The Assessment of the Production Outsourcing Strategy in the Wood Furniture Industry of the Uba Region (Brazil), through the Development of a Dynamic Model

Luciana Baldez de Almeida
Altair Dias de Moura

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1. Introduction

The wood furniture sector has an important role in the Brazilian economy, due to its high employment rate. More specifically, in the Ubá's region (Minas Gerais state - Brazil), this sector employs 6.8% of the industry's workers (IEL-MG/INTERSIND/SEBRAE-MG, 2003). This sector is also important as a contributor to the local Gross Domestic Production (GDP) (INTERSIND, 2004).

Compared to other wood furniture industries in Brazil, the Uba's one is the fourth and sixth in terms of employment and numbers of premises, respectively. (IEL-MG/INTERSIND/SEBRAE-MG, 2003).

The Brazilian wood furniture sector has undergone substantial changes in the last two decades, as firms have directed their efforts towards the mass production of standardized furniture, using diversified raw materials (Biscaia Júnior, 2001). Theses changes in the domestic sector are following worldwide trends toward more efficiency and competitiveness. Thus, firms are focusing on the market segmentation and product differentiation (Fleury, 2003).

Another important trend refers to the specialization process through outsourcing, in which firms are passing part of their production operations on to specialized service providers (Fleury, 2003). In the outsourcing process, firms search for performance improvements by increasing the learning process; gaining with the economy of scale, synergy and specialization; using efficiently their production capacity; reducing overhead costs; focusing in more profitable market segments; and making production process more flexible (Rezende, 1997 and Brasil, 1993).

As in the Brazilian wood furniture industry, the Ubá's wood furniture industry is highly vertically integrated at the firm level. As a consequence, this industry presents a low level of specialization, with firms producing alike furniture and competing with each other in terms of the product price. This leads to low economy of scale gains and, consequently, higher production costs (IEL-MG/INTERSIND/SEBRAE-MG, 2003).

In terms of competitiveness, two main aspects are identified to raise the Brazilian wood furniture industry performance. The first one refers to the specialization and deverticalisation of the firms' production structure, through the development of efficient supply chains and networks. The second aspect refers to the improvement of the production line and searching for product differentiation (Coutinho, 1999).

Considering the importance that the production outsourcing may have for the Ubá's wood furniture industry, this research studied the possible improvements that this strategy may bring to this industry. Thus, the objective of the research was to assess the production outsourcing strategy of the Ubá's wood furniture industry, through the identification and characterization of the factors related to this strategy and its consequences for firms' profitability. This strategy may bring benefits to this industry as the Ubá's wood furniture supply chains are considered inefficient (Coutinho, 1999).

This article is structured in five sections. After this introduction, it is discussed some concepts regarding outsourcing. After, the research methodology is discussed and it is followed by the results and conclusions.

2. Deverticalisation of supply chains

Until the first half of the twenty century, most firms were strongly vertically integrated, as almost all production stages were performed internally. As the competition and the product complexity rose, firms' production structure became less vertically integrated, as they started searching for more efficiency through the production specialization. These change leaded firms to become involved in supply chain arrangements (Gasparetto, 2003).

Supply chain can be defined as all stages needed to attend a customer's order. A supply chain comprises the main following stages: suppliers, producers, wholesalers, retailers, and customers. Considering that a specific producer may have several suppliers as well as customers, the supply chain's structure resembles more a network than a channel configuration (Chopra & Meindl, 2003).

A less vertically integrated chain is a chain in which the production structure is less centralized. Deverticalisation refers to the reduction of a firm's activities in terms of managerial and or production levels through outsourcing (Amado Neto, 1995). This reduction of the activity levels

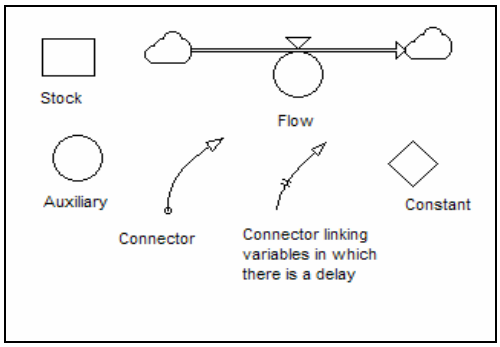
changes the chain extension and means that a firm not only simply transferred some of its supporting activities, but also the production of parts and components to other firms. (Bernstorff & Cunha, 1999).

3. Methodology

One important challenge of the supply chain management studies is to deal with chains' complexity, as the single knowledge about each level is not enough to guarantee an efficient management of the chain. This happens because, with the time, the relationship and dependency among chains components become more important than the isolated view of each component (Saito et al., 1999). In this context, the System Dynamics (SD) framework becomes an important tool to study supply chain management, due to its capacity of analyzing behavior and interdependency over the whole system.

SD is a useful tool to study complex events, considering the systemic logic. Systemic events generally present looping relationships of cause and effect. Thus, the structure of the system comprises feedbacks and delays. Feedbacks refer to two or more variables that form a closed loop of relationships, in which the first variable affect the second, which affects the third and so on, until the time, in which the last one in the row affects the first one, closing the loop. Delays refer to the time needed for one variable to affect the other (Fernandes, 2001).

Figure 1 depicts the graphic language of the POWERSIM computer software, used for SD modeling and simulation.



Source: POWERSIM 2.5 software.

Figure 1: System dynamics (SD) modeling symbols used in the POWERSIM software.

Stocks (or level variables) are accumulations or quantities measured in a period of time. The flow represents the rate of the changes in the stock and can increase or decrease stocks amount. Auxiliary variables have their values based on other variables. They are used to keep constant values or convert input values using equations that generate output values, which will be used by other variables. Connectors are links that show relationship between stocks and flows. When the connector is drawn with a double dash, it means that there is a delay between the input and the output values. Finally, constants are fixed values (Martin, 1997).

The research comprised the application of a survey in 42 wood furniture producing firms in the Ubá's region, which aimed to characterize the vertical arrangements and structure of their supply chains. The information gathered in this process also gave support to the building of a general dynamic model for the Ubá's wood furniture industry. After the development of the general model, it underwent a refinement to be applied to a specific firm that was selected from the 42 firms surveyed. This firm was chosen for the case study, because it was considered a typical firm inside the industry, and had the information needed to run the dynamic model.

According to Yin (2001), case study is an empirical research method that investigates a contemporary phenomenon in a real context, in which there are no clear boundaries between the phenomenon and the context, and multiple sources of evidences can be used.

Case studies are applied to situations in which the research focuses on "why" and or "how" questions and the phenomenon's factors are not easily controlled, but it is possible to perform direct observations or systematic interviews (Yin, 2001).

The use of case study in this research is due to three main aspects. First, the research includes "how" questions (i.e. How are the firms organized in terms of the vertical arrangements along the production chains?; and which factors and how they affect the process of vertical integration of chains.); second, it deals with events in which it is difficult to control all the involved variables; and third, the event studied is contemporary as the discussion about vertical integration of the wood furniture chains is a current issue in this industry.

3.1. Data sourcing

During the research, it was used information from secondary sources (IPEA[1] e IBGE[2]) to get overall information about the Ubá's region and its wood furniture industry. As said before, 42 firms were surveyed to get information about the vertical organization and structure of the production chains inside this industry.

Additionally, structured interviews were performed in the case study firm, aiming to gather information to tailor the general dynamic model to perform the simulation.

4. Results and Discussion

4.1 The Dynamic Model

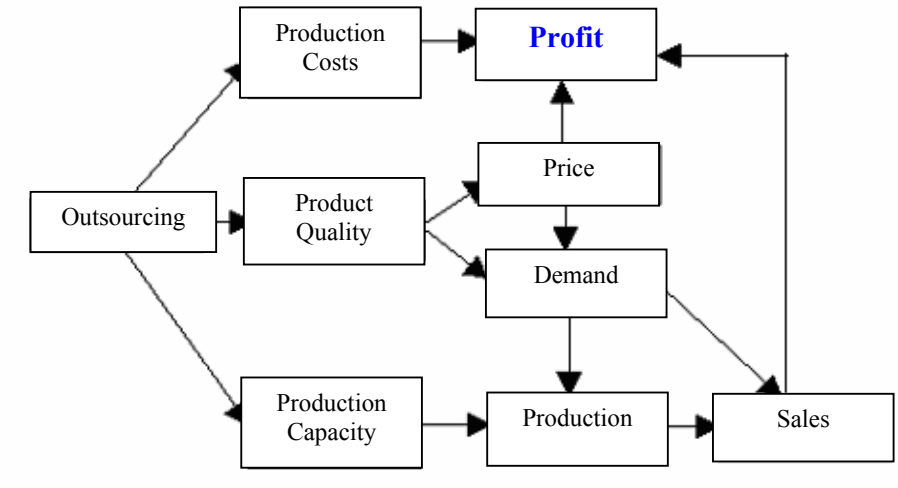
An influence diagram depicting how various aspects affect outsourcing is showed in the Figure 2. In this model, outsourcing is affected by production costs, product quality and production capacity of the firm. A reduction in production cost affects positively the firm's profit. If the product quality is improved, it may affect product price and demand. If product quality does not affect the product price for some reason, it still may increase product demand with the time, causing sale increase and, consequently, higher profit. However, if product quality improvement is followed by price rising, three events may happen at the same time: a) the price rising increases income per unit of product; b) the price rising reduces product demand; and c) the product quality improvement increases product demand, which may increase sale and, consequently, profit. If the events described in "a" and "b" happen, the result may increase or decrease profit, depending on the intensity of each one. Thus, in general, the balance of the three possible events described in "a", "b", and "c" will defines if the price rising due to the product quality improvement will lead to a higher or lower profit.

An improved product quality may also reduce production costs, as it may reduce faulty products. However, to avoid more complexity in the model, this relationship was not considered.

[1] Brazilian Research Institute of Applied Econimics

[2] Brazilian Institute of Geography and Statistics

The last relationship depicted in Figure 2 focuses on the case in which outsourcing may increase the production capacity and, if there is a repressed demand, this may increase sales and, consequently, profit.



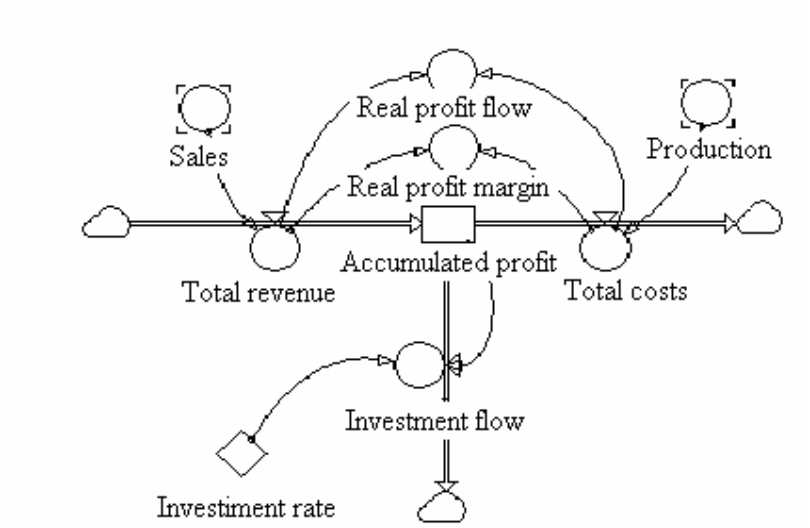
Source: Research Data.

Figure 2: General model for a firma that performs outsourcing

After the identification of the main input variables and their relationships with the output variable – profit (Figure 2), it is possible to build the stock and flow diagrams.

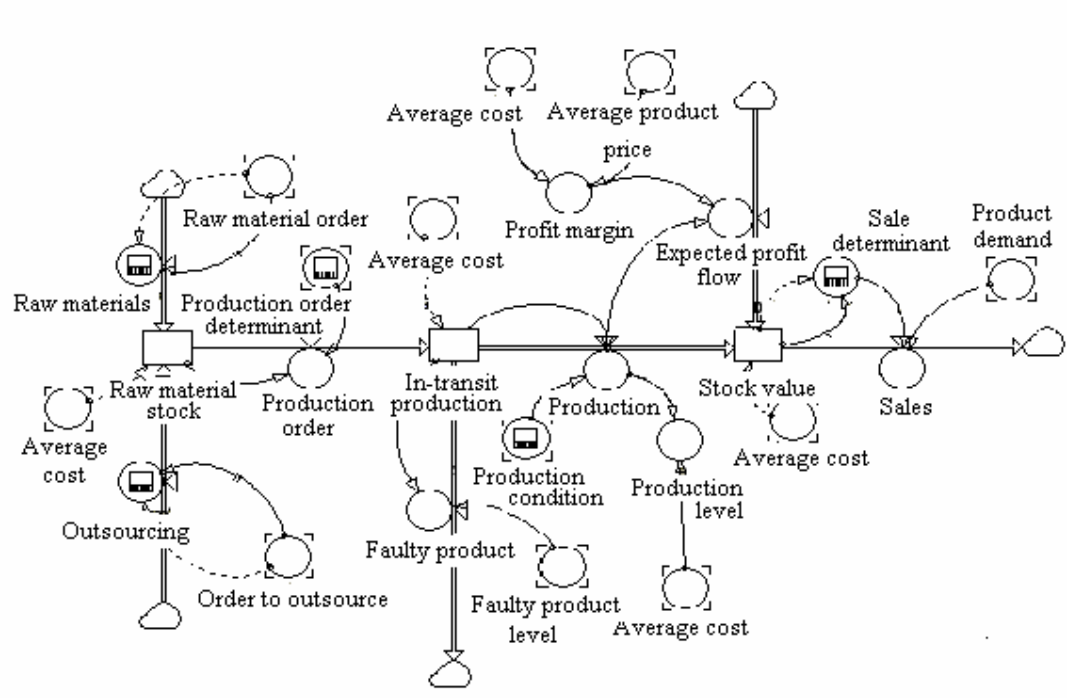
In general terms, the proposed dynamic model aims to show the dynamics of a wood furniture production firm. The model logic considers that a firm establishes its production level based on the product demand, and this triggers the need for raw material acquisition. Once the firm places an order for buying the raw materials, they take some time to get to the production place. When the raw materials arrive in the factory, they start being used and generate an "in-transit production" (i.e. the production that was started by not finished). After the production leading time, the production is finished and can be sold. Taking this dynamics as base, it is possible to simulate the accumulated profit of a firm over the years, which is the difference between the revenue from sales and the production cost. Thus, the two main diagrams (i.e. the production (Figure 3) and the profit diagrams (Figure 4)) represent the dynamics discussed above, and are depicted below[3].

[3] The full model can be found in Almeida (2005).



Source: Research Data.

Figure 3: Stock and flow diagram for the wood furniture production system



Source: Research Data.

Figure 4: Stock and flow diagram for the profit of a wood furniture production firm.

4.2. Simulation results

A wood furniture production firm (Firm A) was selected to supply the information that allowed the tailoring of the general dynamic model to its specific characteristics, and, consequently, the simulation of this firm under different scenarios.

Firm A focuses on the production of wood closet, and has outsourcing costs, which represents 5.96% of the total production cost. This firm outsources metal kits and accessories, cabinet feet and drawer's lateral face. The outsourcing strategy has brought benefits to the firma A by reducing the production cost in 0.7%, increasing production capacity in 10 %, and reducing losses and faulty products in 0.5%. Additionally, the firm improved its product quality, which allowed a product price rising of 3% and a product demand increase of 8%.

The dynamic model generated for Firm A was simulated according to different scenarios, which had different combination of the three main model variables (i.e. production cost, product quality and production capacity) as a consequence of the outsourcing strategy. As commented before, the output variable used to assess the outsourcing strategy was the accumulated profit of the firm over the months. Table 1 shows the scenarios and their characteristics.

Table 1: Characteristics of the different scenarios simulated for Firm A (case study)

Scenario	Characteristics
1	- The outsourcing strategy causes: a) production cost reduction; b) product quality improvement; and c) production capacity increase.
2	- The outsourcing strategy causes: a) product quality improvement; and b) production capacity increase.
3	- The outsourcing strategy causes: a) production cost reduction; b) product quality improvement *; and c) production capacity increase.
4	- The outsourcing strategy causes:

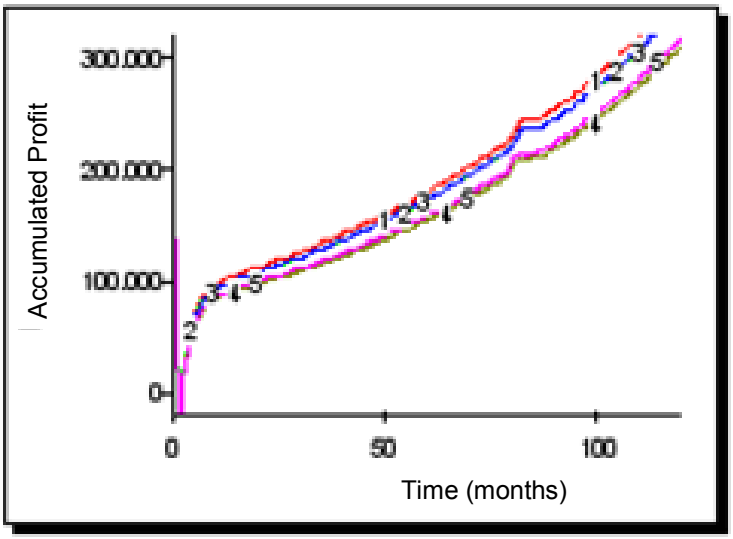
	a) production cost reduction or product quality improvement; and b) production capacity increase.
5	- The outsourcing strategy causes: a) production cost reduction; and b) product quality improvement.

* In this scenario, product quality improvement happens only in some cases.
Source: Research Data.

It is important to highlight that there are several other possible scenarios to be built; however, the focus was on the ones considered more important for the research.

The Firm A simulation comprises the following level of outsourcing: 5.96, 5.46, 5.30, 1.16, and 0.0% of the total production cost. These were the levels informed by the firm, which supplied the information necessary to run the model.

Scenario 1 considers that the outsourcing brings production cost reduction, product quality improvement, and production capacity increase (Figure 5).



Legend
1 – Outsourcing level of 5,96% (red line)
2 - Outsourcing level of 5,46% (green line)
3 - Outsourcing level of 5,30% (blue line)
4 - Outsourcing level of 1,16% (brown line)
5 - Outsourcing level of 0,00% (pink line)

Source: Research simulation.

Figure 5: Outsourcing strategy causing production cost reduction, product quality improvement, and production capacity increase (Scenario 1 – Firm A).

In this scenario, the option that brings higher accumulated profit is the higher level of outsourcing, which indicates that higher levels of outsourcing bring higher levels of accumulated profit for Firm A.

It is important to highlight that the scenarios simulated generated graphics, such as the one depicted in Figure 5. However, the results generated by the simulated scenarios were condensed in the Table 2, aiming to save space in the article.

Table 2: Simulation results for Firm A under different scenarios

Scenario	Key Results
1	Outsourcing reduces production costs and the option that leads to higher Accumulated Profit (AP) is the higher level of outsourcing.
2	Outsourcing does not affect production costs and outsourcing (regardless its level) and vertical integration have equal effect on AP.
3	Considering that in this scenario, the product quality improvement is different for the different outsourcing levels, the lower quality option leads to the worse AP.
4	The outsourcing option which leads to product quality improvement results in higher AP than the outsourcing strategy that leads to production cost reductions.
5	The best strategy in terms of AP is associated with the higher level of outsourcing, regardless if the outsourcing brings or not production capacity increase.

Source: Research data.

The Scenario 2 considers that outsourcing increases production capacity and brings product quality improvements, but with a level of production cost that is equal to the cost of producing the

parts internally. This situation shows that different levels of outsourcing bring the same result in terms of accumulated profit. Thus, this suggests that the effect of the outsourcing on the production cost is essential for decisions related to this strategy. The comparison of Scenarios 1 and 2 shows that different levels of outsourcing brings different results, in terms of accumulated profit, if outsourcing causes reduction in the production costs.

In the Scenarios 1 and 2, there was the condition that the product quality was the same, regardless the level of outsourcing. In the Scenario 3, it is assumed different product quality levels due to different levels of outsourcing, and reduction of production costs due to this strategy. In this scenario, it was conditioned that the outsourcing level of 5.96% does not bring product quality improvement, but the others do. This condition was chosen as 5.96% of outsourcing was the best option in the general scenario (Scenario 1). The simulation of the Scenario 3 shows that the 5.96% of outsourcing becomes the less desirable option in terms of accumulated level.

Therefore, a second general conclusion can be derived: as it happens with the production cost variable, product quality is also an important variable to take decisions regarding outsourcing. However, up to this point, it is not possible to conclude which variable (production cost or product quality) affects more intensively outsourcing. The fourth scenario tries to elucidate this situation. Scenario 4 intends to compare two situations:

a) increase in production capacity, gains in product quality, but no production cost reduction;

b) increase in production capacity, reduction in production costs, but no improvement in product quality.

The results of this simulation showed that option “a” leaded to a higher accumulated profit than option “b”. This indicates that for this specific firm, product quality is more important than production costs for the outsourcing decision. However, it is important to stress that, when product quality does not bring price rising (i.e. it brings only an increase in product demand); this variable loses some importance (i.e. it leads to a lower accumulated profit).

Scenario 5 focuses on outsourcing bringing production cost reduction and product quality improvement, without production capacity increase. To test this option, the 5.96% level of outsourcing was simulated, because this option leaded to the better results in terms of accumulated profit in the Scenario 1. The results of Scenario 5 showed that regardless the effect on production capacity, the 5.96% level of outsourcing was the best strategy.

5. Conclusions

In general terms, it may be concluded that for Firm A, production cost and product quality are important variables in the making decision process regarding outsourcing. Production capacity showed to have a secondary importance in the outsourcing decision. However, it is important to stress that, as Firm A is not operating in its maximum production capacity limit, this aspect may have affected the importance of this variable in the simulations.

For the case of Firm A, the outsourcing strategy showed to be desirable if this firm finds supplier that produce quality raw materials at low production cost. Otherwise, it would be better to produce the parts inside the firm.

Regarding to the dynamic model proposed in the study, it showed to be a powerful tool to aid managers in their outsourcing making decision process. The general model built is a systemic base, in which it is possible for firms to make minor refinements to simulate their own situation and get information to support their decisions. The general model can be also used as an industry tool, showing at industry level if the deverticalisation of chains through firm outsourcing is the way to develop this industry, and which variables are more important for this strategy. On the other hand, some limitations are worth to be cited. First, the lack of more detailed firm information did not allow the study of incremental levels of outsourcing, as it was supplied only information for specific levels of outsourcing. The other important aspect refers to the need of developing further researches to gather different firms in more homogeneous group, which will allow the use of the model inside each group, generating more specific information to guide industry strategies.

Even though, this is a case study, because the research survey explored a representative group of firms inside the industry, and Firm A was chosen because its characteristics are consider common

inside the industry, the results strongly suggest that outsourcing with product quality and efficient production cost is a strategy that may bring Ubá's wood furniture industry to a more competitive position.

6. Literature

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