EVOLVING A THEORY OF PERFORMANCE-BASED LOGISTICS USING INSIGHTS FROM SERVICE DOMINANT LOGIC

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INTRODUCTION

Performance-based logistics (PBL) has emerged as a strategy for improving the performance and lowering the cost to sustain complex systems (e.g., passenger aircraft, defense systems, and high-speed rail) during the post-production phase of their life-cycle. Post-production support cost is significant, often exceeding, by two or three times, the costs incurred in the development and production phases (Flint 2007; Geary and Vitasek 2008; Government Accountability Office 2008). Transactional relationships between upstream suppliers have greatly hampered efforts to reduce cost associated with sustainment. Instead of developing solutions that increase performance and decrease failure rates for the end-user, suppliers have sub-optimized the supply chain by concentrating on actions that increase their individual profitability. Transactional relationships incentivize suppliers to decrease the costs associated with repair, overhaul, inventory, and sourcing, rather than fixing the underlying problem. PBL overcomes this situation by focusing upstream trading partners on what matters most to the end-user—an aircraft or system that rarely fails and has lower operating costs.

PBL shifts responsibility for system performance from the end-user to the upstream supplier network. The supplier network is compensated based on the ability to deliver a performance-based outcome (e.g., having 95% of trucking or aircraft fleet fully operational) instead of being paid to overhaul parts or provide replacement components. PBL requires a sustainment provider, frequently the original equipment manufacturer (OEM), to integrate upstream suppliers and processes in a way that aligns the supply chain on the achievement of performance-based outcomes. The sustainment provider and upstream supplier network agree to produce a specified service level in return for the assurance of a steady stream of income, as long as the supplier network maintains the required performance outcomes. Through the assurance of a steady stream of income, PBL creates incentives for the supplier network to make upfront investments that will lower costs and achieve the performance outcomes throughout the post-production phase. The result is lower cost for the end user and improved profit potential for the supplier network (Fowler 2008; Geary and Vitasek 2008; Sols, Nowicki, and Verma 2007). PBL is an area of emerging research and practice where supply chain networks use outcomes, inter-firm relationships, and knowledge driven innovation to drive superior performance.

The purpose of this article is to present a theoretical framework for PBL. By focusing on performance and outcomes, PBL represents a major departure from traditional supply chain strategies focused on delivering a product or service to the end-user. Despite the success and savings attributed to PBL (Fowler 2008; Kim, Cohen, and...
Netessine 2007), a gap exists in our understanding of how processes spanning multiple trading partners can be effectively aligned by performance-based outcomes at the end-user level. The framework explains the antecedents, constructs, processes, relationships and resulting outcomes occurring within supply chains adopting PBL. The supporting research employed a grounded theory methodology and conducted over 60 interviews to emerge the theoretical framework.

Service dominant logic (SDL) is introduced from the marketing literature as a “theoretical lens” (Charmaz 2006; Glaser 1978; Wooten 2000) for examining PBL and interpreting the results. SDL and its fundamental premises provide many insights due to a service dominant, rather than product dominant explanation of supply chain behavior and relationships (Lambert and Garcia-Dastugue 2006; Vargo and Lusch 2004). PBL outwardly exhibits many of the characteristics of SDL due to its reliance on outcomes, centrality of knowledge within relationships, and extensive collaboration among trading partners. SDL provides conceptual insight into how knowledge and skill can provide supply chain based value propositions (Lambert and Garcia-Dastugue 2006; Vargo and Lusch 2004).

The theoretical framework and supporting research make two major contributions to supply chain research and practice. The investigation introduces SD-Logic as a vehicle for examining and explaining supply chain relationships. The research provides a theoretical model that extends our understanding of the antecedents, processes, and outcomes in performance-based supply chain relationships.

This article is organized as follows. The first section reviews the related literature, identifies the insights obtained from SDL, describes PBL, and explains how SDL can be used to examine and explain PBL relationships. Next, we describe the grounded theory methodology and the analytical process employed during the research. The final section presents the theoretical model resulting from the research and describes how PBL relationships can be explained using this framework. Suggestions for future research and a summary of the key findings conclude the article.

LITERATURE REVIEW

Grounded theory uses the literature to position and scope the broad themes involved in a research effort. This investigation involves two such distinct themes. The first is SDL, which serves as a conceptual frame of reference for understanding and interpreting outcome based value propositions. The second theme is PBL. PBL and SDL outwardly manifest many of the same concepts and fundamental premises. SDL as a theoretical lens offers the potential for emerging a performance-based theory supportive of supply chain management. The following sections provide a review of the relevant literature to facilitate the emergence of a grounded theory supporting PBL.

Insights from the Service Dominant Logic Literature

Market exchange has long been focused on the 4P’s (product, price, place and promotion) of marketing. The microeconomic focus of the 4P’s, that seeks to maximize firm profit by optimizing the marketing mix, appears limited. The 4P’s fail to explain new constructs such as customer orientation, relationship marketing, quality management, and supply chain management. Further the 4P’s framework has proven inadequate in explaining how customers and suppliers can create benefit from working together (Vargo and Lusch 2004). The value proposition and supplier network focus is what gives SD-Logic great promise for advancing theory in marketing and supply chain management (Lambert, Garcia-Dastugue, and Croxton 2005; Vargo and Lusch 2004). SDL addresses these deficiencies by explaining how inter-firm collaboration may lead to the creation of superior value propositions. Collaborating firms learn from each other and, thus, enhance their overall knowledge, skills, and abilities (Flint and Mentzer 2006; Vargo and Lusch 2004). By focusing on value creation as opposed to producing products, the firms can obtain a sustainable competitive advantage. Strengthened relationships coupled with the exchange and co-creation of knowledge enable these firms to sustain the competitive advantage over time. SDL conceptually describes how the exchange of knowledge and skills creates value. The SDL knowledge and skill based framework suggests that supply chains provide value propositions which transcend the product alone (Lambert and Garcia-Dastugue 2006; Vargo and Lusch 2004). These value propositions satisfy customer requirements, and those requirements evolve over time. In SDL the customer is not the target of the exchange but an active co-creating participant (Jaworski and Kohli 2006) where value is based upon exchange of intangible skills, knowledge, and
relationships (Vargo and Lusch 2004). The supply chain, properly aligned, provides significant sources of knowledge and skill (Vargo and Lusch 2004).

This focus on provisions of value and service, which evolve with the customer is what makes SDL a “robust alternative to the traditional view” (Webster 2006, p. xiv) of the 4P’s of marketing. SDL has been described as “brilliantly insightful” and poised to provide an integrative explanation of modern knowledge-based exchange constructs (Rust 2004, p. 23). The centrality of knowledge and illumination of the collaborative exchange mechanism forms the “brilliance” of the SD framework (Day 2004). Value, as defined by SDL, provides a superior explanation of core competency (Vargo and Lusch 2004), market orientation (Jaworski and Kohli 2006), and the co-creation of value (Lusch and Vargo 2006a; Oliver 2006; Prahalad and Ramaswamy 2004). Evolving value propositions also better explain structural changes in the market place (Day 2006; Deighton and Narayandas 2004), and the rise of collaborative and competitive supply chain process models (Flint and Mentzer 2006; Lambert and García-Dastugue 2006; Lusch and Vargo 2006b). For the business researcher, “SDL is an open source code” that has the potential to evolve into a “fully integrative and complete general theory of marketing” (Lusch and Vargo 2006b, p. 419). The value proposition and supplier network focus gives SDL great promise for advancing theory in marketing and supply chain management.

SDL embeds a new way of conceptualizing competitive resources (Vargo and Lusch 2004). Knowledge and skill based resources are “resources that produce effects” (Vargo and Lusch 2004, p. 3). These resources “are often invisible and intangible; often they are core competencies or organizational processes” (Vargo and Lusch 2004, p. 3). Knowledge and skill based resources are considered superior to micro economic optimization of land, labor, and capital, as predictors of competitive success. Value, and outcome, derived from knowledge and skill is what satisfies customer desire. For example, a washing machine provides the service provision of clean clothing. The value proposition is not about the machine but clean clothing. Products are valuable to the customer only in that they lead to achieving a desired outcome.

By focusing on effects and outcomes, SDL determines value in use and anticipates that value creation will change over time (Jaworski and Kohli 2006; Prahalad and Ramaswamy 2004; Vargo and Lusch 2004). This change in value is explained in SDL because value is dyadic between the supplier network and the customers (Vargo and Lusch 2004). The knowledge and skill resources present within the exchange predict the competitive position of the particular supplier network. These variables, customer, knowledge, skill, and trading partners are likely to change over time. Supply chain management provides an effective mechanism to efficiently adapt to those changes.

SDL posits nine fundamental premises (FP’s). Each premise encapsulates theoretical and practical potential (Day 2006; Lambert and García-Dastugue 2006). The FP’s (Table 1) are the abstract conceptual structure of SDL (Vargo and Lusch 2004). The FP’s describe, without structure, a new exchange paradigm where skill, knowledge, and exchange processes are the source of value (Vargo and Lusch 2004). Table 1 provides a definition and explanation of each of these premises.

SDL is customer-oriented. The end customer is viewed as a key source of knowledge from which to create value propositions (Jaworski and Kohli 2006). The customer judges the current value proposition and interacts with the network to evolve future value propositions. Value between the customer and the supplier network is created through “interactivity, integration, customization, and co-production” (Vargo and Lusch 2004, p. 11). The supplier network actively engages with customers to create greater learning and value (Vargo and Lusch 2004). The outcome focus has potential for exploring and explaining actions that align the supply chain.

SDL suggests supply chain integration is the highest form of exchange-based “core competencies” (Vargo and Lusch 2004, p. 3). This premise is consistent with findings that integration is the critical element in supply chain management (Bernabucci 2008; Ogden et al. 2005; Vargo and Lusch 2004). Integration enables trading partners to combine inter-firm knowledge to generate superior value propositions (Lusch and Vargo 2006a). Integration brings together the co-creation of knowledge and supply chain management to explain the creation of value. Although SDL appears to offer substantial promise, significant theoretical development remains for SDL to become applicable in practical settings (Day 2006). SDL requires an investigation that brings definition to its antecedents, processes, and outcomes; “without such an investigation most firms, and most researchers, are unlikely to embrace and extend what is argued by Vargo and Lusch” (Day 2006, p. 88). An actionable model is required if firms and networks are to unlearn the lessons of a product based culture (Bettis and Prahalad 1995).
TABLE 1
FUNDAMENTAL PREMISES (FP) OF SDL

<table>
<thead>
<tr>
<th>FP 1</th>
<th>The application of specialized skills and knowledge is the fundamental unit of exchange.</th>
</tr>
</thead>
<tbody>
<tr>
<td>FP 2</td>
<td>Indirect exchange masks the fundamental unit of exchange. Currency and the use of the supply chain partners remove upstream suppliers from contact with the end customer.</td>
</tr>
<tr>
<td>FP 3</td>
<td>Products are distribution mechanisms for service provisions. End consumers seek value propositions, not the products themselves.</td>
</tr>
<tr>
<td>FP 4</td>
<td>Knowledge is the fundamental source of competitive advantage. Knowledge and skill transform land, labor, capital, and natural resources, to create sustained competitive advantage. Supply chains represent a significant source of knowledge.</td>
</tr>
<tr>
<td>FP 5</td>
<td>All economies are service economies, economic output value is based upon value propositions created and accepted.</td>
</tr>
<tr>
<td>FP 6</td>
<td>The customer is always a co-creator. Customers define requirements, judge the value proposition, and represent a significant knowledge source.</td>
</tr>
<tr>
<td>FP 7</td>
<td>The supplier network and its customers make value propositions. Exchange occurs when all members make and accept value propositions. Firms exchange for profit and customer knowledge. Customers exchange for affordable value propositions.</td>
</tr>
<tr>
<td>FP 8</td>
<td>Value propositions are customer oriented and relational. The customer and supplier network exchange knowledge and resources to create value for all exchange partners.</td>
</tr>
<tr>
<td>FP 9</td>
<td>Organizations integrate the microspecialized competences into complex services demanded in the marketplace. Supplier network integration is the highest core competency. Integration focuses the supplier network on customer value propositions, and rewards achievement of those value proposition.</td>
</tr>
</tbody>
</table>

Source: Adapted form Vargo and Lusch (2004).

Insights from the Performance-based Logistics Literature

Post-production support networks are moving away from product based, repair—to—specification contracts and finding greater value in collaborative performance-based supply chain strategies (Berkson 2005; Kim, Cohen, and Netessine 2007; Sols, Nowicki, and Verma 2007). These strategies are known as “performance contracting” in aftermarket sales, “power by the hour” in the commercial sector, and “Performance-Based Logistics” (PBL) in defense contracting (Fowler 2008; Kim, Cohen, and Netessine 2007; Pagonis 2004). PBL leverages long-term relationships, network risk reduction, co-investment, customer interactivity, and knowledge based exchanges to create improved performance and decreased life cycle cost (Geary and Vitasek 2008). The product is merely an element supporting the value proposition (Sols, Nowicki, and Verma 2007).

The U.S. Department of Defense (DoD) is leading the implementation of PBL. The DoD spends $125 billion annually on logistics (Kratz 2007). Based on a decade of success with PBL, DoD has a stated objective to convert this sustainment spend into PBL contracts (Berkson 2005; Fowler 2008). The DoD has initiated 215 PBL programs with firms such as Lockheed Martin Aeronautical Company, Northrop Grumman, Boeing, Air Bus and others (Ahern 2007). Seventy-six PBL contracts are currently in place with another 95 programs scheduled for the near future (Geary and Vitasek 2008). Some of these programs are small and focused on subsystems while others are remarkably large, such as the multi-national Joint Strike Fighter (JSF). The JSF program includes $300 billion to acquire 2,458 aircraft, and $650 billion in post production support (Government Accountability Office 2008). The program will use PBL exclusively for post production support to include sparing, repair, distribution and reliability improvement (Gill 2004).

Commercial acceptance of PBL has been growing as well. PBL is appealing because it reduces risk and capital investment for the customer by employing the skills and knowledge of the supplier network to reduce cost and create performance-based value propositions (Berkson 2005; Flint 2007; Phillips 2005; Sols, Nowicki, and Verma 2007). Of the $45 billion expended on post production support for commercial aircraft, almost 70 % is performed under a PBL strategy (Flint 2007; Phillips 2008). PBL is also being used in areas such as highway construction and operation, high speed rail, and facility construction and operations (Randall 2009).
PBL is fundamentally different from the traditional sustainment strategy of spare and repair. PBL trades the transactional costs of repair and replacement components for an upfront investment focused on improving affordability over the remaining life of the supported system (Cipicchio 2006; Fowler 2008; Pagonis 2004; Wynne 2004). The customer commitment to a predetermined level of system performance and payment over a specified time horizon incentivizes the supplier network to incur upfront investments. Those investments are rewarded when the suppliers achieve the desired performance objectives while reducing costs. Suppliers increase their return on investment by eliminating the need to repair parts, improving system reliability, improving the spare and repair process, and avoiding the associated costs (Kim, Cohen, and Netessine 2007; Phillips 2005; Wolfowitz 2004). The supplier retains these savings to earn a return on the initial investment. Conceptually, the optimal return on investment model occurs when the system does not fail. This process results in improved affordability for the customer as the contract price is periodically renegotiated in ways that enable the customer to share some of the savings achieved through the relationship (Geary and Vitasek 2008). Additionally performance improvement curves are frequently included in a contract. The incentive structure of PBL drives continuous improvement as measured by greater performance and decreased cost (Fowler 2008). PBL represents a large-scale shift toward return on investment and knowledge-based exchange in post-production sustainment industries (Kim, Cohen, and Netessine 2007). Knowledge, and decisions that act on the knowledge, are the engine that drives achievement of the performance outcome. The fundamental value proposition in a PBL strategy is the conversion of knowledge into improved supply chain performance.

Other Insights Obtained from the Literature

The SDL and PBL concepts of service dominance and performance-based outcomes appear to be very similar. SDL and PBL focus on the outcome of inter-firm value creation and not the delivery of a product (Berkson 2005; Kim, Cohen, and Netessine 2007; Vargo and Lusch 2004). Value is the ability of the network to co-create, evolve, and satisfy a service [performance] requirement (Defense Acquisition University 2005; Geary and Vitasek 2008; Kim, Cohen, and Netessine 2007; Vargo and Lusch 2004).

Service and performance are not synonymous with services. Service within SDL is “the application of specialized competences (knowledge and skills) through deeds, processes, and performances for the benefit of another entity or the entity itself” (Vargo and Lusch 2004, p. 3). Service is not: “(1) the restricted traditional conceptualizations that often treat services as a residual (that which is not a tangible good); (2) something offered to enhance a good (value-added services); or (3) what have become classified as services industries, such as health care, government, and education” (Vargo and Lusch 2004, p. 3). Similarly, performance is the manifestation of a network’s ability to use goods, services, and knowledge, to meet a desired performance requirement (Pagonis 2004; Wolfowitz 2004). Service and performance use a combination of goods, services, skills, and knowledge to achieve a performance outcome. Performance and service represent the value proposition offered by the network.

Although similar, performance and service are different. Performance is defined by the performance metric while service is a more ambiguous concept. Service suggests that the product transmits value in the form of a service offering (Vargo and Lusch 2004). Performance uses metrics, incentives, and investment to create knowledge-based outcomes and continuous value for the end-user.

The similarity between PBL and SDL represents a rich source of empirical data supportive of further investigation. PBL provides observable supplier networks operating across inter-firm, supply chain processes. These “supply chain management processes are cross functional and cross firm, which enables the exchange of a broad set of skill and knowledge” (Lambert and Garcia-Dastugue 2006). SDL similarly acts through cross-functional and interconnected, knowledge-based processes. As a result, SDL provides an appropriate theoretical lens for use in investigating supply chains employing a PBL strategy.

METHODOLOGY

Grounded Theory (GT) is an appropriate research methodology when the objective is to emerge theory. GT provides a process oriented mechanism through which to create a theory structure of PBL using insights from SDL. GT is appropriate because both PBL and SDL lack an explanatory and predictive framework of antecedents, processes, and outcomes (Kim, Cohen, and Netessine 2007; Webster 2006). By employing a GT methodology using
case studies, archival review, practitioner conference interaction, and interviews drawn from PBL and non-PBL programs, this investigation generates antecedents, processes, and outcomes explanatory of PBL and suggestive of SDL. GT provides a methodology based on an inductive and pattern searching technique for conducting in-depth investigations within and across organizations (Charmaz 2006; Glaser 1992; Glaser and Strauss 1967; Holland 1992).

GT is an appropriate methodology for studying how complex organizational systems adapt to their environments (Bettis and Prahalad 1995; Charmaz 2006). By investigating management behavior, GT develops key variables and their relationships (Glaser and Strauss 1967; Hunt 1992) without imbibing the bias of previous theoretical structure (Charmaz 2006). GT has proven successful in supply chain management (Flint et al. 2005; Flint, Woodruff, and Gardial 2002; Mello, Stank, and Esper 2008; Mollenkopf, Russo, and Frankel 2007; Pappu and Mundy 2002) and marketing research (Kohli and Jaworski 1990; Noble and Mokwa 1999; Parasuraman, Zeithaml, and Berry 1985). The strength of a GT application lies in its ability to apply a linear method to what is a non-linear organizational system. Figure 1 depicts the non-linear grounded theory process in a linear fashion.

![Grounded Theory Process Diagram](source: Adapted from Charmaz (2006).)

This investigation employed multiple iterations of the process shown in Figure 1. The research generated 61 different recorded interviews, of which 41 were transcribed. An additional 20 interviews were not transcribed, but were reviewed to support model building and validation of proposed variables and relationships (Charmaz 2006). Each interview lasted between 45 and 70 minutes.

The research team relied on both practitioner and academic supply chain experts to define the research objectives, form the initial interview structure, and identify initial participants. During the first step, the research problem was clarified and the specific research questions developed:

**Research problem:** Lack of a theoretical structure of PBL.

**Research question 1:** What are the antecedents, processes and outcomes of that theory structure?

**Research question 2:** What is the potential for using SDL as a framework to understand supply chain phenomena?

The first step involved meetings with industry, government, and academic experts in order to focus the research problem, identify the initial research questions, qualify the initial sample, and create an interview protocol. In this research the step also included an archival review of program information, policy, meeting memos, and discussions with participants involved with performance and product oriented sustainment programs (Charmaz 2006; Glaser...
1992; 1978; Glaser and Strauss 1967). As shown in Table 2, the various levels of expertise (executive, engineer, logistician manager, and technician), supply chain position (supplier, and customer), and program stage (PBL, non-PBL, Converting), ensured multi-dimensional emergence of each construct (Charmaz 2006). The sample included both contractor and government employees, and covered a variety of DoD air and land programs.

**TABLE 2**

**PARTICIPANT BACKGROUND***

<table>
<thead>
<tr>
<th>Primary Functional Expertise</th>
<th>Logistics</th>
<th>Business Strategy</th>
<th>Maintenance</th>
<th>Program Mgmt Contracting</th>
<th>Engineer</th>
<th>Depot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer</td>
<td>40 %</td>
<td>13 %</td>
<td>5 %</td>
<td>19 %</td>
<td>8 %</td>
<td>16 %</td>
</tr>
<tr>
<td>Type of program</td>
<td>60 %</td>
<td>Supplier</td>
<td>45 %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBL</td>
<td>40 %</td>
<td>Non PBL</td>
<td>28 %</td>
<td>Converting</td>
<td>12 %</td>
<td></td>
</tr>
<tr>
<td>Years Experience</td>
<td>1-5</td>
<td>6-9</td>
<td>10-14</td>
<td>15-20</td>
<td>20+</td>
<td></td>
</tr>
</tbody>
</table>

|                                | 8 %       | 3 %               | 10 %        | 49 %                     | 30 %    |       |

Interviews transcribed (four people interview twice, 41 transcribed, 20 not transcribed)

The analytical process of GT is called constant comparison. Constant comparison emphasizes the “discovery of what concepts and hypotheses are relevant for the area that one wishes to research” (Glaser and Strauss 1967, p. 2). Comparisons involve interviews aimed at identifying themes and then testing whether these themes remain consistent in subsequent or previous interviews (Charmaz 2006; Glaser and Strauss 1967). The participant interviews, steps two and four, continued over a period of three years. During this process, as shown in step three, constant comparison led to the emergence of initial categories and more focused follow-on coding. To support constant comparison new interviews were conducted, either with previous or new participants, to gain clarification. This process is shown in step four. As new insights emerged, previous interviews were also reexamined.

Valid GT research requires documentation of how researchers arrived at a particular concept, category or relationship. Memos, mentioned in step three and five, provide that documentation. Memos record how relationships developed in subsequent interviews and document the logic behind the emerged variables (Charmaz 2006). Memos document questions for follow-on interviews and record the emergence of theoretical coding as shown in step five.

Unlike statistical validity, GT is concerned with theory validation (Charmaz 2006; Cho and Trent 2006; Glaser and Strauss 1967). The mechanism of theory validation in GT is theoretical sampling as shown in step six. Theoretical sampling in GT is the critical analytical step that involves both negative (non-PBL) and positive (PBL) instances. By proposing categories and relating them to one another, and then testing those relationships in follow-on interviews theoretical sampling and constant comparison raise codes into theoretical categories as shown in step seven (Charmaz 2006; Glaser 1992).

The final analytical process, shown in step eight, involves relating the theoretical categories into an emerging theoretical structure or framework (Charmaz 2006). Establishing relationships and then testing these relationships leads to saturation. Saturation is associated with validity in qualitative research (Bowen 2008; Cho and Trent 2006), and involves gathering new data, until no new insights are obtained, no new themes are identified, and no issues arise regarding a category of data (Bowen 2008; Cho and Trent 2006; Strauss and Corbin 1998). As suggested by Cho and Trent (2006) the veracity of qualitative validity resides in the rigor of the approach used to achieve saturation. Saturation results in theory emergence as shown in step nine. In this research, saturation, and thus validity, occurred when additional interviews demonstrated a consistent group of constructs and consistent relationships between the constructs. In this research, saturation was achieved in the 61st interview.
We conducted a number of member-checking sessions with senior executives, senior managers, engineers, program managers, and logisticians familiar with performance-based strategies to ensure adequate fit. Flint et al. (2002) suggest researchers evaluate “fit” with practitioners to determine whether the researchers’ interpretation is consistent with the data. Fit means that the data, the analysis and the emerged theory, fit with the environment as interpreted by experts (Flint, Woodruff, and Gardial 2002). To gain fit, we presented the GT to an industry summit comprised of more than 40 first- and second-tier suppliers, supporting both PBL and non-PBL programs. In addition, the framework and propositions were presented at a conference of over 200 industry and government sustainment managers. During these sessions, professionals familiar with both PBL and traditional sustainment verified the proposed construct definition and relationships.

RESULTS

The grounded theory methodology emerged a theory of performance-based logistics; this is represented by the theoretical framework as shown in Figure 2. The framework depicts the theoretical structure for PBL and provides considerable insight into SDL as a foundation for a general theory of exchange (Lusch and Vargo 2006). Four antecedents are identified. The antecedents influence the performance-based decision process. The decision process produces several effects that create continuous value for the end-user. The performance outcome focuses inter-organizational and intra-organizational activities to create supply chain alignment. The core process of PBL is a knowledge and decision mechanism where supply chain knowledge is converted into value.

The results section is organized by using the categories and relationships depicted in the framework: antecedents; decision processes; effects; and outcomes. Each section begins with an overview of that category followed by a table defining the category and the corresponding codes that emerged during the qualitative analysis. The discussion concludes by describing the emerged categories and relationships.

FIGURE 2

THE PERFORMANCE-BASED THEORY FRAMEWORK
Antecedents

Four categories of antecedents emerged: collaboration dynamics; organizational leadership; information systems; and environment. The antecedents influence the amount of knowledge and resources available from the supply chain to influence the decision process and create improved performance. A discussion of each of the antecedents and their associated codes follow.

Collaboration Dynamics Antecedent

Unlike transactional sustainment, research participants characterize PBL as collaboration. Table 3 outlines this antecedent and associated codes.

<table>
<thead>
<tr>
<th>Category: Collaboration dynamics</th>
<th>Collaboration involves integration, shared goals, governance, co-management, roles, and rewards. Collaboration is a partnership, a relationship, and a management mechanism (e.g., collaborative investment in reliability improvement).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code 1: Integration</td>
<td>Performance outcome requires a single entity integrate supplier network activities. Integration links achievement of an outcome with network members’ actions. Effective integration requires system knowledge, authority, and leadership ability.</td>
</tr>
<tr>
<td>Code 2: Co-management</td>
<td>Supply chain co-management, between the suppliers, the OEM, and the customer, coupled with knowledge sharing, provides an adaptive strategy that maximizes value for all exchange partners.</td>
</tr>
<tr>
<td>Code 3: Flexible response capability</td>
<td>PBL is dynamic, the PBL economic model affordably adapts to changes in the operating environment, changes customer requirements, and the emergence of new material, process, and technology improvements in search of superior solutions. This drives flexible response structures.</td>
</tr>
<tr>
<td>Code 4: Incentive</td>
<td>PBL links decisions with incentives by rewarding achievement of customer value as represented by performance metrics. Incentives result from shared future cost avoidance. Cost avoidance spurs upfront capital investment and alignment of the supplier network.</td>
</tr>
</tbody>
</table>

Supply chain collaboration, focused by network integration, aligns supply chain management, investment, response, and reward, to improve value for the entire supplier network and the customer. According to a manager on a multinational PBL program, the key is an organization that focuses the supplier network:

You need organizationally someone who understands the whole network and how the whole thing is put together, so that you can then model and predict what trends are occurring and what to do to get the trends to go better.

Integration. The integrator aligns supply chain investment, knowledge, and decisions to improve system level performance. The integrator acts as the network entrepreneur, bundling knowledge and capital resources to achieve the end user’s requirements. A senior logistician explained how this occurs:

Integration is really the functional aspect of managing relationships. You have to make sure the right knowledge is getting to the right place, at the right time, and make sure that all of the players have the information they need. You have to understand what impact an activity will have over the long term. Part of achieving the performance requirement is making sure everyone understands the requirements...at some point someone has to define what the total (supplier network) architecture is.
The criticality of integration is consistent with qualitative research from Ogden et al. (2005) who suggest that integration is emerging as the aligning construct in supply chain management. The integrator uses system knowledge and leadership to improve supplier network decisions and increase the value potential of the supply chain. According to a senior business manager working for an OEM integrator:

_So how do we (as the primary system integrator) take the industrial base that we have and see how that fits into the global supply chain system that we are putting together? ... Because we are selling a service ultimately, not parts. We are in it to make a profit, but we are also in it to bring a reduced cost for sustainment to our customer._

The integrator aligns supplier network objectives (profit) and supplier resources (knowledge and capital) to meet end-user objectives (performance and affordability). Alignment through financial performance allows PBL to predict the supply chain competitive position and a firm’s position within that supply chain. The integrator uses incentives to align network behaviors, define outcomes, and enable decision cycles. As stated by a senior PBL strategy manager:

_Your business decision cycle, your performance incentives, and your performance outcomes have to be aligned. If you can align those three things, your chances of success are multiplied immensely. Your decision cycles, what you reinforce, what you are trying to achieve are all aligned with an output type of metric as opposed to transactional sub metrics...then you can optimize toward the end-result that you really want._

**Co-management.** Co-management involves trust, communication, collaboration, and shared risk and reward. PBL involves collaboration between the suppliers, the OEM, and the customer to manage activities and maximize value for all trading partners. According to a PBL manager:

_I was very fortunate to work on a PBL program in which the OEM and the government had a good working relationship. The government personnel had a close working relationship with the contractor logistics, engineering, and contracts personnel. There was a very big team (co-management) environment.....it took a lot of trust on everyone’s part. It took communication and trust and they sound very simple like simple things, but that is what you need to be successful._

Similar to SDL, co-management in PBL relies on improved trust and communication to co-create value.

**Flexible response capability.** The outcome focus of PBL is inherently dynamic. PBL is structured to anticipate and adapt to changes in the environment, the customer, and the supplier network. PBL rewards responses that affordably act on new technology, materials, knowledge, and processes that create lower cost and higher performance solutions. As stated by one manager, PBL logisticians are “entrepreneurial.” That entrepreneurship requires flexible response. PBL relies on upstream suppliers to create innovative solutions, as one manager stated, “the vendors have that knowledge.” The supplier is the most likely source of a knowledge-based improvement. The centrality of supplier knowledge in PBL contrasts sharply with the trickle down, transactional approach to reliability improvement in traditional sustainment.

**Network incentive structure.** Incentives, based upon achievement of the metrics, align investment and decisions. Upfront capital investment is encouraged by the prospective of harvesting any cost avoidance resulting from that investment. The harvest represents the difference between the agreed to multi-year fixed price and the new cost incurred by the supplier network. By improving reliability and logistics processes, these upfront investments reduce future costs. PBL converts these pools of cost avoidance into a performance-based incentive. The supplier network harvests any cost savings for a predetermined period to recoup and reward their investment and risk. Periodically, new baselines are established for supplier performance and costs. The new baselines pass cost savings on to the customer. This incentive creates a return on investment business model as opposed to return on sales (repair), as summarized by a new business development (PBL) manager for an OEM:
What you want to do is incentivize the supplier to make their product better. Today the sustainment world is based upon return on sales (repair), not a return on investment. You want to get the supplier to shift their business model from a return on sales to a return on investment.

Properly balanced, this mechanism provides a win-win strategy that uses cost avoidance as a means to improve supplier return on investment. As stated by a contractor field representative:

> Ultimately, we (industry) would like to see a longer-term contract to incentivize behaviors. Currently, generating investment is hard to do with one-year money. I cannot make a business case with my folks for investment because I have to recoup that within a one-year contract. With longer-term contracts, I can leverage the beauty of business community and make a case for us to invest in reliability... if I'm out there solving the problem, and can guarantee performance at the level of the metric, then I know I can generate return on our investment.

The metrics focus the network members’ efforts on generating innovation by tapping into supplier knowledge and investment. The network learns, and receives a reward, if management can create and apply new knowledge, thereby leading to a more cost effective solution. The incentive structure drives a shift in mindset that sets PBL apart from traditional sustainment.

> PBL requires a mindset switch with your supplier base. You have to incentivize the supplier to do things for you that you are doing for the customer. In the prior contracting strategies, you were in the same kind of transactional (repair based) relationship with the supplier that the customer has with you (paying to repair parts as they break).

--- PBL manager

Organizational Leadership Antecedent

PBL evokes an entrepreneurial approach to supply post-production support. Sustaining that culture requires the proper leadership. Organizational leadership transforms that culture from a focus on traditional sustainment activities to a focus on achieving PBL outcomes. Table 4 summarizes this antecedent and its codes.

<table>
<thead>
<tr>
<th>Category: Organizational leadership</th>
<th>Organizational leadership aligns the supplier network with the customer’s and organization’s objectives. The organizational leader adapts and applies resources to achieve firm-network objectives.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code 1: Influence a performance oriented mindset</td>
<td>Organizational leaders educate employees on the logic of PBL. Leaders foster performance-oriented decisions by rewarding employees efforts that harvest cost avoidance to create return on firm investment.</td>
</tr>
<tr>
<td>Code 2: Linking network and firm strategy</td>
<td>PBL provides a metric that aligns supply chain behavior. Organizational leaders align the firm strategy in a way that maximizes firm performance while meeting network objectives.</td>
</tr>
<tr>
<td>Code 3: Promote PBL competencies</td>
<td>The dynamic nature of PBL requires structures that disseminate, harvest, and act on knowledge to achieve a desired outcome. PBL leaders provide resources to create competencies and structures that support this new business model.</td>
</tr>
</tbody>
</table>

Influencing a performance oriented mindset. PBL engenders an entrepreneurial approach to supply chain management. When asked to define PBL, one manager stated: “I believe it is a mindset.” As stated by another manager, “what I was telling my folks is the mindset has to change.” The interview segments suggested that PBL mindset is an orientation that seeks knowledge and makes decisions focused on long-term potential for return on investment. This orientation drives a causal understanding of how decisions and resource expenditures affect the
PBL outcome. PBL is a dynamic approach that continuously adapts decisions and network resources to achieve customer value. The approach recognizes what is optimal today may not be optimal tomorrow. As stated by one manager involved with converting a non-PBL program to a PBL program: “I am excited about PBL, I have been waiting a long time to be allowed to do smart things that get results.” PBL requires a transformational organizational leadership culture that manages risk, investment, and knowledge to achieve performance-based outcomes. PBL adopts an entrepreneurial approach to sustainment. As stated by one logistician:

“Our resource managers are being entrepreneurial...they have this mindset, and they have good decision support tool sets...They understand the needs of the war fighter... By helping our people with better decision support tools we get a better product. We think we have good people, but it is not just the good people. By giving them good information to make their decisions and to do their planning with, that is this entrepreneurial piece of PBL.”

The decision process in PBL rewards a mindset that couples knowledge of improved processes, material, and solutions to create decisions that improve outcomes. This mindset seeks new solutions to old problems. This dynamism rewards leaders who clearly articulate network level goal, aligns activities, and fosters a culture that encourages, rewards, and protects those individuals who act with an entrepreneurial mindset.

Linking network and firm strategy. PBL leaders link their firm strategy to the performance objective to create profit opportunity. The return on investment strategy requires leaders align their firm’s activities with their supply chain partners to leverage knowledge in a way that creates opportunities for cost avoidance. As stated by a senior manager for an OEM integrator:

“The buyers are used to just buying parts for the product and building the product. I had a briefing where I had to stress to the buyers, that their job is now a 30-year job. Now every month they must focus on our performance standards. That is what our pay is based upon now (performance), we are not going to be paid based on the parts that are breaking.”

Promote PBL competencies. Converting knowledge into improved performance and return on investment requires competencies and structures that support decision-making across the supply chain. The non-static nature of PBL requires structures that harvest, disseminate, and act on knowledge to achieve a desired outcome. Senior leadership must resource competencies and structures that support this new business model.

Information Systems Antecedent

The centrivity of knowledge requires strong information technology linkages between trading partners and the end-user to facilitate the rapid exchange of information and new learning. Table 5 demonstrates this antecedent and its codes.

### TABLE 5

<table>
<thead>
<tr>
<th>Category: Information systems</th>
<th>PBL requires a robust IS infrastructure to create value. Knowledge in PBL is only valuable in use. IS strategy, architecture, and sharing require an open and accessible approach to knowledge management.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code 1: Strategy</td>
<td>IS strategy supports extensive knowledge sharing. These systems provide an audit trail as to how supplier decisions affect performance outcomes and provide mechanisms to reward those decisions.</td>
</tr>
<tr>
<td>Code 2: Architecture</td>
<td>The supply chain decision process requires an IS architecture that makes knowledge widely available.</td>
</tr>
<tr>
<td>Code 3: Information accessibility</td>
<td>Information is valuably when it is available to the right individual, at the right time. Knowledge is only valuable when it is in use.</td>
</tr>
</tbody>
</table>
**IS strategy.** PBL requires real time information on how network decisions affect performance. Managers act on knowledge from the suppliers, customer, and integrator to improve outcomes. IS strategy must align and enable supply chain decisions that convert knowledge into performance.

**IS architecture.** Planning, forecasting, predicting, and evaluating how decisions affect performance outcomes requires a robust IS architecture. As one senior executive stated: “if you want better decisions, you need better decision support systems.” The achievement of dynamic performance outcomes requires an IS architecture that provides a clear, auditable, link between a decision and its effect on performance to achieve incentive-based learning.

**Information accessibility.** Knowledge is valuable when acted upon to achieve a performance outcome. PBL frequently creates tension between a need for broad knowledge sharing and more typical approaches that guards proprietary information. According to one logistics information manager: “you have to have access to data and be able to analyze the data to make the most cost-effective decision.” During another meeting between the OEM, customer, and upstream suppliers, a logistics new business strategy manager stated:

> I want (part failure/performance) information shared throughout the pipeline. We have to kill the information is power culture...I want the ability that when a part fails, even in flight, I want to hear about that failure back here as the integrator, and at the vendor, so that the vendor is already looking forward... it's a supply chain thing. We need to just open this whole thing up to give everyone visibility.

**Environment Antecedent**

PBL projects typically involve some type of public-private partnership and operate in supplier networks that span states, regions and nations. The public nature of PBL programs means that the socio-political environment will influence the outcome of the network. Table 6 describes the antecedent and its related codes.

**TABLE 6**

**ENVIRONMENT ANTECEDENT AND CODES**

<table>
<thead>
<tr>
<th>Category: Environment</th>
<th>PBL projects frequently involve considerable cost and involve services that are of interest to the public. Factors external to the network impact the outcome produced by the network.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code 1: Regulatory policy</td>
<td>PBL projects, due to their expansive public nature, are influenced by regional, national, and transnational regulatory policy.</td>
</tr>
<tr>
<td>Code 2: Supplier base</td>
<td>The knowledge resources of a particular supplier base impact the network’s ability to improve performance outcomes.</td>
</tr>
<tr>
<td>Code 3: Public perceptions of PBL</td>
<td>PBL moves beyond the cost reimbursement of traditional sustainment to create cost avoidance return on investment opportunity. If that return is perceived as “too great” for a public program then investment will be curtailed.</td>
</tr>
</tbody>
</table>

**Regulatory policy.** The size and public-private nature of PBL means that regulatory factors are likely to influence the ability to execute a PBL program. One manager explained how a federal law restraining multi-year contracts limits investment and forgoes future year savings. Another manager discussed how regulations curtailed their ability to reinvest cost savings generated by a government operated repair facility. In both cases, institutional constraints reduced management’s ability to improve performance.

**Supplier base.** Participants shared the belief that the declining supplier base, especially among small- and medium-sized vendors, constrained performance. One manager stated: “we have a number of complex issues, diminishing manufacturing sources and material related challenges are a part of all of that.” In the past, small- and medium-sized firms provided knowledge and technology that improved performance. These small- and medium-
sized firms represent essential sources of innovative knowledge. Participants suggested that PBL requires more high quality suppliers.

*Public perceptions of PBL.* In our interviews, we found managers using words other than profit, or high profit, to discuss financial success on government programs. Several participants contend the shift to a price based, return on investment, contract structure may be difficult to implement and sustain due to negative perceptions. The possibility exists that lawmakers or media will perceive future year financial performance as being too profitable when taken out of context of prior year investment.

**Performance-based Decision Process**

Performance-based decisions are those made in supplier networks that act on acquired knowledge or changes in the environment. PBL drives a shift from transactional, product-based relationships to collaborative, knowledge-based relationships in the supply chain. Knowledge and its creation play a central role because decision-makers must continually create value for the end-user and other stakeholders in the supply chain. Decision-makers must know what knowledge exists and where it resides in the supply chain. Value creation results from decisions that act on this knowledge to improve performance, reduce costs, or both. PBL requires that decisions respond to any changes or new opportunities on a recurring basis at multiple levels in the supply chain. A decision response includes management action to align, or realign, supply chain performance with changing performance requirements at the end-user level.

The process occurs on an ongoing basis as decision-makers acquire knowledge or identify opportunities to increase value. The performance-based outcome “pulls” decisions through the process. For example, demands received from the end-user for repair or replacement parts may lead to a decision to redesign a sub-system to eliminate the failures. Value increases through increased system reliability and reduced transaction costs. Knowledge acquired or created in the supplier network may also “push” decisions through the process. Suppliers may develop new technologies or become aware of innovations that could be used to generate additional value. For example, the development of composites in other applications may be applied to the end-user’s system (e.g., aircraft, trucks). The use of lighter composites reduces fuel consumption for the end-user, and reduces manufacturing and material costs for the supplier network.

Table 7 outlines the performance-based decision process construct and associated codes.

**TABLE 7**

| Category: Performance-based decision process | Converts knowledge into value through management decisions. PBL operates in a dynamic environment where existing and newly created knowledge is used to increase value for all of the stakeholders in the supply chain. |
| Code 1: Knowledge awareness | Better knowledge leads to better decisions. Knowledge allows the supplier network to continuously increase value through improved performance or lower costs. |
| Code 2: Decision response | Converting knowledge into value requires resources and structures that support innovation. |

**Knowledge Awareness**

PBL leverages the supplier network’s ability to acquire and create knowledge to improve performance. Suppliers are valued for their ability to achieve current performance levels and to create additional value in the future. Knowledge is converted into value when decision-makers in the supplier network sense the value of knowledge and are incentivized to respond through value-producing decisions. When asked who has the knowledge necessary for improving performance at a lower cost, a senior manager responded:
The vendor in my opinion; the vendor is most capable of fixing the product, because they know so much and know the product so well.

**Decision Response**

PBL establishes network response structures that act on knowledge of the end-user’s requirements and within the supplier network to improve performance. According to two different managers working for a major aerospace firm:

*We have to have knowledge of everything that impacts the mission capable rate.*

*On one PBL program we combined field (OEM) representatives with computerized diagnostics tools. The computer would capture the fault codes and what worked. That information would go on the (ERP) system. Then other field representatives would get updates every night on their home computers. So this learning was shared; if I get this set of circumstances and this problem, here is the answer.*

Responsive decision-making enables PBL to exploit knowledge within the supplier network and adapt as necessary to create value. Decision-makers must continually respond to changes resulting from the dynamic environment in which the supply chain operates to meet customer requirements for improved performance and affordability. To develop an effective response, decision-makers must draw on knowledge regarding the customer, competitive offerings, technological advances, the environment, and capabilities within the supply chain. The outcome of the decision response must be linked to a tangible effect on end-user value. An entrepreneurial mindset is essential for providing an effective decision response. Decision-makers encourage and foster the continual development of ideas that may lead to new solutions or additional value.

PBL shifts the orientation of decision-making and supply chain management away from a product-dominant orientation and instead aligns and rewards decisions that convert knowledge into value for the end-user. In this regard, PBL exhibits several similarities with the service-dominant orientation of SD-Logic. “Effective market sensing and sharing of information” (Day 2006, p. 90) are used to create new value propositions for the customer. “Long-term relationships with stakeholders, suppliers, employees and competitors” (Hunt and Madhavaram 2006, p. 79) represent potential sources of knowledge on which decision-makers can act to provide new and innovative solutions for the customer. Both PBL and SDL rely on a decision process that uses knowledge and an entrepreneurial mindset to understand, adapt, and make decisions that respond to ever-changing customer requirements.

**Effect of the Performance Decision Process**

PBL outcomes are the result of knowledge-based processes. Decision effect is that tangible link between the decision and the impact the decision has on an outcome. Effect is an intermediary step that converts decisions into value. The decision process creates an effect (e.g., improvement of inventory management), and that effect produces an outcome (e.g., reduction in expenditure).

Managers continuously evaluate alternatives to improve performance in PBL. Decisions are re-evaluated based on knowledge of new material, processes, and technology. As stated by a U.S. Government overhaul facility manager:

*To reduce, or control costs; and the predominate cost is in repair. You can do it one of two or three ways. Either find a lower cost repair source in terms of labor rates, you can find a way to improve the reliability of that part, or you improve the repair process.*

The primary effects in PBL strategy include supply chain management (SCM), system reliability, improved process management, and resource use. Table 8 outlines effect and its associated codes.
TABLE 8
EFFECT

<table>
<thead>
<tr>
<th>Category: Effect</th>
<th>Decisions do not directly create performance. Decisions create effects that improve performance and increase affordability.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Code 1:</strong> Supply chain management (SCM)</td>
<td>SCM involves those processes and functions that occur to maintain and sustain a system. Effective SCM results in a system being kept in service, or being returned to service, as cost effectively as possible.</td>
</tr>
<tr>
<td><strong>Code 2:</strong> Reliability</td>
<td>System sustainment involves a constant evaluation of spare or redesign. Reliability represents decisions that reduce the need to spare or repair.</td>
</tr>
<tr>
<td><strong>Code 3: Maintainability and repairability</strong></td>
<td>A significant cost in sustainment is the labor and logistics cost of repairing a system when it fails (unscheduled maintenance) and maintaining a system in a proactive fashion (scheduled maintenance). PBL rewards improved methods that reduce the cost associated with maintenance and repair.</td>
</tr>
<tr>
<td><strong>Code 3: Resources</strong></td>
<td>Decisions in PBL represent a constant balancing of implementation costs against the potential cost avoidance.</td>
</tr>
</tbody>
</table>

**Supply Chain Management (SCM)**

SCM incorporates multiple, material, processes and information flows spanning multiple trading partners and the end-user. SCM seeks to satisfy demand either by providing the required levels of spares at least cost, or by determining how to reduce demand through some type of innovation. In the near-term, PBL managers focus on ensuring the right parts are at the right location at the right time at the least cost. In the long-term, decisions are made using a multi-year perspective to minimize total cost through system improvement. As stated by a senior industry manager:

> The system availability metrics has two aspects to it. It has the supply chain aspect, and the metric has a [product] design aspect [reliability]. If we are going to increase performance, you have to give us a reliability improvement curve. You have to have that design element in the metric, or the supplier could just fill the supply chain with parts.

**System Reliability**

PBL provides greater reward potential for investment driven improvement than sales-driven repair. Improved reliability reduces the volume of repair transactions, decreases sustainment costs, and improves system performance. PBL uses supplier knowledge and investment to improve the reliability of the system, decrease cost, and then share in that cost avoidance. Suppliers typically have the greatest knowledge of where opportunities exist to improve products and reliability. Typically, upstream suppliers have lower costs and greater cost avoidance potential. Cost effective reliability improvement, over the long-term, reduces sustainment costs.

**Maintainability and Reparability Improvement**

Decreasing the expense of the maintenance and repair processes improves affordability. Maintainability involves making decisions that reduce the cost associated with keeping the system in service. Reparability involves returning a component to service. The aerospace industry incurs a significant expenditure on maintenance and repair activities (Sauser 2006). As stated by one OEM manager discussing public-private repair partnerships, combining reliability with repair process improvements can avoid significant future costs and improve long-term affordability.

> If you look at the process for an average repair, say it takes 15 hours for tear down and evaluation, and 20 hours of touch labor. Then there is another 15 hours for testing, packaging, etc. That entire time you used is 50 hours. If you could take that 50 hours and make it, say 40. Not only have you decreased the time that it takes for repair, but also the dollar figure of that cost. So if you can incentivize the OEM to give the repair agency a better tool, better diagnostics, faster testing, better material, and packaged in there, the repair organization is doing real value touch
labor. Then the repair agency has incentive to reduce because the agency is incentivized with those dollars saved from the 10 hours.

---OEM PBL Manager discussing private-public repair agency partnership

Resources

The overall effect of a decision takes into account the resources consumed to generate effects on SCM, reliability, and maintenance and repair. The efficiency of a decision is then the ratio of cost avoidance created by a decision, compared to the amount of resources consumed implementing that decision. The integrator, by creating a link between decisions, the co-created metric, cost avoidance, and the incentive, creates performance based learning driven by a rational desire to maximize that incentive (profit).

Outcome

PBL rewards decisions that generate continuous value. As shown in Figure 2, the effects of the decision process create three outcomes: achievement of customer value; customer/network financial performance; and an increased understanding of customer value. Table 9 summarizes this construct and its codes.

<table>
<thead>
<tr>
<th>Category: Outcomes</th>
<th>Decisions create effects that generate outcomes. The outcome, not the product, is the focus of PBL. The outcome provides value to the exchange partners.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code 1:</td>
<td>The performance metric aligns the supplier network on customer value. Value is in performance, not product.</td>
</tr>
<tr>
<td>Customer</td>
<td></td>
</tr>
<tr>
<td>performance value</td>
<td></td>
</tr>
<tr>
<td>Code 2:</td>
<td>PBL creates supply chain alignment that results in financial value for the customer and network. For the customer value means increased affordability. For the network, value means profitability.</td>
</tr>
<tr>
<td>Financial</td>
<td></td>
</tr>
<tr>
<td>performance</td>
<td></td>
</tr>
<tr>
<td>Code 3:</td>
<td>The knowledge based decision process of PBL aligns the supply chain by learning what constitutes value for the customer and how that value perception evolves over time. Knowledge of customer value, as it evolves, protects against extra-network competition.</td>
</tr>
<tr>
<td>Knowledge of</td>
<td></td>
</tr>
<tr>
<td>customer value</td>
<td></td>
</tr>
</tbody>
</table>

Customer Performance Value

The customer judges the network value proposition. The customer defines the what (in terms of value), and the network determines the how. The incentive structure aligns superior decisions, knowledge-based solutions, and financial reward in the supply chain on customer value. The following statement from a consultant advising firms on metric-based customer value illustrates how PBL aligns decisions toward a customer objective.

The decision cycle has to link to how you reinforce behavior or incentivize behavior. One without the other, over time they will default to whatever sub-optimized solution you have. I think one of the challenges on the table, to make PBL really work, is that you have to have the right incentive... You have the right kind of metrics, and they have to align to our objective.

The metric defines in operational terms the performance outcome desired by the customer. PBL shifts the supplier network from a product delivery focus, to delivery of performance-based outcomes the meet customer needs. This concept was captured by statements made by a customer, and an OEM field representative:

In a product base strategy, you are only interested in delivering what is on the contract. Whereas in an outcome-based strategy you are interested in providing the service that meets a need of your customer.
PBL is recognizing what the customer wants and being responsive to what they are asking for.

PBL aligns the supplier network to create a structure that provides continuous value in the form of a performance metric.

**Financial Performance**

The supply chain creates financial value by implementing decisions where the net present value of the harvested cost avoidance is greater than resources expended to generate that avoidance. PBL uses projected sustainment spending as a potential source of return on investment for the supplier network, as stated by an OEM supplier manager:

> Commercial companies go after a market. If they can see that they can get into that market. What they do is they exploit that by updating their product all the time, to keep that market share. This is the same thought process that our vendors are in, because a lot of them are doing commercial work. On the government side we have to get them to understand that this could be a market (environment); meaning that the contractor can have long-term market share in this. So it behooves you to improve your product; to keep that market share.

Customer financial performance improves when the supplier network harvests a return on investment and a new price is established for the customer.

**Knowledge of Customer Value**

PBL improves the competitive position of the supplier network by providing them with an increased understanding of customer value, and how that sense of value evolves. PBL creates an iterative dialogue through the performance evaluation and feedback process. The dialogue reveals the customer’s evolving sense of value and shapes expectations with respect to network capability. The network and the customers share knowledge regarding the product, the environment, and value. This dialogue is sustainable as long as network decisions, based upon new knowledge, spur investment that produces effects that lead to long-term cost reduction and performance improvements.

**CONCLUSIONS**

This grounded theory investigation identified constructs and relationships that form a theoretical framework for performance-based logistics. The research applied insights from SDL and its fundamental premises as a “lens” through which an underlying structure for PBL emerged from the investigation. Grounded theory enabled the research to use the existing literature to gain an initial context. The research then moved away from literature to allow a grounded theory to emerge based upon the observational findings.

The research found that the performance-based strategy framework (Figure 2) is consistent with SDL. The framework provides a knowledge-based structure and philosophy for PBL that is also consistent with the fundamental premises of SDL. This framework has significant implications for SDL and supply chain management research and practice. PBL shifts the focus of the trading partners in a supply chain from working independently to deliver a product, to working collaboratively to produce a service-based performance outcome. The key contributions of this research are described in the next section. The article concludes with suggestions for future research and a summary.

**Contributions**

This research provides two major contributions: (1) introduces SDL to the SCM community and demonstrates the potential of SDL to serve as a foundation for investigating supply chain phenomena; and (2) provides a theoretical model that depicts the antecedents, knowledge processes, and outcomes of a PBL approach.
Introduction of SDL

The literature review and the analysis introduce SDL and its fundamental premises to the SCM community. PBL’s performance-based outcomes represent an operationalization of Vargo and Lusch’s (2004) conceptualization of service. Vargo and Lusch (2004, p. 3) define service as:

*The application of specialized competences (knowledge and skills) through deeds, processes, and performances for the benefit of another entity or the entity itself.*

The decision process within the framework (Figure 2) provides the mechanism through which specialized knowledge and value are converted into performance-based outcomes.

The investigation demonstrates how the SDL premises of knowledge centricity, customer co-creation, and integration, make SDL particularly applicable to supply chain research and practice (Flint and Mentzer 2006; Lambert and Garcia-Dastugue 2006; Vargo and Lusch 2004; Woodruff and Flint 2006). PBL is consistent with the premises of SDL. Table 10 reviews the SDL premises and then reinterprets them using the PBL framework. As shown in Table 10, significant consistency and support exist to support the conclusion that PBL represents a theoretical and practical application of SDL.

Theoretical Understanding of PBL

The theoretical framework (Figure 2) depicts the antecedents, knowledge processes, and outcomes of a PBL approach. The emerged theoretical model suggests an explanatory theory for PBL and can be stated as:

Performance-based outcomes will lead managers to co-create and exchange knowledge across a supply chain to achieve continuous value creation for the end user and the entire network.

The theory suggests that the co-creation and exchange of knowledge increase the likelihood that the customer and supplier network will achieve superior performance over time. In this exchange, products merely transmit and service performance requirements. The metric provides an incentive-feedback mechanism that drives learning and supplier investment. Supplier networks achieve a competitive advantage when new knowledge results in management decisions that improve performance and generate additional value for the customers and the entire network.

PBL uses knowledge within the supplier network to improve performance. Through the exchange and co-creation of knowledge, the supplier network augments core skills and resources while simultaneously generating economies of scale based on their complementary resources. This finding is consistent with other supply chain research that suggests supplier network structures are critical to achieving success in the global market place (Mentzer, Min, and Zacharia 2000; Santos 2004). The increasing complexity of modern supply chains makes cooperation between trading partners necessary for them to compete effectively (Christopher and Ryals 1999; Prahalad and Hamel 1990).

PBL is consistent with supply chain management concepts and frameworks. PBL and SCM represent strategies where customers, suppliers, manufacturers, and distributors form collaborative structures to achieve inter-organizational benefits that would not otherwise be possible if these entities operated independently (Kim, Cohen, and Netessine 2007; Lambert and Knemeyer 2004). PBL and SCM begin by defining customer value, then employ supplier network actions that seek to minimize cost associated with providing that value. Both SCM and PBL seek to meet customer requirements at least total cost. PBL defines a customer requirement by a performance metric and then seeks least cost to meet that metric by improving supply chain response, or making investments that decrease the supply chain demand by reducing failures. A total cost solution is created by making decisions that consider “all activities associated with the flow of goods from the raw materials stage, through the end-user, as well as the associated information flows” (Ballou 1999, p. 8). The goal of a total cost approach is to balance the interdependent nature of firm and customer activities that generate a superior value proposition (Langley 1980; LeKashman and Stolle 1965).
### TABLE 10
FUNDAMENTAL PREMISES, EXPLANATIONS, AND PBL INTERPRETATION

<table>
<thead>
<tr>
<th>Fundamental premise</th>
<th>Explanation—adapted from Vargo and Lusch (2004)</th>
<th>PBL interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FUNDAMENTAL PREMISE 1</strong>: The application of specialized skills and knowledge is the fundamental unit of exchange.</td>
<td>Value is measured in use; the application of knowledge resources through servicing of needs satisfies customers. Satisfaction of service requirements is the fundamental unit of exchange.</td>
<td>Performance networks exchange knowledge, skills, and resources to create continuous value. Knowledge and skills are intangible resources. PBL aligns supplier knowledge and resource to create customer and network value proposition.</td>
</tr>
<tr>
<td><strong>FUNDAMENTAL PREMISE 2</strong>: Indirect exchange masks the fundamental unit of exchange.</td>
<td>Indirect exchange based in micro-specialization and monetization masks the fundamental unit of exchange. Industrial production efficiencies distanced those performing tasks from the customer. Upstream suppliers seldom have a view of the entire product. This structure, unchecked, fosters slow degradation in quality to both internal and external customers.</td>
<td>The tangible PBL outcome, as represented by a metric, brings those performing value producing functions back into contact with the customers perception of value.</td>
</tr>
<tr>
<td><strong>FUNDAMENTAL PREMISE 3</strong>: Goods are distribution mechanisms for service provisions.</td>
<td>The market is centered on the application of specialized knowledge, and skills. Goods to serve as a vehicle to transfer knowledge and skill to satisfy higher order needs.</td>
<td>Products transmit embedded knowledge (e.g., superior test equipment); customers use products as appliances to create performance outcomes. Knowledge adapts to meet evolving customer value propositions. Products transmit performance.</td>
</tr>
<tr>
<td><strong>FUNDAMENTAL PREMISE 4</strong>: Knowledge is the fundamental source of competitive advantage.</td>
<td>Knowledge is at the core of competitive advantage. The application of specialized skills and knowledge is the fundamental unit of exchange. The primary inter-firm flow is knowledge with or without accompanying product. It is through knowledge that firms, aligned with partners, bring value to consumers. Knowledge, particularly knowledge based in supplier networks, harvested through co-creation, appears to be the essence of the SDL framework.</td>
<td>Value is defined as system performance and financial performance. Value is determined by the customer and the network. Value relates performance to cost. Supplier networks only make value propositions. Integration brings together the supplier knowledge resources to create a value proposition. Supplier network knowledge applied to the evolving value proposition creates competitive advantage.</td>
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<td><strong>FUNDAMENTAL PREMISE 5</strong>: All economies are service economies.</td>
<td>Knowledge and skill-based competition overcomes limitations with land, labor, capital, and manufactured output approach to judging and predicting competition. Knowledge-based skills and services more accurately predict overall economic value and competitive potential.</td>
<td>Wealth is obtained through the application and exchange of specialized knowledge and skills—a decision process. Wealth provides the supplier network the ability to use and create future knowledge-based resources. The supplier network provides a performance outcome that exchange is contingent upon customer acceptance and valuation of that network value proposition.</td>
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### TABLE 10 (cont.)

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<th>FUNDAMENTAL PREMISE 6: The customer is always a co-producer (co-creator).</th>
<th>The customer is the target of production in a product-oriented strategy. In a service-oriented view, the customer is a co-creator of the network value proposition. This customer orientation focuses the network on current customer needs while anticipating and adapting to future needs.</th>
<th>The customer is a knowledge resource. Customers are active participants in the co-production process. The customer establishes and continuously evaluates the performance outcome. The customer integrates and distributes their resources (knowledge and financial) to support maintain the network value proposition.</th>
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<td>FUNDAMENTAL PREMISE 7: The enterprise can only make value propositions SDL infers a dyadic sense of co-created value propositions where value is in co-creation, coupled with customer acceptance of value proposition. This implies the firm can only offer value propositions.</td>
<td>Wealth is obtained through the application and exchange of specialized knowledge and skills. The performance network obtains wealth by rewarding decisions that provide customers and suppliers with superior value propositions.</td>
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<td>FUNDAMENTAL PREMISE 8: A service-centered view is customer oriented and relational Service-oriented involves interactivity, integration, and customer co-production. These activities are inherently customer focused and relational. Doing things not just for, but also with customers, provides a balanced-centricity that hinges upon co-creation through learning. This requires, at the aggregate, relational structures supportive of knowledge sharing, dissemination, and response.</td>
<td>The customer and the supplier network co-create performance outcomes. The customer evaluates the network value proposition as performance in use. Integration decomposes customer value metric, rewards decisions that create value, which leads to network based learning.</td>
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<td>FUNDAMENTAL PREMISE 9: Organizations exist to integrate and transform micro-specialized competences into complex services that are demanded by customers in the marketplace. Integration motivates and facilitates exchange. Resource integration is at the heart of inter-firm co-creation of value. Integration is a dynamic process that bundles together micro-specialist and their resources, and aligns them through co-creation (understanding what people want) to create evolving value propositions.</td>
<td>Integration aligns supplier network activities on customer value. Integration decomposes customer value metrics to create a clear decision and response process. Integration is the highest form of network-based competency. Integration reduces supply chain transaction costs and inherently moves the make versus buy decision towards buy. Integration represents an extension into supply chain management of Coase’s (1937) firm-based entrepreneur.</td>
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The findings demonstrate that performance [service] provides evolving value propositions that subsume the product. The framework addresses research and execution issues in performance-based strategies:

*The two main roadblocks for the successful implementation of a PBL contract (which) are the appropriate selection of the figures of merit that represent systems effectiveness and the adoption of a sound and fair reward scheme that links reward to actual performance, indicating when appropriate how to deal with eventual underperformance regarding some figures of merit and over performance in others. Both areas should be subjects of further research in order to bring substantial improvement to them (Sols, Nowicki, and Verma 2007, p. 49).*
The theoretical framework explains the process through which co-created knowledge resources (Vargo and Lusch 2004) are generated and disseminated to the decision-maker. Within the process, metrics link decisions, performance, and incentive (reward) to generate performance-based learning. In doing so, PBL brings individuals performing tasks and making decisions back in contact with the customer (Vargo and Lusch 2004). Those supplier network firms able to leverage knowledge to create superior value propositions for the customer achieve a competitive advantage.

**Limitations and Recommendations for Future Research**

The findings provide a platform for future investigation into PBL and SDL. While this research is consistent with the practical implementation of PBL and the concepts within SDL, the investigation is based on inductive theory generation—that theory building process limits the generalizability of the research beyond the current context. Future research should empirically test the emerged constructs and their relationships to determine whether these relationships exist in other performance-based networks or service oriented markets.

**Summary**

PBL is an approach that represents a supply chain application of SDL. In PBL: (1) knowledge is the source of competitive advantage; (2) advantage is achieved though optimizing inter-firm supply chain relationships that increases knowledge competency; (3) customers are co-producers of value offerings; and (4) financial performance is driven by inter-firm knowledge-based value creation.

The introduction of SDL has significant implications for supply chain management research. SDL offers greater explanatory power for understanding knowledge intensive supply chain relationships that characterize a PBL and SCM. This investigation suggests that supplier networks, oriented toward a performance-based value proposition, represent an example of SDL in practice. This orientation has significant implications for SCM and market exchange research.

In their conceptualization of SDL, Vargo and Lusch (2004) describe how a service-dominant view reinterprets key elements of economic exchange. This investigation validates those suggestions by demonstrating, theoretically, a price-based, return on investment, SCM strategy consistent with SDL. This investigation demonstrates how integration harnesses network knowledge to create decisions that continuously improve performance outcomes.

The PBL framework (Figure 2) begins to address the call for a “theoretical framework of SCM” (Mentzer, Min, and Bobbitt 2004, p. 64). The research provides a foundation for Lambert and Cooper’s (2000) “normative model that can guide managers in their efforts to manage their supply chains.” The framework represents a normative supply chain theory that has actionable antecedents, a performance-based decisions process, and a measurable outcome. PBL theory suggests that by aligning the trading partner’s knowledge and decision processes with performance-based outcomes, supply chain management can create continuous value for the end-user and other stakeholders.

**REFERENCES**


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