist, 1984; Murphy and Poist, 1994). Stank et al. (2001) include an item to assess joint rewards on their "internal collaboration" scale, and Mollenkopf et al. (2000) utilize a separate scale to assess the use of joint rewards.

In an early case study, Dutton and Walton (1966) noted that top management's emphasis on joint performance led to increased inter-functional collaboration and better performance. Gupta et al. (1987) observe that joint reward systems tend to be used by firms where R&D and marketing are highly integrated. Maltz and Kohli (2000) refer to "compensation variety" (compensation dependent in part by the individual's contribution to other functions), and Rho et al. (1994) recommend mutual performance evaluations.

Like joint reward systems, the use of integrating personnel is a method by which upper management attempts to foster cross-functional integration. "Integrating personnel" are employees who are officially designated as liaisons between functions. Often, they have titles such as "project manager" or "functional specialist," which denote their boundary-spanning status. The use of liaisons and/or integrator roles is frequently cited in studies of integrating mechanisms (Galbraith and Nathanson, 1978, Miller and Droge, 1986; Griffin and Hauser, 1996; Lambert and Cook, 1990; Lawrence and Lorsch, 1967; Lawrence and Lorsch, 1969; Lynagh and Poist, 1984; Lim and Reid, 1992; Rogers, 1990; Souder and Chakrabarti, 1978; Souder and Sherman, 1993). Some researchers have specified these roles, calling for distribution specialists (Murphy and Poist, 1992), expeditors/coordinators (Rho et al., 1994) or internal "change agents" (Gupta and Rogers, 1991). Other researchers (Droge and Germain, 1998; Germain and Droge, 1997; Claycomb et al., 1999) have incorporated an integrating personnel element in their measure of integrating mechanisms. Mollenkopf et al. (2000) incorporate a "liaison activities" scale into their measurement instrument.

Finally, spatial proximity can also be conducive to integrative behavior. Brown (1983, p. 23) defined some interfaces in terms of proximity, pointing out that "units interact because they are near each other". Physical separation has been identified as a barrier to communication and cooperation (Griffin and Hauser, 1996). Moving functions or personnel within close spatial proximity has been considered another integrative device (Gupta, 1984; Maltz and Kohli, 2000). Gupta et al. (1987) found that companies with high degrees of integration between R&D and marketing also tend to encourage close spatial proximity between these functions.

This research paper proposes that underlying these elements is a unifying construct which is labeled OA that reflects the integrative efforts of upper management. It is upper-level managers who have the authority to implement formal changes in performance evaluations and informal changes in corporate culture such that employees feel that cross-functional cooperation and information sharing are to their benefit. Likewise, upper management has the authority to make personnel decisions regarding the need for integrators – roles in the organizational chart that are boundary spanners by definition. Even the physical location of personnel is typically determined at a relatively high managerial level.

Given the importance of successful integration and strategic alignment among various functions (Krause et al., 2001; Monczka et al., 2005), it seems likely that upper management will encourage cross-functional cooperation and information sharing through the above mechanisms. Accordingly, the OA measurement scale is designed to assess the prevalence of these activities, which we believe capture much of upper management efforts to foster inter-functional integration. The scale items used to operationalize OA were adapted from the literature cited above, and are provided in Table I. OA includes measures of the extent to which firms put joint reward systems in place to encourage integrative behaviors (items a and b), the extent to which integrating roles such as functional liaisons and program/project managers are used (items c and d), and the influence of closer spatial proximity between purchasing and logistics personnel (item e).

2.2 Supply chain governance structure

The SCGS construct takes shape from the conceptual work of sociologists Gary Gereffi and John Humphrey, and economic geographer Timothy J. Sturgeon, whose intersecting area of research is the development of global supply chains. Gereffi et al. (2005) utilize the transaction cost, global supply chain, and firm-level learning literature to conceptualize three dimensions useful in assessing a given SCGS:

1. the level of information complexity in knowledge transfer transactions;
2. the ability to codify these transactions; and
3. supply base capabilities relative to the outsourced transaction itself (Table II).

The SCGS index is an attempt to effectively operationalize and measure these dimensions (Table I).

The first two of these dimensions relate to knowledge transfer between supply chain partners. “Transaction complexity” refers to the complexity of information and knowledge transfer that would be required to sustain the transaction in question (e.g. detailed product specifications, special requirements, etc.). It specifically captures the extent of “non-price information flowing across the inter-firm boundary” (Gereffi et al., 2005, p. 85). The items used to operationalize this dimension (items a and b) therefore attempt to capture the extent to which rich information beyond price is exchanged (e.g. “considerable information,” and “more than a simple price quote”).

“Ability to codify” refers to ease with which complex information and knowledge can be encapsulated for efficient transfer between parties without creating the necessity for transaction-specific investments (the “asset specificity” of transaction cost economics). Gereffi et al. suggest that highly complex information and knowledge can be easily codified though technological standardization within an industry. Broadly adopted technology standards provide a “common language” and platform for use in knowledge transfer activities. Thus, items c and d operationalize this dimension by assessing the extent to which technological standardization for buyers and suppliers is perceived to exist by the respondent.

Last, “supply base capabilities” indicate the competence of suppliers (relative to the focal firm) in providing the outsourced item or service in question. Items e and f operationalize this dimension, by assessing the extent to which existing suppliers are capable of meeting buyer requirements with little interference or direction from the focal firm.

Gereffi et al. (2005) then suggest that these three dimensions, when given binary values of “high” or “low,” result in a typology that consists of five global SCGSs: hierarchy, captive, relational, modular and market. The three remaining high/low combinations are discarded as unlikely or untenable structures (notes at the bottom of Table II).

The SCGS construct has several potential applications to further research in logistics and supply management. First, it provides an instrument to empirically assess the Gereffi et al. (2005) SCGS typology. To our knowledge, few (if any) attempts have been made to broadly evaluate SCGSs across industries, yet a clear understanding of them is increasingly important in a global, outsourced, and accelerating business environment. The three dimensions comprising SCGS could also be considered separately by researchers pursuing related questions. The importance of efficient knowledge transfer and accurate assessment of supplier capability have arguably increased with increasing trends in outsourcing and global purchasing. Information complexity, stances towards sharing knowledge and the impact of supplier capability on buyer success factors are prevalent throughout the extant literature. Researchers need to understand these phenomena more fully, and to understand the extent to which they are perceived as important in practice.

Second, a portion of this measurement instrument can also be used to assess supply chain modularity. A system can be said to have a high degree of modularity when "its components can be disaggregated and recombined into new configurations – possibly substituting various new components into the configuration – with little loss of functionality" (Schilling, 2000, p. 315). Schilling and Steensma (2001) define a modular supply chain as one consisting of flexible, loosely coupled units, and Gereffi et al. (2005) characterize a modular supply chain as one where "suppliers and customers can be easily linked and de-linked, resulting in a very fluid and flexible network structure" (Gereffi et al., 2005, p. 85).

Measurement of supply chain modularity is of particular interest, as internal supply chain functions would increasingly need to coordinate their efforts and share information as elements of the inbound supply chain are frequently shifted and replaced. Put another way, the more frequently suppliers are "linked and de-linked," the more frequently purchasing and logistics personnel will have to coordinate their efforts to bring new suppliers on-line and transition from ones being eliminated. Operationally, SCGSs with high values of "ability to codify transactions" and "supply base capability" (items c-f on the SCGS index) would measure high in overall modularity (switching costs are lowered when standardized technical specifications can be easily shared with competent potential suppliers).

3 Data collection and non-response bias testing

Data were collected via an online survey targeting matched samples of purchasing managers and their inbound logistics counterparts. The initial contact for the survey was the purchasing respondent, and the initial survey population frame was a random sample (1,482 members) of the Institute for Supply Management membership in three broad (two-digit) SIC codes: foods (SIC 20), chemicals/pharmaceuticals (SIC 28) and electronics (SIC 36). The purchasing respondent was asked to take the survey with a particular inbound logistics counterpart in mind, and at the end of the survey, he or she was asked to provide the contact information for this counterpart. This logistics respondent then received a nearly identical survey, creating a matched logistics sample. The survey was administered via the Internet in a variation of the Dillman total design method (Dillman, 2000). Zoomerang (www.zoomerang.com), a company specializing in Internet survey hosting and administration, hosted the survey instrument. Table III shows descriptive statistics for the two samples. The purchasing sample is necessarily the larger sample, because not all of the purchasing respondents were willing to provide contact information for their logistics counterparts, and not all logistics contacts were willing to complete the survey.

The purchasing manager response rate was 14.2 percent, prompting the testing of this sample for non-response bias (Lambert and Harrington, 1990; Armstrong and Overton, 1977). Non-response bias was tested in two ways:

1. by performing *t*-tests for differences between early and late respondents on a random selection of survey items; and
2. by performing *t*-tests for differences between 100 respondents and 100 non-respondents (all randomly selected) on revenues and number of employees (Hoovers online financial database provided these figures for non-respondents).

The t-tests yielded no statistically significant differences between the early and late responders or between the respondents and non-respondents on any of the items selected. A total of 153 purchasing managers provided contact information for their logistics counterparts and 110 logisticians responded, yielding a logistics sample response rate of 71.9 percent. Lambert and Harrington (1990) suggest that non-response bias needs to be addressed with response rates less than 40 percent; as this far exceeds that threshold, non-response bias testing was not conducted for the logistics sample.

4 Construct validation

As there are significant differences in the construct validation process for measures of latent and composite variables, a few remarks are in order concerning how such determinations are made for new measures. A latent variable cannot be directly observed, but is rather measured through a scale of reflective (or "effect") indicators. The latent variable is implicitly the cause of variation in the observed scale items (DeVellis, 2003; MacCallum and Browne, 1993). Modeling latent variables through reflective scales is a standard approach in the social science literature, and has been used extensively since at least 1960 (Lazarsfeld, 1960). For latent variables, the construct validation process is also known as scale development.

Composite variables, by contrast, are measured with an "index" composed of a number of formative (or "cause") indicators (Howell, 1987). Such composite (or emergent) variables are conceived as "explanatory combinations of their indicators" (Diamantopoulos and Winklhofer, 2001), meaning that the observed indicators are the "cause" of the construct, not vice versa as with latent variables. A classic example is socioeconomic status (SES), a composite variable measured by a combination of three key indicators: occupational prestige, education, and income (Edwards and Bagozzi, 2000). The construct validation process for composite variable instruments is referred to as index construction (Diamantopoulos and Winklhofer, 2001).

Jarvis et al. (2003) lay out a useful framework for determining whether a new construct is latent or composite. Put briefly, a construct should be modeled as a composite variable if the following conditions are met (and as a latent variable with a reflective scale if opposite):

- the indicators are defining characteristics of the construct;
- changes in the indicators cause changes in the construct;
- changes in the construct are not expected to cause changes in the indicators;
- the indicators do not necessarily share a common theme;
- eliminating an indicator may alter the conceptual domain of the construct;
- a change in value of one indicator is not necessarily expected to be associated with a change in all others; and
- the indicators are not expected to have the same antecedents and consequences (Jarvis *et al.*, 2003).

After assessing these constructs and their measurement items against the above criteria, OA was determined to be latent, while SCGS was determined to be composite. The OA indicators are expected to be driven by the overall management effort in fostering internal supply chain integration, and these items are expected to track together with changes in OA. On the other hand, differing levels of the three SCGS dimensions will yield a different supply chain classification on Gereffi et al.'s typology (Table II).

4.1 Construct validation process

The guidelines for construct validation are found in multiple sources. However, when assessed broadly, the general "construct validation" process consists of three major stages:

1. "Generation," in which the construct is conceptualized and a preliminary measurement instrument created.

2. “Refinement,” in which the preliminary measurement instrument is purified through a series of statistical tests against collected data.
3. “Affirmation,” in which the purified instrument is tested against other constructs in a theory-grounded framework.

Within each of these stages are a number of potential steps that researchers follow based upon the nature of the constructs and the methodology they have chosen (Figure 1).

For this paper, we focus upon the generation and refinement stages (the stages most commonly thought of as the “construct validation” process), leaving the establishment of nomological validity (affirmation stage) for future testing. Our primary source for latent variable scale development (for the OA scale) is O'Leary-Kelly and Vokurka (1998), and for composite variable index construction (for the SCGS index), we follow Diamantopoulos and Winklhofer (2001). There are of course many other potential sources, but these papers have (in our opinion) done an excellent job of integrating past construct development research into an integrated and parsimonious schema. In Figure 1, the validation process for OA is above the dashed line, and that for SCGS is below.

Regarding the construct validation process for these constructs, the stage 2 (refinement) analyses were performed on the purchasing and logistics samples separately. This was done to increase the rigor of the analyses – evidence of construct validity is strengthened if the statistical tests hold true for multiple samples. In addition, combining the purchasing and logistics data together would result in the loss of nearly half of the purchasing dataset for construct validation purposes (as only 110 logistics counterparts responded to the survey).

4.2 Organizational alignment scale development

Content validity exists for a reflective scale when the domain of the construct has been adequately represented by the items in the scale (DeVellis, 2003). There are no formal methods or statistical tests for content validity assessment, which means that researchers must construct preliminary scales via literature review and the judgment and insight of subject matter experts (Garver and Mentzer, 1999; Dunn et al., 1994). As noted by Nunnally (1978, p. 93)

> […] inevitably, content validity rests mainly on appeals to reason regarding the adequacy with which important content has been sampled and on the adequacy with which the content has been cast in the form of test items.

Although this means that the establishment of content validity is ultimately a qualitative exercise, sorting procedures (Anderson and Gerbing, 1991; Menor and Roth, 2007), or exploratory factor analysis (Dunn et al., 1994) can be used to provide a measure of quantitative support if the researcher deems them appropriate.

The preliminary OA scale was evaluated by five academic researchers, eight purchasing managers, and five logistics managers. They answered the questions posed by the scale, evaluating it in terms of concept and instruction clarity, ease of readability, and ambiguity. The consensus was that the five items in the scale were an adequate representation of the OA construct, understood as upper management efforts to foster inter-functional integration. At the end of this stage, it appeared that content validity had been reasonably established.

It has been suggested that substantive validity (the extent to which each individual item is theoretically linked to the construct) is a necessary, but not sufficient condition for scale content validity (Dunn et al., 1994). Therefore, post-hoc sorting procedures were conducted with a different panel of subject matter experts in order to establish individual-item substantive validity, and to provide additional support for the establishment of scale content validity (Dunn et al., 1994; Menor and Roth, 2007). Sorting was performed by a sample of nine purchasing managers, four logistics managers and one academic. The proportion of substantive agreement (PSA) and the coefficient of substantive validity (CSV) were calculated for each measurement item (Anderson and Gerbing, 1991). PSA values ranged from 0.79 to 0.93, and CSV values ranged from 0.64 to 0.86. All values are above the cutoff values of 0.70 (PSA) and 0.50 (CSV) suggested by Dunn et al. (1994) and Menor and Roth (2007), credibly establishing substantive validity for all OA scale items.

The refinement stage of scale development consists of psychometric testing for unidimensionality, reliability, convergent, and discriminant validity (O'Leary-Kelly and Vokurka, 1998). Unidimensionality is an assessment of whether a single construct underlies the items of a scale (Gerbing and Anderson, 1988). Reliability is a measure of scale internal consistency, the degree to which the scale is free from error and that its items tend to track together (Garver and Mentzer, 1999; Peter, 1979). Convergent validity is the extent to which different methods of measuring a given construct agree, whereas discriminant validity is an assessment of the extent to which measures of different latent variables are unique (DeVellis, 2003, O'Leary-Kelly and Vokurka, 1998).

Reliability was assessed using Cronbach's coefficient α (DeVellis, 2003) and the Raykov coefficient ρ, a reliability measure similar to α but specifically geared towards structural equation modeling (Bentler and Wu, 2002; Byrne, 2006). For exploratory scales, an α of 0.50 is considered acceptable, with $\alpha \geq 0.70$ being desirable for more established scales (O'Leary-Kelly and Vokurka, 1998). During unidimensionality analysis, item e (spatial proximity) was dropped due to poor loading (below), improving the OA scale α in both datasets (Table IV). The purified OA scales also had a $\rho \geq 0.853$ in both datasets.

Unidimensionality and convergent validity were assessed with confirmatory factor analysis (CFA), following the guidelines set forth by Garver and Mentzer (1999). Acceptable unidimensionality and convergent validity are met when all factor loadings are significant at $p \leq 0.05$, and all loadings are the correct sign and ≥ 0.70. For both datasets, item e was dropped due to poor loading. For CFA, model fit indices such as normed fit index (NFI) and comparative fit index (CFI) should be ≥ 0.90 (Byrne, 2006). Table IV shows these results. The OA scale met the conditions for unidimensionality and convergent validity when tested against the purchasing dataset, and marginally met these conditions (values > 0.89) when tested against the logistics dataset.

Discriminant validity was assessed following the paired variance extraction methods put forth by Fornell and Larcker (1981). As formative indexes do not undergo discriminant validity testing, the OA scale was compared with a Collaboration scale (Table I), adapted from work by Kahn (1996), and Ellinger et al. (2000). Collaboration has been used to test functional integration, and was thus deemed a related and appropriate construct for this testing. A two-factor CFA model of OA and Collaboration was run with latent variable correlations allowed to vary freely. For both datasets, the average variance extracted from OA and Collaboration was greater than their shared variance, thus establishing discriminant validity.

4.3 Supply chain governance structure index construction

The generation stage for formative indicators consists of content and individual item specification (Diamantopoulos and Winklhofer, 2001). Content specification ensures that the domain of the construct is clearly delineated, and individual item specification aims to ensure that the items in the index cover all facets of the construct. Index items should constitute a "census" of the content domain; the index items should ideally cover the entire scope of the construct as defined during content specification. Items should only be removed from the index after this stage with great caution, since item removal may alter the meaning of the construct.

SCGS content specification was established by operationalizing the dimensions of the Gereffi et al. (2005) typology. The content domain of SCGS consists of three facets: transaction complexity, the ability to codify transactions, and supply base capability. Individual item specification was achieved by selecting two items to cover each of these three facets, thus covering the entire scope of the SCGS variable. The same subject matter experts also reviewed the SCGS index, and agreed that content and individual item specification had been reasonably established. There might be some objection that six items seem insufficient to cover the entire "scope" of the SCGS construct. However, the construct consists of three specific facets, and each of these is operationalized by two items. In a similar vein, another formative index such as SES is adequately represented by three items, as these cover the scope of the construct as defined.

As with the OA scale (Section 4.2), post-hoc substantive validity analyses were performed with a subject matter expert panel to assess the PSA and CSV of the individual SCGS items. Although these sorting procedures are intended primarily for latent variables, it seems logical that the individual items in composite indexes should still display acceptable values of these ratios (i.e. even if the items to not track well with one another, they should separately connect well to the construct in question). PSA values ranged from 0.79 to 0.1.0, and CSV values ranged from 0.57 to 1.0. As all values are above the cutoff values of 0.70 and 0.50, respectively, we therefore believe that substantive validity has been credibly established for all SCGS index items. In this instance, the acceptable PSA and CSV values provide further support for the content and individual item specification established earlier.

The refinement of a formative index is a test for item multicollinearity (Diamantopoulos and Winklhofer, 2001). Whereas multicollinearity is a desirable trait in a scale (as all the items are expected to track together), it is not to be expected in an index, where items are not necessarily expected to have a common cause. Furthermore, the paths from item to construct in a model with composite variables are the equivalent of a multiple regression equation, and multicollinearity would be a threat to explanatory validity.

Diamantopoulos and Winklhofer (2001) recommend that items displaying a variance inflation factor (VIF) of 10 or more be considered for elimination. The maximum VIF among all items was 1.334 for the purchasing dataset, and 1.676 for the logistics dataset. Based upon these results, the SCGS index did not appear to suffer from multicollinearity issues, and all six items were retained.

5 Contributions

The initial construct validation results for OA and SCGS are encouraging. The objective of this paper was to present two new constructs with the potential to sharpen our understanding of how and why firms integrate their internal supply chain functions and how they might assess the governance structure of their supply chains. Integration is a subject with a long history in academic research, but the mechanisms by which upper management enables or encourages internal supply chain integration have not previously been explored in detail in the literature. The OA construct provides a potentially useful tool to aid in understanding this phenomenon.

SCGS and modularity are more recent topics of study, but seem to have become more significant as the competitive environment becomes increasingly intense, uncertain, and accelerated. The SCGS instrument presented here can serve to enrich supply chain management research by linking it with theoretical research in sociology and economic geography. A more thorough understanding of SCGS and modularity would benefit researchers seeking to understand the broader contextual issues influencing the behavior of various supply chain actors. For example, the Gereffi et al. (2005) typology posits that power asymmetry increases as one moves through supply chain governance types from market to hierarchy (as transaction complexity increases while supplier capability decreases, Table II). Research on buyer-supplier relations often focuses upon trust and commitment to the relationship; research models in this area could be enriched by adding transaction complexity or perceptions of supplier capabilities as moderating or contextual variables. To what extent are individual buyer-supplier relationships shaped by the macro-structure of the supply chain in which they are embedded?

As new constructs, it can be expected that they will evolve with future research efforts. The OA scale tests the extent of two closely-related phenomena: performance incentives for integration (items a and b) and use of formal integrating roles within the organization (items c and d). Thus, far, construct validation results suggest that the four scale items are tapping a common latent variable which drives both of these phenomena, but future research could modify this finding.

Spatial proximity was dropped from this scale due to poor tracking with other scale items, even though the initial literature review, assessment by subject matter experts, and substantive validity analysis suggested its inclusion. Perhaps in companies with different organizational structures or with different reporting relationships, this element would have been more significant. It may be that its removal was an artifact of these specific samples, and future research with different samples from different industries or firm structures may provide evidence for its reconsideration.

It has also been noted that the OA scale has only been tested against data from respondents in purchasing and logistics roles. The OA scale items were drawn from literature assessing integration across a number of different functional groups (Section 2.1), so their applicability beyond the purchasing-logistics interface is to some extent established. Future research should, however, make an attempt to utilize and adapt this scale to the continuing research efforts on inter-functional integration beyond purchasing and logistics, to further validate this scale as a generalizable measurement instrument.

The SCGS instrument as presented here attempts to operationalize three dimensions important to understanding SCGSs. Future research could focus on expanding these items and developing a separate index (or scale) for each supply chain dimension, so that attempts can be made to empirically validate the Gereffi et al. typology with a much more detailed framework.

For practitioners, the new constructs may provide some insight into how upper management efforts to foster inter-functional integration are succeeding in the eyes of the personnel in these areas. If employees perceive that a high premium is placed on interacting across functions, and that integrating roles to facilitate this interaction are widespread, then upper managers may get a sense of how successfully their attempts have "trickled down." With respect to SCGS, this index may have some utility in allowing managers to better understand the underlying governance structure of their existing supply chain (or supply base). It has been suggested that supply chains tend to emerge somewhat spontaneously over time, rather than from purposeful efforts to design an ideal chain (Choi et al., 2001). If so, it may well be that managers are to some extent unaware of the nature of their supply chain, and the SCGS index may provide an initial way to assess the firm's supply network and determine how the future configuration should look. In different industries and at different times, this knowledge may prove useful in aiding in decisions pertaining to supply chain design and supply base optimization.

Figure 1 Construct validation process

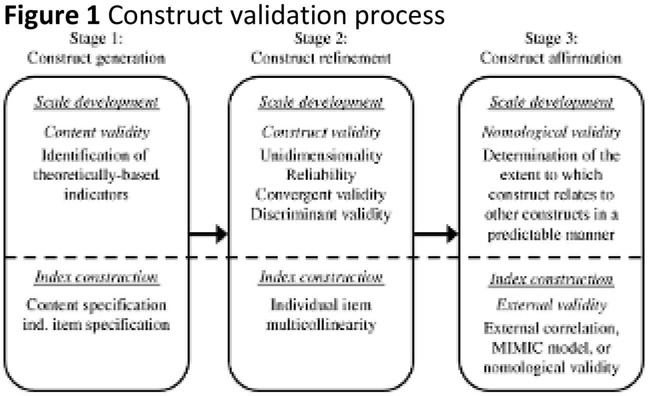

Table I OA and SCGS scales

OA: To what extent are the following policies and situations evident in your business unit? (7-pt Likert scale: 1 = "not at all" 4 = "somewhat" 7 = "to a great extent")
a. Our performance evaluations are partly based on integrative objectives for purchasing and logistics
b. Purchasing and logistics people are rewarded for working together
c. People from purchasing or logistics are often designated as liaisons to the other function
d. The company makes use of integrating roles such as program/project managers between purchasing and logistics
e. Purchasing and logistics are physically located near one another (in this case, 7 = on same floor of same building, and 1 = in different states or farther away)
SCGS: to what extent do you agree with the following statements? (7-pt Likert scale: 1 = "strongly disagree" 4 = "neither agree nor disagree" 7 = "strongly agree")
a. We exchange considerable information with our key suppliers (e.g. product design info or inventory and item movement info)
b. We require more than a simple "price quote" to award business to a supplier
c. Technology is by and large the same across potential suppliers
d. Our industry is characterized by well-known and accepted technical standards
e. Our key suppliers are "full service" outfits who can deliver a complete design with little input from us
f. We do not have to spend a lot of time monitoring our suppliers for quality or to make sure they are fulfilling their commitments
Collaboration[a]: to what extent does purchasing engage in the following activities with logistics? (7-pt Likert scale: 1 = "not at all" 4 = "somewhat" 7 = "frequently")
a. Achieve goals collectively
b. Develop a mutual understanding of responsibilities
c. Work together on cross-functional teams or task forces
d. Share information and ideas
e. Share resources
f. Conduct joint planning to anticipate and resolve problems

Sources: [a] Adopted from Kahn (1996) and Ellinger et al. (2000); used for establishment of OA discriminant validity

Table II Global supply chain governance typology

Governance type	Complexity of transactions	Ability to codify transactions	Capabilities in the supply-base	Degree of explicit coordination and power asymmetry
Market	Low	High	High	Low
Modular	High	High	High	↑
Relational	High	Low	High	|
Captive	High	High	Low	↓
Hierarchy	High	Low	Low	High

Note: There are eight possible combinations of the three variables. Five of them generate global value chain types. The combination of low complexity of transactions and low ability to codify is unlikely to occur. This excludes two combinations; further, if the complexity of the transaction is low and the ability to codify is high, then low supplier capability would lead to exclusion from the value chain. While this is an important outcome, it does not generate a governance type per se Source: Gereffi et al. (2005)

Table III Sample description

	Logistics sample (total = 110)		Purchasing sample (total = 211)	
	Count	%	Count	%
Industry				
Food	48	43.6	85	40.3
Electronics	27	24.5	64	30.3
Chemicals	35	31.8	62	29.4
Revenues				
<$100M	19	17.3	46	21.8
$100M-$500M	25	22.7	37	17.5
$500M-$1B	7	6.4	10	4.7
$1B-$5B	18	16.4	32	15.2
$5B-$10B	17	15.5	28	13.3
$10B -$20B	10	9.1	25	11.8
>$20B	12	10.9	23	10.9
N/A	2	1.8	10	4.7

Table IV Construct validity results for the OA scale

Factor/model	Loadings	Final loadings	NFI	CFI	α (pre)	α (post)	ρ
Purchasing dataset			0.969	0.967	0.779	0.831	0.850
item a	0.77	0.78					
item b	0.78	0.78					
item c	0.67	0.67					
item d	0.74	0.75					
item e	0.34						
Logistics dataset			0.896	0.893	0.758	0.852	0.854
item a	0.82	0.81					
item b	0.75	0.74					
item c	0.74	0.75					
item d	0.78	0.78					
item e	0.20						

Note: Reliability, unidimensionality and convergent validity results

References

Anderson, J.C. and Gerbing, D.W. (1991), "*Predicting the performance of measures in a confirmatory factor analysis with a pretest assessment of their substantive validities*", *Journal of Applied Psychology*, Vol. 76 No. 5, pp. 732-40.

Armstrong, J.S. and Overton, T.S. (1977), "*Estimating nonresponse bias in mail surveys*", *Journal of Marketing Research*, Vol. 14, pp. 396-402.

Bentler, P.M. and Wu, E.J.C. (2002), *EQS 6 for Windows User's Guide*, Multivariate Software, Encino, CA.

Bozarth, C., Handfield, R. and Das, A. (1998), "*Stages of global sourcing strategy evolution: a exploratory study*", *Journal of Operations Management*, Vol. 16 Nos 2/3, pp. 241-55.

Brown, L.D. (1983), *Managing Conflict at Organizational Interfaces*, Addison-Wesley, Reading, MA.

Byrne, B.M. (2006), *Structural Equation Modeling with EQS: Basic Concepts, Applications and Programming*, Lawrence Erlbaum Associates, Mahwah, NJ.

Choi, T.Y., Dooley, K.J. and Rungtusanatham, M. (2001), "*Supply networks and complex adaptive systems: control versus emergence*", *Journal of Operations Management*, Vol. 19 No. 3, p. 351.

Churchill, G.A. Jr (1979), "*A paradigm for developing better measures of marketing constructs*", *Journal of Marketing Research*, Vol. 16 No. 1, pp. 64-73.

Claycomb, C., Germain, R. and Droge, C. (1999), "*Total system JIT outcomes: inventory, organization and financial effects*", *International Journal of Physical Distribution & Logistics Management*, Vol. 29 No. 10, pp. 612-22.

Colquitt, J.A. and Zapata-Phelan, C.P. (2007), "*Trends in theory building and theory testing: a five-decade study of the academy of management journal*", *Academy of Management Journal*, Vol. 50 No. 6, pp. 1281-303.

Daugherty, P.J., Ellinger, A.E. and Gustin, C.M. (1996), "*Integrated logistics: achieving logistics performance improvements*", *Supply Chain Management*, Vol. 1 No. 3, p. 25.

DeVellis, R.F. (2003), *Scale Development: Theory and Applications*, Sage, Thousand Oaks, CA.

Diamantopoulos, A. and Winklhofer, H.M. (2001), "*Index construction with formative indicators: an alternative to scale development*", *Journal of Marketing Research*, Vol. 38 No. 2, pp. 269-77.

Dillman, D.A. (2000), *Mail and Internet Surveys: The Tailored Design Method*, Wiley, New York, NY.

Droge, C. and Germain, R. (1998), "*The design of logistics organizations*", *Transportation Research. Part E, Logistics & Transportation Review*, Vol. 34 No. 1, pp. 25-37.

Dunn, S.C., Seaker, R.F. and Waller, M.A. (1994), "*Latent variables in business logistics research: scale development and validation*", *Journal of Business Logistics*, Vol. 15 No. 2, pp. 145-71.

Dutton, J.M. and Walton, R.E. (1966), "*Interdepartmental conflict and cooperation: two contrasting studies*", *Human Organization*, Vol. 25 No. 3, pp. 207-20.

Edwards, J.R. and Bagozzi, R.P. (2000), "*On the nature and direction of relationships between constructs and measures*", *Psychological Methods*, Vol. 5 No. 2, pp. 155-74.

Ellinger, A.E., Daugherty, P.J. and Keller, S.B. (2000), "*The relationship between marketing/logistics interdepartmental integration and performance in US manufacturing firms: an empirical study*", *Journal of Business Logistics*, Vol. 21 No. 1, pp. 1-21.

Fawcett, S.E. and Magnan, G.M. (2002), "*The rhetoric and reality of supply chain integration*", *International Journal of Physical Distribution & Logistics Management*, Vol. 32 No. 5, pp. 339-61.

Fornell, C. and Larcker, D.F. (1981), "*Evaluating structural equation models with unobservable variables and measurement error*", *Journal of Marketing Research*, Vol. 18, pp. 39-50.

Galbraith, J.R. and Nathanson, D. (1978), *Strategy Implementation: The Role Structure and Process*, West Publishing, St Paul, MN.

Garver, M.S. and Mentzer, J.T. (1999), "*Logistics research methods: employing structural equation modeling to test for construct validity*", *Journal of Business Logistics*, Vol. 20 No. 1, pp. 33-57.

Gerbing, D.W. and Anderson, J.C. (1988), "*An updated paradigm for scale development incorporating unidimensionality and its assessment*", *Journal of Marketing Research*, Vol. 25 No. 2, pp. 186-92.

Gereffi, G., Humphrey, J. and Sturgeon, T.J. (2005), "*The governance of global value chains*", *Review of International Political Economy*, Vol. 12 No. 1, pp. 78-104.

Germain, R. and Droge, C. (1997), "*Effect of just-in-time purchasing relationships on organizational design, purchasing department configuration, and firm performance*", *Industrial Marketing Management*, Vol. 26 No. 2, pp. 115-25.

Germain, R., Droge, C. and Daugherty, P.J. (1994), "*A cost and impact typology of logistics technology and the effects of its adoption on organizational practice*", *Journal of Business Logistics*, Vol. 15 No. 2, pp. 227-48.

Griffin, A. and Hauser, J.R. (1996), "*Integrating R&D and marketing: a review and analysis of the literature*", *The Journal of Product Innovation Management*, Vol. 13 No. 3, pp. 191-215.

Gupta, A. (1984), *A Study of the R&D/marketing Interface and Innovation Success in High Technology Firms*, Syracuse University, Syracuse, NY.

Gupta, A.K. and Rogers, E.M. (1991), "*Internal marketing: integrating R&D and marketing within the organization*", *The Journal of Services Marketing*, Vol. 5 No. 2, pp. 55-68.

Gupta, A.K. and Wilemon, D. (1988), "*The credibility-cooperation connection at the R&D-marketing interface*", *The Journal of Product Innovation Management*, Vol. 5 No. 1, pp. 20-31.

Gupta, A.K., Raj, S.P. and Wilemon, D. (1987), "*Managing the R&D-marketing interface*", *Research Management*, Vol. 30 No. 2, pp. 38-43.

Howell, R.D. (1987), "*Covariance structure modeling and measurement issues: a note on 'interrelations among a channel entity's power sources'*", *Journal of Marketing Research*, Vol. 24 No. 1, pp. 119-26.

Jarvis, C.B., MacKenzie, S.B. and Podsakoff, P.M. (2003), "*A critical review of construct indicators and measurement model misspecification in marketing and consumer research*", *Journal of Consumer Research*, Vol. 30 No. 2, pp. 199-218.

Kahn, K.B. (1996), "*Interdepartmental integration: a definition with implications for product development performance*", *The Journal of Product Innovation Management*, Vol. 13 No. 2, pp. 137-51.

Krause, D.R., Pagell, M. and Curkovic, S. (2001), "*Toward a measure of competitive priorities for purchasing*", *Journal of Operations Management*, Vol. 19 No. 4, pp. 497-512.

Lambert, D.M. and Cook, R.L. (1990), "*Integrating marketing and logistics for increased profit*", *Business*, Vol. 40 No. 3, pp. 22-9.

Lambert, D.M. and Harrington, T.C. (1990), "*Measuring nonresponse bias in customer service mail surveys*", *Journal of Business Logistics*, Vol. 11 No. 2, pp. 5-25.

Lawrence, P.R. and Lorsch, J.W. (1967), "*Differentiation and integration in complex organizations*", *Administrative Science Quarterly*, Vol. 12 No. 1, pp. 1-47.

Lawrence, P.R. and Lorsch, J.W. (1969), *Organization and Environment: Managing Differentiation and Integration*, Richard D. Irwin, Homewood, IL.

Lazarsfeld, P.F. (1960), *Latent Structure Analysis*, Columbia University Bureau of Applied Social Research, New York, NY.

Lim, J.-S. and Reid, D.A. (1992), "*Vital cross-functional linkages with marketing*", *Industrial Marketing Management*, Vol. 21 No. 2, pp. 159-65.

Lynagh, P.M. and Poist, R.F. (1984), "*Managing physical distribution/marketing interface activities: cooperation or conflict?*", *Transportation Journal*, Vol. 23 No. 3, pp. 36-43.

MacCallum, R.C. and Browne, M.W. (1993), "*The use of causal indicators in covariance structure models: some practical issues*", *Psychological Bulletin*, Vol. 114 No. 3, pp. 533-41.

McGinnis, M.A. and Kohn, J.W. (2002), "*Logistics strategy-revisited*", *Journal of Business Logistics*, Vol. 23 No. 2, p. 1.

Maltz, E. and Kohli, A.K. (2000), "*Reducing marketing's conflict with other functions: the differential effects of integrating mechanisms*", *Journal of the Academy of Marketing Science*, Vol. 28 No. 4, pp. 479-92.

Menor, L.J. and Roth, A.V. (2007), "*New service development competence in retail banking: construct development and measurement validation*", *Journal of Operations Management*, Vol. 25, pp. 825-46.

Miller, D. and Droge, C. (1986), "*Psychological and traditional determinants of structure*", *Administrative Science Quarterly*, Vol. 31 No. 4, pp. 539-60.

Mollenkopf, D., Gibson, A. and Ozanne, L. (2000), "*The integration of marketing and logistics functions: an empirical examination of New Zealand firms*", *Journal of Business Logistics*, Vol. 21 No. 2, pp. 89-112.

Monczka, R.M., Trent, R.J. and Handfield, R.B. (2005), *Purchasing and Supply Chain Management*, Southwestern/Thompson Learning, Mason, OH.

Murphy, P.R. and Poist, R.F. (1992), "*The logistics-marketing interface: techniques for enhancing cooperation*", *Transportation Journal*, Vol. 32 No. 2, pp. 14-23.

Murphy, P.R. and Poist, R.F. (1994), "*The logistics-marketing interface: marketer views on improving cooperation*", *Journal of Marketing Theory and Practice*, Vol. 2 No. 2, pp. 1-13.

Nunnally, J.C. (1978), *Psychometric Theory*, McGraw-Hill, New York, NY.

O'Leary-Kelly, S.W. and Vokurka, R.J. (1998), "*The empirical assessment of construct validity*", *Journal of Operations Management*, Vol. 16 No. 4, pp. 387-405.

Peter, J.P. (1979), "*Reliability: a review of psychometric basics and recent marketing practices*", *Journal of Marketing Research*, Vol. 16 No. 1, pp. 6-17.

Peter, J.P. (1981), "*Construct validity: a review of basic issues and marketing practices*", *Journal of Marketing Research*, Vol. 18, pp. 133-45.

Petersen, K.J., Frayer, D.J. and Scannell, T.V. (2000), "*An empirical investigation of global sourcing strategy effectiveness*", *Journal of Supply Chain Management*, Vol. 36 No. 2, pp. 29-38.

Rho, B.-H., Hahm, Y.-S. and Yu, Y.-M. (1994), "*Improving interface congruence between manufacturing and marketing in industrial product manufacturers*", *International Journal of Production Economics*, Vol. 37 No. 1, pp. 27-40.

Rogers, E.M. (1990), "*The R&D/marketing interface in the technological innovation process*", in Saghafi, M.M. and Gupta, A. (Eds), *Managing the R&D Marketing Interface for Product Success: The Telecommunications Focus*, JAI Press, Greenwich, CT.

Schilling, M.A. (2000), "*Toward a general modular systems theory and its application to interfirm product modularity*", *The Academy of Management Review*, Vol. 25 No. 2, pp. 312-34.

Schilling, M.A. and Steensma, H.K. (2001), "*The use of modular organizational forms: an industry-level analysis*", *Academy of Management Journal*, Vol. 44 No. 6, pp. 1149-68.

Souder, W.E. and Chakrabarti, A.K. (1978), "*The R&D/marketing interface: results from an empirical study of innovation projects*", *IEEE Transactions on Engineering Management*, Vol. 25 No. 4, pp. 88-93.

Souder, W.E. and Sherman, J.D. (1993), "*Organizational design and organizational development solutions to the problem of R&D-marketing integration*", *Research in Organizational Change and Development*, Vol. 7, pp. 181-215.

Stank, T.P., Keller, S.B. and Daugherty, P.J. (2001), "*Supply chain collaboration and logistical service performance*", *Journal of Business Logistics*, Vol. 22 No. 1, pp. 29-48.

Sturgeon, T.J. (2002), "*Modular production networks: a new american model of industrial organization*", *Industrial and Corporate Change*, Vol. 11 No. 3, pp. 451-96.