A decisional modelling for supply chain management in network franchise: applied to franchise bakery networks

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Abstract

This paper proposes a modelling process to evaluate/optimize supply chain flows in a franchise network. We will study bakery networks composed of a supply chain producer and a retail outlet that sells the products made by the operator of the network in his own factories. Our modelling is a combination of two modelling processes: a first modelling reproduces the running supply chain through simulation and/or optimization (Comelli et al., 2008a); then data given by this model are used by a model (B) which reproduces the consequences of model (A) on the mixed franchise network thanks to a MILP optimisation based on the four management challenges. Then, for the opening of a new outlet, generated cash flow is analysed to choose between a company owned and a franchise. We show that the plural form is more efficient in generating cash flow for the operator. This form is, in fact, the best choice for an operator that wants to develop his network while balancing challenges such as growth, uniformity, local responsiveness and global adaptation. This kind of approach links together two research fields: a strategic one with the choice of the statutory form of the outlet in a mixed franchised network and a tactical and operational one that optimizes the cash flow in supply chains.

Keywords: SCM, financial flows evaluation, franchise network, optimization, mix rate.

Introduction

One of the most studied problems in franchise theory is the choice between the two forms of outlets which are company owned and franchise. First studies point to a resource scarcity problem and focus on a financial and a managerial criterion: to overcome these constraints, the operators have to develop their networks under a franchised form (Oxenfeld, Kelly, 1968). Other studies, based on agency problems focalize on organization efficiency to overcome the principal/agent dilemma (Jensen, Meckling, 1976). In some cases, franchise outlets are considered preferable due to owner motivation as the operator of the outlet is also the owner. In other cases, such as territories where consumer attraction does not exist (Cliquet, 1997) because consumers mobile, companies owned are better choices. Whether one or the other is considered, choosing franchising, rather than branching, is justified in a contingent manner compared to criteria, such as the distance from the operator, the ability to settle within a local competitor's territory, winning consumer attraction, mobilization "know-how" for uniformity, and so on. Unfortunately, numerous empiric works based on such explanations lead to contradictions (Lafontaine F. and Bhattacharyya S, 1995; Combs, Ketchen 2003). We therefore believe that the analysis of

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franchising and statutory choices (franchising versus branching versus mixing) must not be undertaken in a contingent manner, but in a global manner, using a systemic view, which will allow for a retroacting phenomena. What Bradach's research (1997, 1998) has essentially contributed is the following : we should go beyond the problem of contingency to expose, not the advantages of the alternative statutory forms, but rather the advantages of mixing itself. The author has studied American fast-food networks, allowing the confirmation of the appearance of synergies linked to statutory plurality, focusing on four main challenges facing networks. Based on this, in the case of franchised mixed networks, it is not necessary to carry out a sequential analysis, but rather a holistic one, so as to take into account the basical systemic aspect of this type of organization both in its physical and management form (managing shape).

Typically, on one hand, franchise researches focused on the question of the statutory choice in franchised networks: how and why an operator should choose between a franchise outlet and a company owned outlet so as to allow a maximum return for franchisees and franchisors (it is both a question of financial returns and organizational efficiency). On the other hand, supply chain research focuses on flows optimization (physical, informational and financial). A supply chain can be defined as a strict set of terms in which partners can share the value they have created with the other partners and their consumers. Considering this point, it is possible to jointly study supply chain and franchise networks. A large part of franchise theory focuses on the incentive alignment of a franchisor and its franchisees in order to create value that meets consumers' tastes. With this in mind, Lagrange and Féniès (2005) produce an analogy between franchise networks and supply-chains and conclude that the aims of an operator of a supply chain and of an operator of a mixed network are the same since it is all about optimizing a collective performance in a global manner, while bearing in mind a local sense of identity. Thus, considering a similar view between the two schemes we are able to produce a dedicated modelling that takes into account two franchise approaches that are traditionally opposed, to optimize flows in the whole system (franchise network plus its logistic chain).

Considering that in franchise theories there is an opposition between analysis based on the resource constraints and analysis based on the agency theory. As such, we are offering a process dedicated to the approach of the four Bradach challenges, allowing a better apprehension of the mixed reticular forms. Based on this, we then use a holistic view to optimize/evaluate the whole structure (transactional and logistic channel) cash flow with a logistic modelling. This paper proposes a modelling process to evaluate/optimize supply chain flows in a franchise network. We extend a first modelling scheme (Comelli et al, 2008) for the supply chain on a tactical level and on a strategic level. We propose a second modelling that deals with four challenges (growth, uniformity, local reactivity and global responsiveness) in the management of retail networks into a MILP for supply chain management.

In section I, we present the theoretical material necessary to understand the problematic of mixed networks and the supply chain modelling process. Next, in section II, we present the general modelling process and the way it can be applied to franchise networks in an evaluation and/or optimization view. Section III presents an optimal model for franchisor production and distribution network design. Then, in section IV, comes the application to french bakery networks and the results of the modelling process both in terms of evaluation and optimization. Finally, we conclude.

I. Problem description and state of the art

Contingency studies propose some explanations of the success of the franchise form: the agency theory argues that franchise is positive when the operator's interest is a problem of relationship between principal and agent (Jensen, Meckling, 1994), and the scarcity resource theory (Oxenfled, Kelly, 1968) looks at the problem of financial or managerial resources that an operator could face when he wants to develop a company-owned network. According to Bradach's results (1998) it also appears that mixed networks are able to raise four management challenges that lead to the success of the network:

The growth of units. If we consider the growth management, this kind of stake is particularly important when Emerson (1982) shows that the growth of the network originates almost exclusively from the addition of units, which allows an income to increase. As far as growth is concerned, it appears that mixed networks have a definite advantage because they allow the operator to call upon several expansion mechanisms simultaneously (Bradach, 1998): the development itself of retail outlets, the attraction of new franchised and a mix of the last two mechanisms that leads to a virtuous circle.

The respect of uniformity. The second stake spelt out by Bradach is related to uniformity: it is about managing to keep a uniformly run commercial process in all network outlets, whether they are owned by the operator or by a franchisee.

The local reactivity. This is the outlet capacity to be responsive to local conditions and local market; beyond that, it appears that this component of reactivity in the management of retail outlets is strongly related to another risk described by Bradach : local adaptation of the network to conditions of local competition and consumer habits.

The system-wide adaptation of the network to the pressures of competitive pressure. In fact, this latest stake can be broken down into sub-elements which represent the generation of new ideas, their selection and the set-up of innovations. The generation of new ideas is based on the local reactivity of franchised outlets and on operator's R&D.

Moreover, taking into account Bradach's challenges and the entire supply chain structure (transaction and logistic chains) it is possible to notice/represent the relation between each of them (figure 1). Past studies have already underlined that there is a real reciprocal relationship between the development and the global adaptation of the network, and that it is necessary to take growth and adaptation into account when operators want to achieve global adaptation, for the purpose of growth management. It is also shown (Lagrange, 2007) that all four challenges are correlated to each other, and it will be difficult to deny that these management challenges, more than simple isolated challenges, are finally closely linked to each other. Another essential issue of Bradach's work is to show that mix is not a transitory form but a real equilibrium allowing for better management of the organization (in terms of the four challenges). The question of the impact of mix rate on the global supply chain of the franchisor is not studied, but seems to have an impact (Lagrange and Fenies, 2005). For this purpose, we have to define what a supply chain should be and how it should be studied.

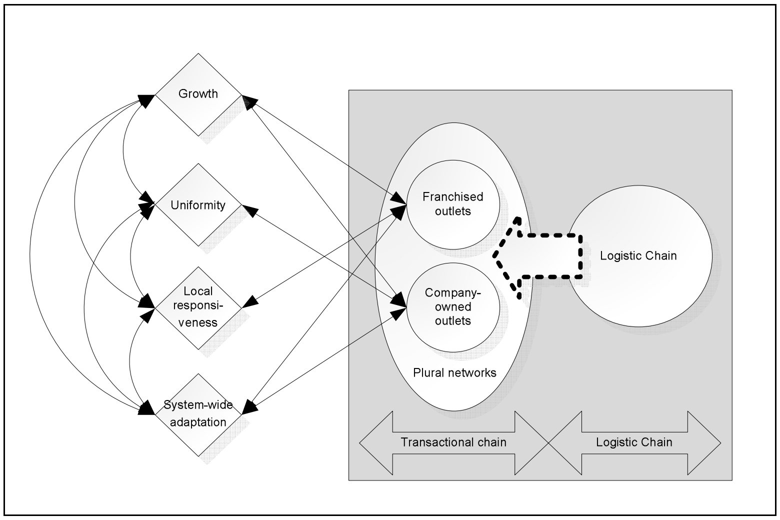

Figure 1. Management model of franchise mixed networks with supply chain sourcing.

Collaborative relationships between firms, outlets, and factories deal with physical, informational and financial flow in Supply Chain. Many definitions of supply chain can be given (Beamon, 1998). In a logistic way, the value for consumers depends on demand satisfaction: one of the main goal of Supply Chain is therefore to increase the customer satisfaction. In the case of the Supply Chain of a franchise network, the operator has to be sure that the value is shared between the franchisor and the franchisee. This last point is well studied in franchise literature since it is one of the most important elements that motivated the agency theory in explaining the choice between franchised and company owned outlets.
Financial value for shareholders (supply chains are made of firms, these firms have shareholders) depends on share value. A part of share value depends on the market level and the firm's financial policy. Another part of share~~s~~ value depends on the cash flow level. The cash flow from operations is important because it indicates the ability to pay dividends. In our opinion, a Supply Chain exists if partners earn money thanks to collaboration, and if cash flow levels are increased for all the supply chain partners. A supply chain may be defined as a coalition of autonomous actors coordinated by an integrated logistic process. Thanks to collaborative planning, Supply chain actors share created value (cash flow). It is important to link physical flows and financial flows in planning because the financial flow depends on physical flow operations in this decisional level. Many works such as Dudek and Stadtler (2005) or Holweg *et al.,*(2005) deal with collaboration in supply chains, but in these approaches, financial aspects are neglected. Value sharing often remains theoretical and deals with costs but not cash. In a recent paper, thanks to a given production planning, Badell *et al.* (2005) optimize financial flows and cash positions at the end of each period. Bertel *et al.*, (2008) show the links between financial flow and physical flow in an operational way, but the domain of research deals with a workshop. To conclude this paragraph, we may note that Shah (2005) suggests that combined financial and production-distribution models should be considered in the area of SCM at a strategic level but that very few works propose this type of approach for the moment. Table 1 presents the variables which should be studied in a global approach for franchise management and supply chain management.

Variables			Evaluation criteria	
Quantity / quality of goods and services (Beamon, 1998)	Size of the Supply Chain (Vidal and Goatshalks, 2002)	Nature of the outlet (Bowersox, 1980)	Demand satisfaction (Vidal and Goatshalks, 2002)	Cash flow and profit (Comelli et al., 2008)

Table 1. Variables and evaluation criteria for franchise management in a supply chain

Comelli and *al.,* (2008a) propose to evaluate the impact of physical flow planning on financial flow, thanks to Activity Based Modelling and cash flow level. The authors propose a mathematical formalization of cash flow evaluation for tactical Supply Chain planning: the use of this approach will be extended in order to include both financial objectives with distribution network constraints for a franchise network on a strategic level. This approach, combining the financial supply-chain aspect and collaborative management problems for franchised networks, is presented in the next section.

II. An approach for the supply chain operator of a franchise network evaluation and optimization

Paragraph one presents our approach for a combined franchise network/ supply chain network evaluation/optimization, and paragraph two details and justifies the evaluation criteria modelled for franchise management.

II.1 A framework for franchisor Supply Chain Management

In order to reach our evaluating goal of a supply chain composed of a transactional network (franchise network) and by a logistic chain, we propose an approach which evaluates and/or optimizes planning for a franchise network and its supply chain. A model (A) reproduces by simulation and/or optimization the running supply chain (Comelli et al., 2008a); then data given by this model are used by a model (B) which reproduces the consequences of model (A) on a mixed franchised network where the operator chooses the form of the stores between company-owned outlet and franchised outlet. This second model (B) is constructed within respect of our systemic vision of the franchise and takes into account the management risks of a mixed network. Therefore, it is possible to use this model (B) as an analytical model, in order to evaluate scenarios for cash flows operators. It is also pertinent to use this model as an optimization model. Two decisional variables are proposed: (*i*) for each period, model (B) shows if each new outlet should be opened as a franchised one or as a company-owned store; (*ii*) for each period, model (B) optimizes cash flow of a franchise operator. Figure 1 presents the proposed approach, and the model coupling. The goal of model B is to reproduce the four challenges observed by Bradach's works, and to translate them into cash flow~~s~~ in order to evaluate/maximize the franchisor's cash flow~~s~~. In order to identify these relationships, we have to determine variables that can be used to stand for each management challenge. Then, we will briefly describe the behaviour of the model.

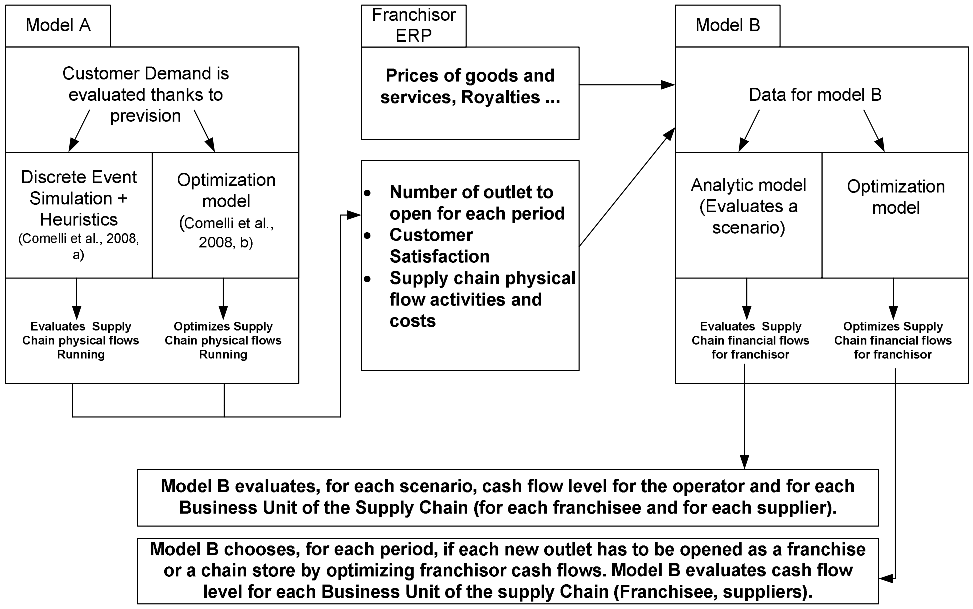

Fig. 2. A framework for franchisor Supply Chain Management.

II. 2 A framework proposal for the modelling of the four franchise management challenge

In order to proceed to our modelling we have to isolate some indicators of the four challenges. In fact, challenges can be considered as indirectly observable variables that have to be measured with indicators (Lagrange, 2007) that are all reflexives. How if their impacts on challenges have been studied in literature (see table 2), the fact of evaluating them together is something new.
As far as the first challenge, i.e. the growth of the franchise network, is concerned, some variables have to be considered in a natural way. This is the case for network size which is an indicator of the effective management of growth: if the franchisor takes into account~~s~~ this growth, it obviously leads to a higher number of outlets. With respect to Castrogiovanni et Justis (2002), it appears that the size of the network is a critical value that indicates the difficulty or the facility that a franchisor has in managing his own development. In the understanding of the number of outlets, the size of the network (SIZE) will be our first variable to approach the growth of the network. We can also consider that growth is managed as far as new outlets are opened as company-owned or franchised outlets. Naturally, we also consider that the growth rate (GRATE) is the second variable we should take into account.
From the point of view of the uniformity, we may consider different variables that can meet this challenge. After Kaufmann and Dant (2001) who have shown that structure fees depend on brand image, we will take this element (FEE) as an indicator of this second challenge. It is also argued by Galini and Lutz (1992), who have developed a signal theory that demonstrates that higher fees protect a brand in such a manner that it discourages potential free ridding from new franchisees. Studies such as Michael's (2002) also tend to show that franchisees are less able to manage the elements of the marketing mix such as trend mark management and concept enforcement. The network evolution towards company-owned outlets is consequently an indicator of operator willingness to have a strong brand mark. This is demonstrated by Lafontaine and Shaw (2001) and Scott (1995) who show that the greater the brand mark is, the more it will be interesting for the operator to have a high rate of company-owned outlets. From that point of view the rate of

company-owned outlets (CORATE) will be a second variable for the management of uniformity. Mathewson and Winter (1985) demonstrate that customers are more receptive to quality if it comes with a global dimension. Foss (1999) believes that a strong brand decreases the risks of free riding. For all these reasons, communication and promotion are obviously important key factors for a franchisor who wants to protect his brand, as mentioned by Lafontaine and Shaw (2001). Thus, fees received from franchisees for national advertising (ADFEE) will be our third indicator of uniformity. It is obvious that without the ability to implement the franchisor's concept the franchisee won't be able to control the concept and its procedures. Lafontaine and Shaw (2001) show that the duration of training is linked to the value of the brand. This is also a way to preserve the intangible assets of the brand as noticed by Windsperger (2002). We will thus take (CFORM) the cost of this training (thanks to the number of annual training days) to represent a measure of the uniformity management.

Windsperger (2001, 2002) explains that the higher the royalties, the higher the franchisor's know-how, and conversely, the bigger the local know-how of the franchisees, the lower the royalties. Consequently, it seems obvious to use set royalties (ROY) as our first measure of local responsiveness. As we described previously, it seems that there are some contradictions between local responsiveness and uniformity. As we decide to use the number of owned outlets to approach uniformity, it is logical to use the number of franchisees to measure the responsiveness propensity of the network. Furthermore, Castrogiovanni G.J., Combs J.G. and Justis R.T. (2006), based on a 439-network study argue that the franchisee rate tends to grow when those networks spread abroad. However thanks to Hayek (1945) followed by Jensen and Meckling (1995) it is known that centralized skills and decentralized skills cannot be possessed by a unique agent. Furthermore a company-owned network is managed in a centralized way whereas a franchise is concerned by decentralization. The franchisee rate (FRARATE) in the network marks the operator's willingness to favour local responsiveness. As mentioned by one coordinator asked by Bradach (1998) local advertising and local marketing operations do not concern management in company-owned outlets, whereas franchisees can do it considering the conditions of local competition. We thus use "local advertising fees" (LOADV) to describe our third measure of local responsiveness.

The last challenge evoked by Bradach (1998) is systemwide adaptation which is a sequence of several operations, the first one being the generation of ideas, the second testing and~~-~~evaluation, the third decision making and the fourth concerns the implementation of innovation. As far as the generation of new ideas is concerned, Lewin-Solomons (1999) notices that the franchisee's autonomy encourages him to innovate and he notices the ability of franchisees to innovate. Bradach (1998) also relies on this to argue that system-wide adaptation is closely connected to local responsiveness. Indeed, the Schumpeterian characteristics of the franchisees lead them to innovate and to try anything that could enhance their profitability in local markets, thus producing a local response. Such behavior~~s~~ on the part of franchisees tend to generate ideas that can be used by the operator if it means a greater satisfaction to all consumers. We take this into account in a variable called "innovation rate from franchisees" (INRATE) which is connected to another one which is "local responsiveness rate" (LORATE) which depends on franchisees. The latter is in fact reflected in (or effected by) the ability of the franchisees to implicate local outsourcing and not be delivered by the operator's supply chain. Then, the author of "franchise organizations" argues that only the operator can engage in research and development expenditures due to elevated costs. It is obvious that the higher this expenditure will be, the higher the franchisor's interest for the system-wide adaptation challenge will be. A second variable (RDEXP) symbolizes this idea.

Growth	SIZE GRATE	Mathewson et Winter (1985) - Ghosh et Craig (1991) - Castrogiovanni et Justis (2002) - Carney et Gedajlovic (1991)
Uniformity	ADFEE CORATE CFORM FEE	Kaufmann and Dant (2001) - Galini and Lutz (1992) - Michael (2002) - Lafontaine and Shaw (2001) - Scott (1995) - Mathewson and Winter (1985) – Foss (1999) - Windsperger (2002)
Local reactivity	FRARATE LOADV ROY	Windsperger (2001, 2002) - Castrogiovanni G.J., Combs J.G. and Justis R.T. (2006) - Hayek (1945) - Jensen and Meckling (1995) - Bradach (1998)
Systemwide adaptation	INRATE RDEXP LORATE	Solomons (1999) - Bradach (1998)

Table 2. Indicators' framework for franchise management.

An important point to stress, is that an operator has to balance between two types of goals: first are growth and uniformity and second, local responsiveness and system-wide adaptation. These aims are in fact issued respectively from company-owned structures and franchised outlets. As Bradach illustrates, it is not possible to emphasize only one of the two groups of goals and the operator has to simultaneously manage all these variables. This is linked to two major costs inside the structure of the network as we demonstrated it: transaction costs and uniformity costs linked to franchised organization and coordination costs due to company owned structure. The former is a symptom of control loss and uniformity loss, and the latter is a consequence of the agency theory and lack of motivation in company owned outlets.

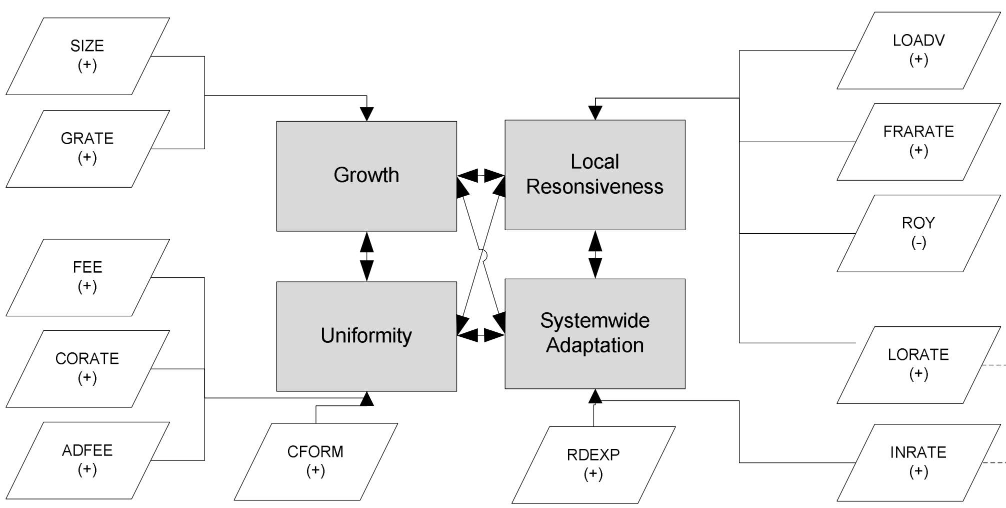

Fig. 3. Modelling of the management challenges

Each of these variables are evaluated and transformed into financial flows. The cash flow of the operator will be optimized or evaluated. The next section details the mathematic modelling of the proposed approach.

III. Evaluation and Optimal design of Franchisor Supply Chain

The above problem is formulated mathematically as a MILP optimisation problem. The aim is to find an optimal design of the supply chain network for the franchisor in terms of a choice between company-owned and franchised outlets.

Notation

The notation used in this section is described below:

Indices/Sets

I	time periods	K	Products.
J	Outlets	J*	Franchisee outlets

Parameters

a_i	Innovation transformation rate at time period i.
a_i^a	New idea selection rate in operator network for period i
b_i	Fee rate for franchisees at time period i with $0 \le b_i \le 1$
c_i	Fee received by franchisor from franchisees for network advertising at time period i.
d_i	Creation Cost of a franchise outlet
d_{ijk}^a	Demand for supply chain by outlet j at time i for product k.
d_{ijk}^s	Satisfied demand by outlet j at time i for product k (given by model A).
d_{ij*k}^s	Satisfied demand by franchised outlet j* at time i for product k (given by model A).
e_i	Royalties for a new franchised outlet at time period i
$f_{i,j*}$	Impact rate of local advertising on franchisee outlet j* in time period i.
g_i	Franchisees new ideas diffusion rate in operator network, with $0 \le g_i \le 1$
h_i	Rate of company owned outlet which reveals principal/agent problems in time period i
l_i	Fixed transaction costs for time period i
m_i	Unit transaction costs for time period i
o_i^s	Creation Cost of a company owned outlet
$p_{i,j,k}$	Unit price of product k in outlet j for time period i.
$q_{i,j,k}$	Unit cost of product k for outlet j in period i.
r_i	Activity level which implies franchisor supply chain modifications at time period i
s_i	Fixed Logistics costs at time period i
t_i	Margin rate for company owned outlet at time period i with $0 \le t_i \le 1$
u_i	Company owned outlets running costs
v_i	Logistic cost for a franchisee outlet for time period i.
w_i	Logistic cost for a company owned outlet for time period i

x_0	Number of company owned outlets at initial time period
y_0	Number of franchisee outlets at initial time
φ_i	Level of use of fee advertising
H	A large positive number

Continuous variables

x_i	Number of company owned outlets opened at time period i
y_i	Number of franchisee outlets opened at time period i
X_i	Number of company owned outlets at time period i
Y_i	Number of franchisee outlets at time period i

Binary variables

λ_i	1 if agency phenomenon exists, 0 otherwise.
α_i	1 if uniformity problem exists, 0 otherwise.
β_i	1 if supply chain resizing exists, 0 otherwise

Linear Formulation

The mathematical model proposed for this problem is a MILP problem as described below. The objective function is a maximisation of Operator Cash Flow ψ_i^F at period *i*. Its expression comes from the entire financial returns of the operator in terms of sales (company owned) or in terms of royalties and fees (franchised outlets) and from all costs due to sales and supply chain administration. This objective function could be easily modified on the whole time horizon.

$$\begin{aligned}
&\forall i, \forall j, \forall j^*, \forall k \ \mathrm{MAX}\ \psi_i^F = \\
&(b_i + c_i)\cdot\sum_{k=0}^{K}\sum_{j=0}^{J^*}\left(d_{ij^*k}^{s}\cdot p_{ij^*k}\right)+\sum_{k=0}^{K}\sum_{j=0}^{J^*}\left(d_{ij^*k}^{s}\cdot q_{ij^*k}\right)+\left(\sum_{k=0}^{K}\sum_{j=0}^{J}\left(d_{ijk}^{s}\cdot p_{ijk}\right)-\sum_{k=0}^{K}\sum_{j=0}^{J^*}\left(d_{ij^*k}^{s}\cdot p_{ij^*k}\right)\right)\cdot t_i + e_i\cdot y_i \\
&-u_i\times X_i-\sum_{k=0}^{K}\sum_{j=0}^{J_*}d_{i,j_*,k}^{s}\times q_{i,j_*,k}^{f}s_i-\beta_i\left(\sum_{k=0}^{K}\sum_{j=0}^{J}d_{ijk}^{s}\cdot q_{ijk}\right)-Y_i\times v_i-X_i\times w_i \\
&-\left(\sum_{k=0}^{K}\sum_{j=0}^{J}d_{i,j,k}^{s}\times p_{i,j,k}\right)\times\left(1+\frac{\sum_{k=0}^{K}\sum_{j_*=0}^{J^*}d_{i,j^*,k}^{a}-\sum_{k=0}^{K}\sum_{j^*=0}^{J^*}d_{i,j^*,k}^{s}}{\sum_{k=0}^{K}\sum_{j_*=0}^{J^*}d_{i,j^*,k}^{a}}\right)\times\frac{g_i}{a_i^a}-o_i^s\times X_i \\
&-(1+\varphi_i)\times c_i\times\sum_{k=0}^{K}\sum_{j=0}^{J^*}d_{ij^*k}^{s}\times p_{ij^*k}-\lambda_i\left(l_i+\lambda_i\times m_i\sum_{i=0}^{n}y_i\right)-\alpha_i\times a\times_i\left(1+\frac{\sum_{k=0}^{K}\sum_{j=0}^{J^*}d_{i-1,j^*,k}^{a}-\sum_{k=0}^{K}\sum_{j=0}^{J^*}d_{i-1,j^*,k}^{s}}{\sum_{k=0}^{K}\sum_{j=0}^{J^*}d_{i-i,j^*,k}^{a}}\right)
\end{aligned} \quad \textbf{(1)}$$

$$\forall i, \qquad x_i + y_i \geq 1 \quad \textbf{(2)}$$

$\forall i$, $x_i \geq 0\, et\;\; y_i \geq 0$ **(3)**

$$\forall i, \qquad \left(h_i - \frac{\sum_{i=0}^{n} y_i}{\sum_{i=0}^{n} (x_i + y_i)} \right) \leq \lambda_i \times H \tag{4}$$

$$\forall i, \qquad \left(\frac{\sum_{i=0}^{n} y_i}{\sum_{i=0}^{n} (x_i + y_i)} - h_i \right) \leq (1 - \lambda_i) \times H \tag{5}$$

$$\forall i, \qquad o_i - \frac{\sum_{i=0}^{n} y_i}{\sum_{i=0}^{n} (x_i + y_i)} \leq \alpha_i \times H \tag{6}$$

$$\forall i, \qquad \left(\frac{\sum_{i=0}^{n} y_i}{\sum_{i=0}^{n} (x_i + y_i)} - o_i \right) \leq (1 - \lambda_i) \times H \tag{7}$$

$$\forall i, \forall j, \forall k \qquad r_i - \sum_{k=0}^{K} \sum_{j=0}^{J} \left(d_{ijk}^{s} \cdot q_{ijk} \right) \leq \beta_i \times H \tag{8}$$

$$\forall i, \forall j, \forall k \qquad \sum_{k=0}^{K} \sum_{j=0}^{J} \left(d_{ijk}^{s} \cdot q_{ijk} \right) - r_i \leq (1 - \beta)_i \times H \tag{9}$$

$\forall i, \forall j, \forall j^*, \forall k$

$$\frac{\sum_{k=0}^{K} \sum_{j=0}^{J} d_{i-1,j,k}^{a} - \sum_{k=0}^{K} \sum_{j=0}^{J} d_{i-1,j,k}^{s}}{\sum_{k=0}^{K} \sum_{j=0}^{J} d_{i-i,j,k}^{a}} \times \frac{1}{\sum_{i=0}^{n} (x_{i+} y_i)} \leq \frac{\sum_{k=0}^{K} \sum_{j=0}^{J^*} d_{i-1,j^*,k}^{a} - \sum_{k=0}^{K} \sum_{j=0}^{J^*} d_{i-1,j^*,k}^{s}}{\sum_{k=0}^{K} \sum_{j=0}^{J^*} d_{i-i,j^*,k}^{a}} \times \frac{1}{\sum_{i=0}^{n} (y_i)} \tag{10}$$

Equation ***(1)*** gives the objective function. Constraints ***(2)*** take into account the growth of the network. Constraints ***(3)*** explain the choice of opening an outlet as a franchise or a company owned. Agency phenomenons are integrated thanks to constraint ***(4)*** and ***(5)***. Constraints ***(6)*** and ***(7)*** explain the existence of uniformity problems. Constraints ***(8)*** and ***(9)*** are an expression of the possible resizing of the supply chain. Constraints ***(10)*** verify if customer satisfaction linked to demand from franchise outlets is better than in the whole network.
Figure 4 presents a mathematical evaluation of the franchise management challenge.

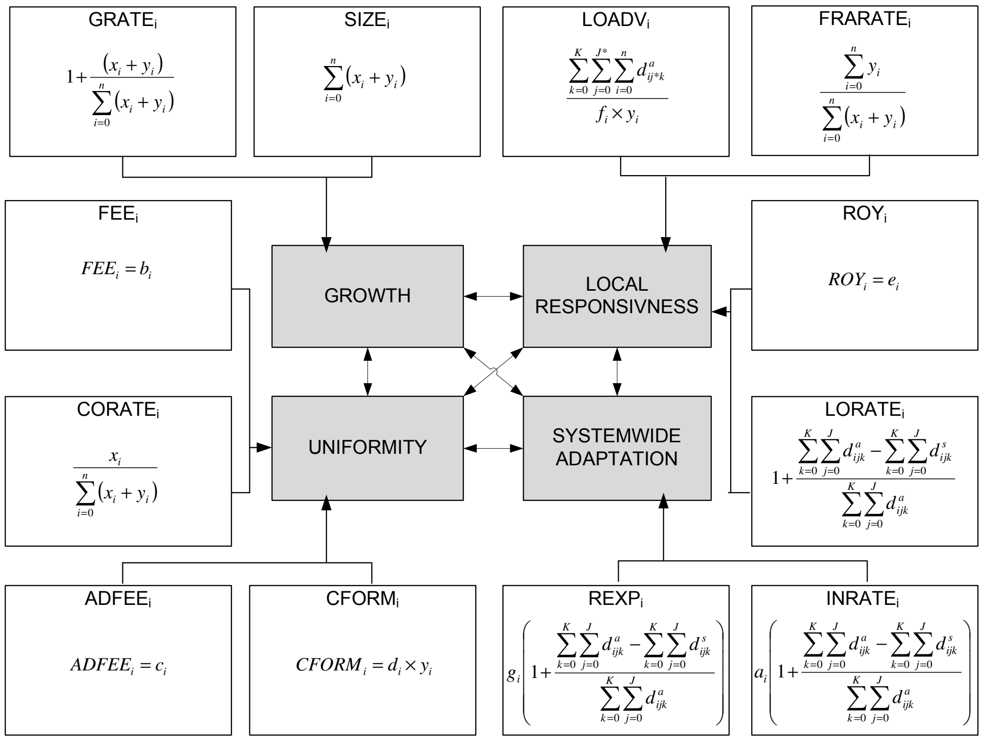

Fig. 4 . Mathematic evaluation of the franchise management challenge.

The next section presents an application on bakery networks of the proposed approach on a supply chain of a franchise system, based on network of bakeries

IV Application on Franchised Bakery Networks

The case study and the action models selected, using the proposed framework, are presented in the first paragraph. Results are then given and discussed in the second paragraph.

Case study presentation and selected action models

The bakery networks we study are made up of a network of franchisees, a network of company-owned outlets, and industrial factories, where bread, cakes, and others goods are produced. Twelve quarters of demand are known. This case study is elaborated by data issued from the French Federation of the Franchise (2006) that provides annually data from networks (table 3).

Name of the Company	Network franchise creation	Growth rate 2005/2007
Saint Preux	1998	60%
Paul	1965	6.43%
La Mie Caline	1985	13.79%
La Croissanterie	1977	8.66%
Brioche Dorée	1992	18.58%
Point Chaud	1981	24.21%

Table 3. The studied franchise networks

The horizon level is 12 quarters, and the planning horizon level is one month. This organization functions with either the push or pull system. Therefore, 2 types of strategies for the supply chain management are evaluated by Model A: a push and a pull strategy. We only use results from the push strategy which gives a better customer satisfaction for distribution networks. A discrete event simulation model running in SIMAN IV allows building input data for Model B. More precisely, a discrete event simulation was preferred to mathematical model for many reasons such as modelling constraints and computation time. Specific modelling was used to take into account particular constraints caused by horizon level and planning horizon of supply chain networks. Two kinds of scenarios are evaluated thanks to Model B (scenario 1: all the new outlets are company-owned; scenario 2: all the new outlets are franchised). Model B is also used as a Mixed linear program and, by selecting the type of each new outlet (franchisee, or company-owned), gives optimal cash flows for the operator. Modelling process is presented in figure 5.

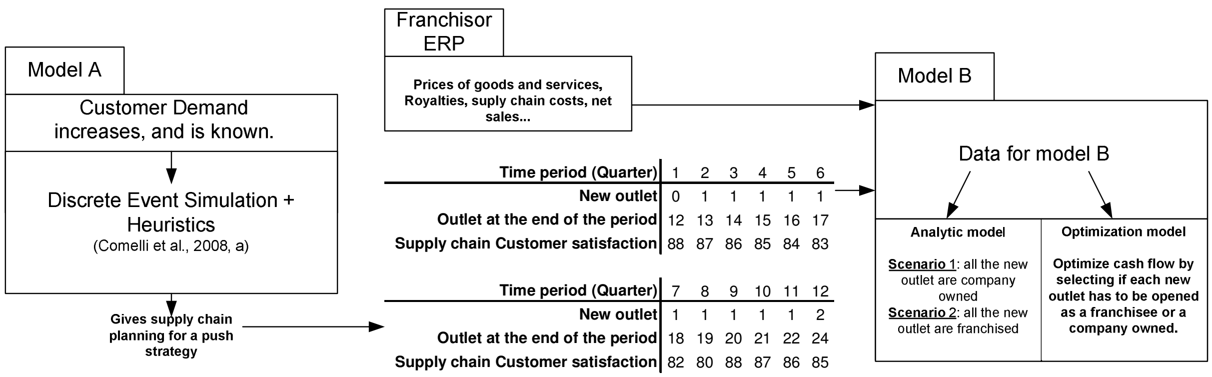

Fig. 5. Model A results and Model B used

Model B Results

Figure 6 presents results if all new outlets are company-owned; figure 7 presents results if all new outlets are franchised; figure 8 presents the results of using model B as an optimization model.

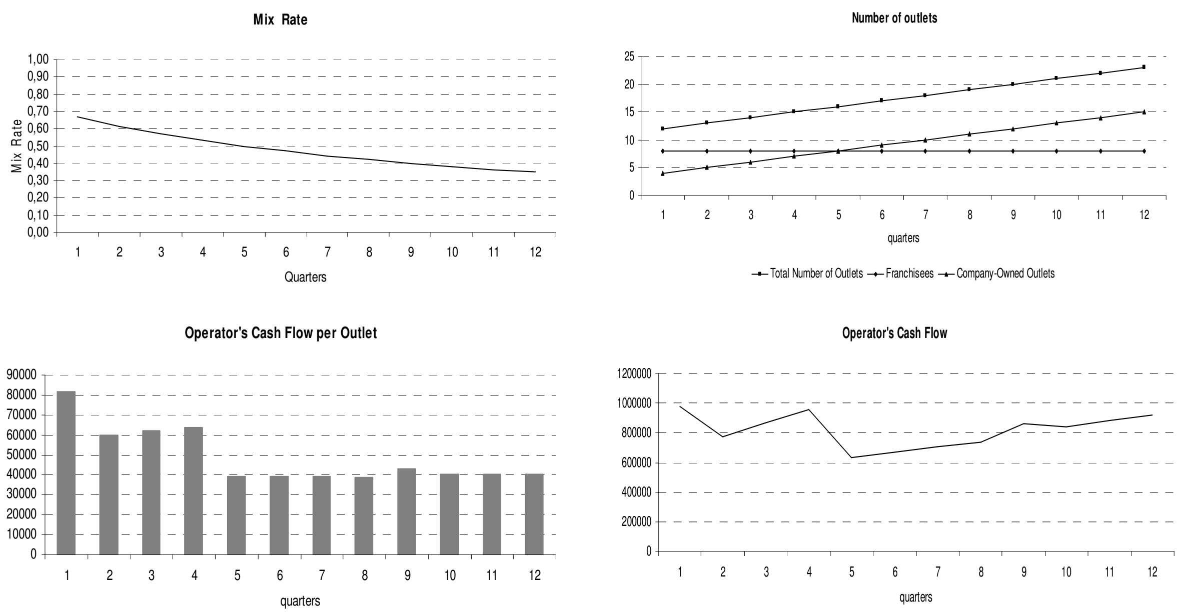

Fig. 6. Scenario 1 results

One of the most important points one should notice is that, in a network which tends to grow with company-owned outlets, the cash-flow per outlets tends to be stable after the fiftieth quarter whereas the operator’s cash flow seems to grow at a fixed rate. In our opinion it is essentially due to the fact that the only way an operator can lever up more cash is to open new outlets (Emmerson, 1982) when he chooses to manage his development with company-owned outlets. Moreover, this phenomenon comes from the growing cost of control (as seen at period 2 and 5) of the whole outlets thanks to the agency theory, and it is also due to the partial use of cash flow to finance the new outlets.

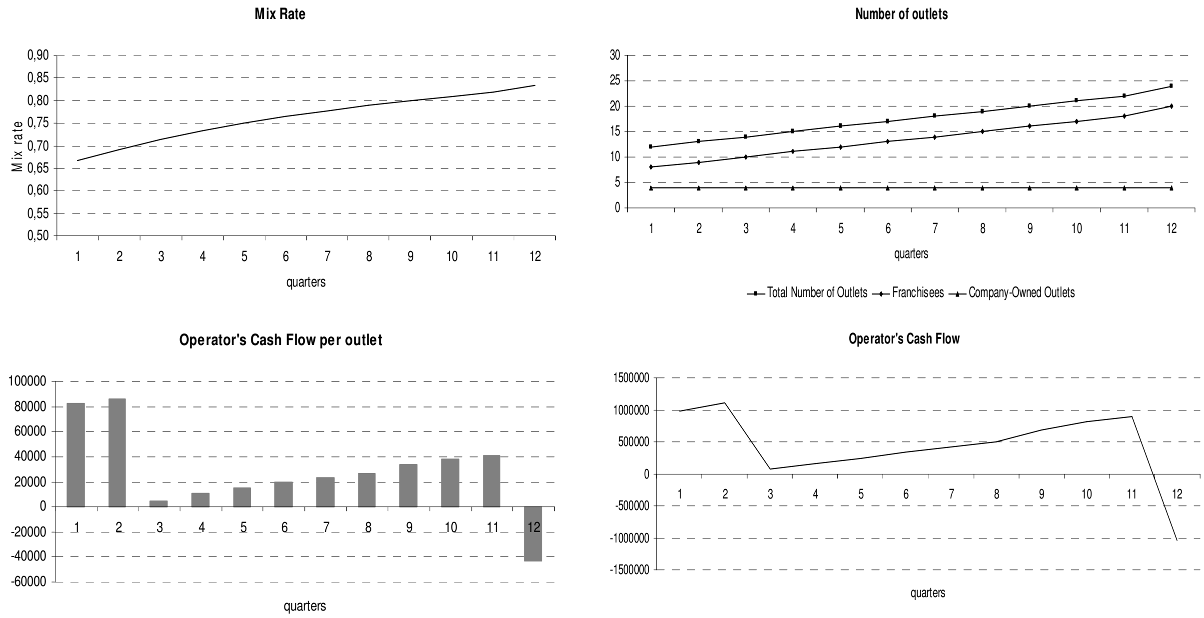

Fig. 7. Results for Scenario 2

In this case our operator chooses to manage his development only with franchisees. If it appears to be a good strategy in the first two periods, we can see that the cash flow is sharply depreciated after those two quarters. Our modelling shows that the growing number of franchisees compared to the stable number of company-owned outlets tends to reduce the ability of the operator to control his network in terms of uniformity due to aspects such as local responsiveness (modelled with the LORATE variable that generates uniformity costs) of the franchisee. Moreover, even if the franchisees can better satisfy demand, after the eleventh period, thanks to Lagrange and Féniès (2005) it leads operators to re-evaluate the supply-chain to face franchisees' demand. This cost concerns all outlets and we can see this in the last quarter. Furthermore, between the third and the eleventh quarter, the operator's cash flow increases. In our opinion, this increase is due to the ability of the franchisees to innovate (here modeled with the INRATE variable) and to generate new ideas which tend to better satisfy demand.

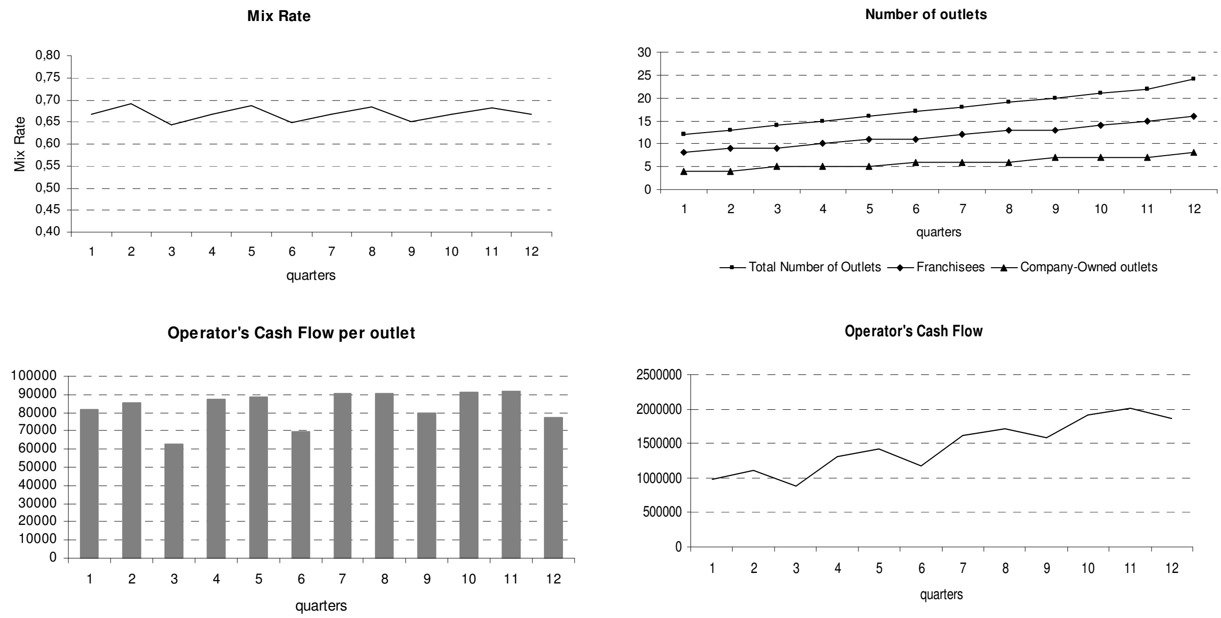

Fig. 8. Optimization results

Thanks to growth balanced between company-owned outlets and franchisees, we notice that the operator's cash-flow tends to grow at a constant rate. Moreover, even though we can periodically observe a slight decrease in operator's cash-flow, it is only due to the purchasing of company-owned outlets (these purchases are reported for all outlets as shown in "the operator's cash-flow per outlets" graphic). But, in the end we do not observe any phenomena such as control costs or uniformity costs which are set to zero by our modelling. If we compare the three kinds of results, it is obvious that the third one is the best: managing the development of the network by maintaining a stable mix of franchisees and company-owned outlets seems to offer the best results for the operator in terms of cash flow compared to growth by adding company-owned outlets or franchisee outlets. Moreover, this latest result also shows the efficiency of the choice of a mixed network for the outlets themselves. In addition, our results tend to show that company-owned structure seems to be a better choice than an entirely franchised system.

Conclusion

Our modelling process shows how an operator of a mixed network can maximize his own cash flow in developing outlets. Considering Bradach's exploratory results in the management of the plural form, our work gives a confirmatory modelling that shows that plural form is more efficient than pure network. But even if mixed network seems to maximize operator's cash flow, we found that purely company owned networks are a second best choice. Considering the choice between companies owned and franchised outlets, our work is also fully compatible with numerous works on scarcity resources and agency theories: this point is important considering Castrogiovanni G.J, Combs J.G., et Justis R.T., (2006) conclusions of their meta-analyses. This had to be underlined because our goal was indeed to reintroduce past work in the choice of our indicators and variables in the modelling. Another original contribution of this paper can also be seen in the coupling of two domains which are franchise distribution and supply-chain management. However, it is important to notice that this approach is based on French bakery networks which have the specificity of being product-oriented: obviously this decisional modelling cannot work on service franchise networks. All things considered, this work has to be further pursued to be generally applied to numerous cases of franchised organizations that are product oriented. A second critical issue of our work is to consider that our modelling is built on a normative view and was later extended to include descriptive methods. From this point of view our normative view does not contradict recommendations for managers: thanks to this modelling we are able to provide operators with a set of indicators that should to be tuned. This is the case, concerning the twelve indicators used to measure management challenges. All these variables are in fact tools that help the operators have a better understanding of their actions in terms of development, uniformity, local reactivity and system-wide adaptation. Thus, we show how managers could run their network to reach cash flow efficiency. We point out that cash flow should not be the only gauge that indicates network efficiency. Further studies should propose modelling in other terms such as life time (Perrigot, 2002)...

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