A SCOR-BASED FRAMEWORK TO PORTRAY WOOD SUPPLY SYSTEMS – PRELIMINARY RESULTS FROM THE UNITED-STATES, FRANCE AND CHILE

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ABSTRACT

The work presented in this paper is a work package within the FlexWood project. It aims to develop a framework to describe, in a generic way, any wood supply systems (WSS) and enables some comparisons. In this paper, we provide a general description of this framework consisting of five main components (environment, strategy, structure, enablers and performance) and partly based on a forestry adaptation of the Supply Chain Operations Reference (SCOR) model. Preliminary results of the framework application are presented for the WSS of three countries (USA, France and Chile). The focus is on the decoupling point (i.e. the boundary between forecast driven and order driven planning) and the customization options in the cases studied. Ten locations of the decoupling point have been identified.

Keywords: Wood supply system, decoupling point, customization options, contingency theory, SCOR model

INTRODUCTION

The FlexWood (Flexible Wood Supply Chain) project is a major European Union funded research initiative. It uses the assumption that wood supply chains in the forest products industry are not able to make full use of the real value of raw materials. The objective of FlexWood is therefore to build a novel logistics wood supply system (WSS) that increases value recovery along the wood supply chain. This "FlexWood WSS" is based on the development and adaptation of logistics concepts that provide better information assessment on wood resources (e.g. aerial and terrestrial laser technologies), enhance optimization models, and increase flexibility and customization capabilities.

The work presented in this paper is a work package within FlexWood. It aims to develop a framework to describe, in a generic way, any WSS and enables some comparisons. The studied WSS spans from the procurement of commercial stands (i.e. both internally from own forestland and externally from purchase) to the delivery at the demand sites (i.e. mills gates, port or train terminal) and includes harvesting, primary and secondary transport and merchandising. WSS are complex system composed of actors, planning and execution processes, coordination mechanisms and information, material and financial flows.

Additional aspects to be addressed within the framework are the agility enablers, the competitive strategy and the customization options of the studied WSS. The results of the framework application on WSS in different countries will support the design of the "FlexWood WSS".

In Section 1, we introduce the five main components of the proposed framework. Focusing on the location of the decoupling point and the customization options in the WSS studied in three countries (USA, France and Chile), preliminary results of the framework are presented and discussed in Section 2. Concluding remarks are then provided.

PROPOSED FRAMEWORK

To support the description and the development of novel logistics concepts within FlexWood, we propose the utilization of a contingency-based framework. Contingency theory is an organization theory originating at the end of the 1960's, based on the open systems theory for organizational analysis (Stanley, 1993). Contingency theory has already been used in different studies in supply chain management, emphasizing that success in value creation is dependent on alignment between actions, structure and the external environment, assuming that there is no universal set of choices that is optimal for all businesses (Daft and Armstrong, 2009).

Combined to recent studies and frameworks on manufacturing and supply chain agility (e.g. Sharifi and Zhang, 1999; Lin et al., 2006; Baramichai et al., 2007), we propose to study and explain the match between external environment factors and the structure of a supply chain through the business and supply chain strategies, as well as specific enablers. A sustainable and competitive performance level of a supply chain is therefore contingent on its external environment through adequate choices of business and supply chain strategies, agility enablers and a supply chain structure. These descriptive elements are structured in five main components in the proposed framework (see Figure 1). The following subsections introduce the five components of the conceptual framework.

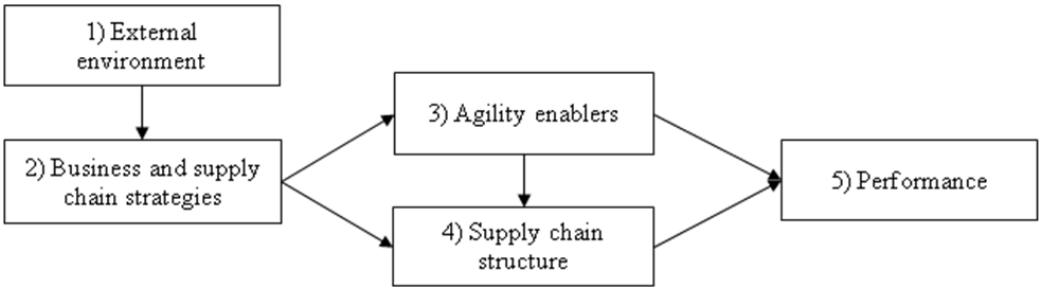


Figure 1: Conceptual framework.

External environment

One of the first and most influential approaches for external environment analysis is Porter's strategic analysis based on five competitive forces: bargaining power of suppliers, bargaining power of buyers, threat of new entrants, threat of substitute products or services and rivalry among existing firms (Porter, 1985). These forces have been combined with the SCOR model for supply chain analysis by Di Martinelly et al. (2009). An enhanced set of ten forces for environment analyses is presented by Daft and Armstrong (2009): internal industry sector,

raw materials, human resources, financial resources, market sector, technology, economic conditions, government, socio-cultural sector and international sector.

A complementary environment analysis is based on its uncertainty, which is a function of the complexity and instability in the aforementioned forces (Daft and Armstrong, 2009). Complexity means the number or heterogeneity of elements relevant to an organization's operations while instability means that some environmental forces shift abruptly and unexpectedly in a short time period (i.e. a matter of days in WSS). The greater the degree of environment uncertainty is, the greater the needs to develop an agile supply chain are, in order to be able to forecast, detect and react quickly and effectively to changes (Christopher, 2000).

By adding climatic considerations to the aforementioned forces, an external environment analysis based on eleven forces and their respective level of uncertainty makes it possible to specify objectively which are: i) the main drivers for agility and ii) the supply chain processes (see 1.4) impacted by the environment uncertainty.

Business and supply chain strategies

Competitive strategy addresses "how an organisation chooses to compete in a market, particularly the issue of positioning the company relative to competitors with the aim of establishing a profitable and sustainable position" (Hallgren and Olhager, 2006). Distinguishing among three major strategies for competitiveness (i.e. cost leadership, differentiation, and focus), the typology for competitive strategy of a company by Porter (1985) is probably the most well-known typology. Cost-leadership means that the company takes the competition head on, offering a product that is equivalent to those offered by competitors, but more efficiently (e.g. cheaper price). The differentiation is to avoid direct competition by differentiating the products and/or services offered to deliver higher customer value, making it possible to charge a premium price. The focus strategy is to target one or more market segments of the company's markets and apply one of the previous strategies in each targeted market segment.

Once the business strategy is defined, it is time to define the supply chain strategy, or how the supply chain processes shall be structured and coordinated to support the company in achieving its business strategies. From a value creation network perspective, the issue is to determine which of the processes should be executed and/or controlled by the organization, and which ones should be made by another enterprise. This is summarized by the strategic options of making, not making, outsourcing or making with someone else (D'Amours et al., 2010).

Agility enablers

The concept of organizational and manufacturing agility originated in the mid 1990's and has started to be spread and adapted to the supply chain field since the end of the 1990's (Li et al., 2008). Supply chain agility is composed of four dimensions: customer sensitiveness, information drivers, process integration and network integration (Christopher, 2000). Enablers, including best-practices, within these dimensions are specific to each industry or sector studied and therefore need to be contextualized and adapted. Moreover, the enablers make the linkage between the business strategy and the supply chain structure. The utilization of the adequate enablers supports companies in the WSS in achieving their business

objectives by "preparing, maintaining, and managing information and relationships upon which planning, sourcing, making and delivering execution processes rely on" (SCC, 2008).

To evaluate the level of acquisition of these enablers by a specific WSS, a four-level scale based on the competence management theory is proposed (Drejer, 2001; St-Amant and Renard, 2006). With this evaluation approach of supply chain agility enablers, it is possible to evaluate the level of agility of a WSS by supply chain process (see 1.4) and by agility dimension.

Supply chain structure

Due to its detailed description of the supply chain processes and their coordination (i.e. inputs and outputs), the SCOR model by the Supply Chain Council was chosen to describe WSS. Moreover, a promising first attempt of the SCOR model adaptation in WSS was made by Schnetzler et al. (2009). The SCOR model has been developed to describe the business activities associated with all phases of satisfying a customer's demand and is organized around five process types: Plan, Source, Make, Deliver and Return (SCC, 2008). For the description of the WSS, only the first four processes will be used (i.e. no Return).

In addition to the planning and execution processes, another important concept to include in the description of a supply chain is the decoupling point. Wikner and Rudberg (2005) define it as "the point in the flow of goods where forecast-driven production and customer order-driven production are separated" or, in other words by Rudberg and Wikner (2004), "the point in the value-adding material flow that separates decisions made under uncertainty from decisions made under certainty concerning customer demand (…)". Four typologies of decoupling point are traditionally defined: engineer-to-order, make-to-order, assemble-to-order and make-to-stock.

The decoupling point is sometimes referred to as the order penetration point (Wikner and Rudberg, 2005). It can also be referred to as the postponement point or where the product is differentiated, with alternative customization options (Poulin et al., 2006). This latter concept of customization refers to the design of offers to the market, including the corresponding manufacturing or service capacities, based on a targeted segmentation of customers. As quoted from Montreuil and Poulin (2005), the goal with customization "is to gradually develop the competitiveness of the firm by having an offer that closely matches the evolving personalized expectations of customers in the targeted segments and by having the capability to profitably deliver the offer on a reliable basis".

Performance

There is a scarce literature on supply chain performance measurement applied to WSS. The publications are mainly on performance measurement system dedicated to a fraction of the WSS (e.g. harvesting) and where the focus is on production metrics such as 'cubic metre per productive hour' or 'utilisation rate' (Drolet and LeBel, 2009). Recently, a computerized decision-support tool, ToSIA, has been proposed to measure the sustainability of an entire forest products industry chain, i.e. from forest regeneration to the end-of-life of forest products (Lindner et al., 2010). In the proposed framework, the first performance measures of the WSS are the agility evaluation in section 1.3 and the customisation capabilities (i.e. the customisation options offered to the wood customers).

PRELIMINARY RESULTS

Between August 2010 and March 2011, study stays in Southeastern USA (Alabama, Georgia and Mississippi), France (region of Aquitaine) and Chile (regions around Concepcion and Valdivia) lead to a total of 42 semi-structured interviews within 39 distinct organizations from the private and public sectors. Several WSS based on plantation of pines were studied in each country, specifically: full-tree harvesting method in Southern yellow pines (e.g. loblolly) plantation in US, cut-to-length harvesting method in maritime pine plantation in France and full-tree harvesting method in radiata pine plantation in Chile. Among these WSS, three main customization options (see Table 1) and ten locations of the decoupling point (see Table 2) were identified.

Table 1: Definition of the customization options

Customization options	Definition
Standard assortment	Product produced strictly to forecast and thus kept in inventory by the wood supplier.
Catalogue assortment	Products ordered by the wood customer from a list of available specifications provided by the wood supplier. These products are not kept in inventory and produced to order by the wood supplier. Note: the specifications of a standard assortment are included in the list of available specifications for a catalogue assortment.
Custom assortment	Product never produced before following new specifications (i.e. not included in the list of available specifications for a catalogue assortment). Designed by the wood supplier according to the requirements from a wood customer.

Table 2: List of the decoupling point locations

	Country		
Decoupling point location	**Usa**	**France**	**Chile**
Buy block-to-order	X	X	X
Start block harvesting-to-order	X	X	X
Adjust bucking pattern-to-order (in the block)		X	
Primary transport-to-order		X	
Felling specific tree-to-order & Primary transport-to-order	X		
Adjust bucking pattern-to-order (roadside)	X		X
Secondary transport-to-order (roadside)	X	X	X
Secondary transport-to-order (intermediate wood yard)		X	
Bucking-to-order (bucking plant)			X
Wood yard transport-to-order (on-site yard)		X	X

Adopting a representation inspired by Poulin *et al.* (2006), Figures 2 to 4 illustrate how the decoupling points relate to the main processes involved in the material flow in the WSS studied in each country. For instance, in Figure 2, the decoupling point can be at six different

locations from "Buy block-to-order" at the extreme left (forest side) to "Secondary transport-to-order" at the extreme right (wood customer side). All activities to the right of the decoupling points are linked to the demand of a wood customer (order driven). The activities prior to the decoupling points are made according to forecast of demand (forecast driven).

Symbolized by a rectangle, the customization options offered to the wood customers in the WSS studied in each country are illustrated at the top of Figures 2 to 4. A dotted arrow links the customization options to each process receiving the customer orders. For instance, in Figure 2, with the "standard assortment" option, there is only one decoupling point possibility, leading to only one process as order driven (Deliver-Secondary transport) and the five others are forecast driven. For the "catalogue assortment" option, there are five different possibilities for the decoupling point and two possibilities for the "custom assortment" option.

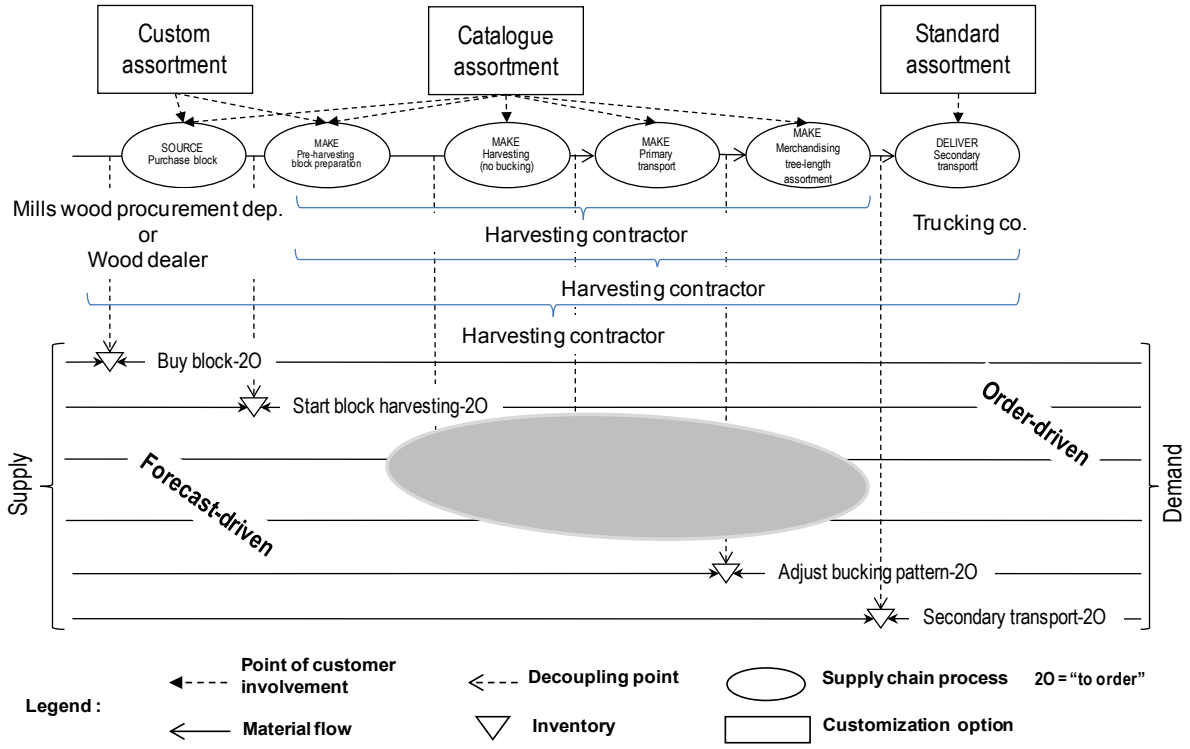


Figure 2: Decoupling points and customization options in the WSS in USA.

Table 3: Process-actor configurations in three WSS (USA, France and Chile).

		Actor						
Process		Bucking plant at the mill	Cooperatives	Harvesting contractor	Mills wood procurement department	Stocking yard at the mill	Trucking company	Wood dealer
Source	Purchase block		F3	U4, F4	U2, U3, F1, F2, C1, C2			U1
Make	Pre-harvesting block preparation			U1, U2, U3, U4, F1, F2, F3, F4, C1, C2	F2			
	Harvesting			F1, F2, F3, F4	F2			
	Harvesting (no bucking)			U1, U2, U3, U4, C1, C2				
	Primary transport			U1, U2, U3, U4, F1, F2, F3, F4, C1, C2	F2			
	Merchandising tree-length assortment			U1, U2, U3, U4, C2				
	Merchandising log assortment	C2		C1				
Deliver	Secondary transport			U1, U3, U4,	F2		U2, F1, F2, F3, F4, C1, C2	
	Loader transport	C2				F1		F1

Legend: *n* = {1,2,...} U*n* = scenarios in USA F*n* = scenarios in France C*n* = scenarios in Chile

Figure 3: Decoupling points and customization options in the WSS in France.

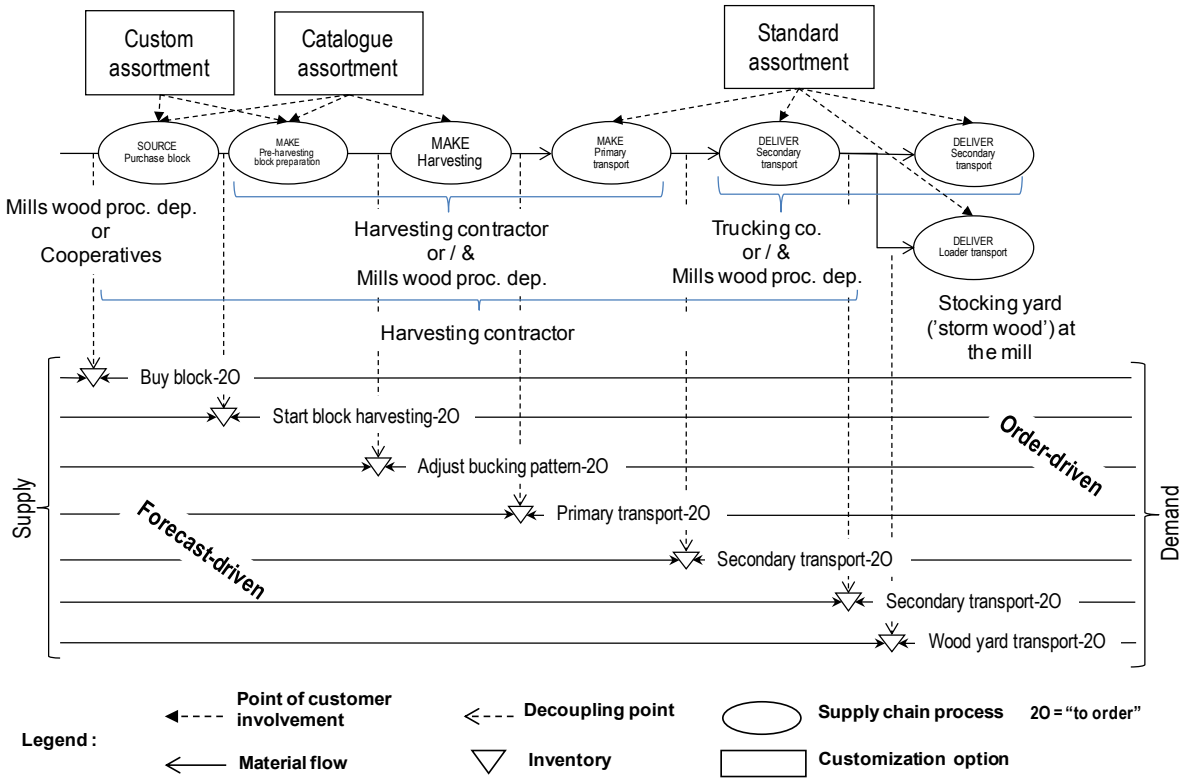
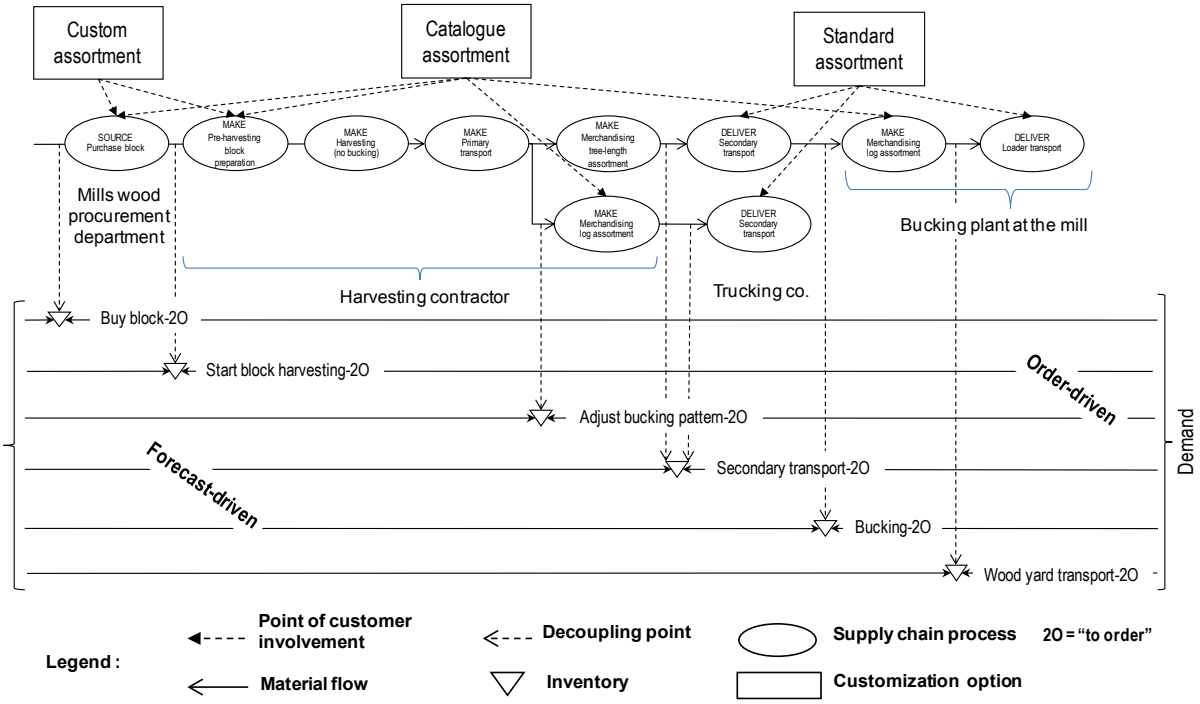


Figure 4: Decoupling points and customization options in the WSS in Chile.



CONCLUSION

The paper introduced the five components of a framework to describe, in a generic way, any WSS and enables some comparisons (e.g. agility). Using this framework in the study of WSS in three countries, ten locations of decoupling point, three main customization options and nine process-actor allocation scenarios were identified and presented. Our results indicate that using the contingency theory along with Porter's organization theory to complement the SCOR model provides a conceptual framework well adapted to describe WSS. The next steps include, for the three countries studied, a better description of the external environments, the agility enablers utilized and the performance levels achieved. Future research directions include the improvement of the framework and its validation on actual cases of WSS as well as on additional cases from three other countries (Canada, Poland and Sweden).

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