The integration of the automobile supply chain: new competitive forms and ICT

Buzzavo, Leonardo and Stocchetti, Andrea and Volpato, Giuseppe

Ca' Foscari Department of Management, Ca' Foscari University

4 September 2003

19th Annual IMP Conference
University of Lugano
4th–6th September 2003

The integration of the automobile supply chain: new competitive forms and ICT

Leonardo Buzzavo Andrea Stocchetti Giuseppe Volpato
buzzavo@unive.it stocket@unive.it volpato@unive.it
Department of Business Economics and Management
Ca' Foscari University of Venice, Italy

1. A stage of hardening of the competitive confrontation

The international automobile industry has been featuring for over a decade a structural excess capacity with respect to international demand. Such excess capacity can be estimated at about 20%, albeit with significant differences among the various automobile makes and the various models. Given the high amount of investments and fixed expenses that automakers must carry out, such unbalance between demand and supply generates a very high competitive tension which on the one hand pushes automakers to heavily invest in markets with a stage of first motorisation (Brazil, China, India, Eastern Europe, etc.) by developing the complex and articulated phenomenon which is usually referred to as globalisation, and on the other hand it pushes them to carry out new strategies in mature automobile markets (USA, Japan, Western Europe) looking for solutions capable of satisfying a replacement demand with more and more demanding customers both on the product side (product innovation) and on the commercial services side (Customer Satisfaction Management-CSM), but through solutions capable of containing and, if possible reducing, the total costs hence the prices (organisational and process innovations)[1].

This paper focuses almost exclusively on the initiatives unfolding in the most developed markets, since the process of entry into emerging markets, albeit important on the quantitative side, it is less relevant with respect to strategy, given that it largely reproduces schemes already developed in the past in markets which have become mature.

2. The need for an 'integrated' vision of the current competitive stage

With respect to innovation processes activated for the most advanced markets, it must be pointed out that it is not only a complex move, but also a risky one, given the huge amount of financial resources which such transformation requires. Such move assumes many forms, that could appear to a superficial observer as different initiatives, and sometimes even contradictory ones. As a matter of fact one of the first theses brought forward in this paper is that the transformation in place reflects a specific stage of interaction between the maturation of the automobile demand on the one hand and the potential brought along by process and product technological knowledge on the other hand[2]. Among the many innovations there are in particular:

a) The focus by OEMs[3] on R&D activities aimed at a more limited number of areas than in the past (mainly vehicle design and powertrain system development: engine and transmission) with a subsequent outsourcing of R&D and innovation functions on the remaining areas of the vehicle (suspensions, braking system, emissions, dashboard, internal body, etc.) towards OESs[4], indicated as first-tier suppliers, and in charge of coordinating their own sub-suppliers[5];

b) The outsourcing by OEMs of manufacturing activities once carried out in a direct way towards suppliers in charge of assembling 'modules' in 'supplier parks'[6], in direct contact with the OEM final assembly lines;

c) The organisation, for the a) and b) points, of just-in-time supply;

d) The development of common platforms for the commonalisation and sharing of components across a range of models.

Such transformations, albeit with peculiar traits, can be considered as examples of a same design of process and product rationalisation and innovation[7]. In other words a first thesis in this paper affirms that if one wants to express an adequate competitive strategy in the most advanced markets, one must recognise in an integrated and deep way the specific elements of the competitive confrontation in place, in order to be able to develop an integrated and coherent strategy capable of playing on the range of fronts involved by the various competitive mechanisms.

Hence it becomes useful to sketch, albeit in a simple form, the succession of the main stages for the demand and supply pair in the automobile industry. The strategy to be developed by automakers, with the specific traits that each one can bring along through its own competitive advantages, cannot be but the reply to the characteristics currently emerging by such demand-supply pair. In such pair, demand is represented by the new mix of needs manifested by consumers, and supply is represented by the whole of product and process technological potential which can be expressed by the whole of automakers and their respective supply chains.

3. The variation of the elasticity of demand with respect to the many attributes of the automobile product

Probably the most effective indicator for the transition from one stage to another in the evolutionary succession of the demand-supply pair in the automobile industry lies in the variation of the elasticity of demand with respect to the distinctive elements of supply, that is the whole of product features. In broad terms, if one considers the needs of the automobile demand considered as a whole, it appears evident that drivers have always wanted cars with higher performance, reliability, quality and safety, etc. However, given the process and product technologies available in a given moment, their choice implies a sort of trade-off between the different features and the price which must be paid to acquire a vehicle. In conclusion, given the range of available supply it is their spending potential to determine the mix of features (in particular the intensity with which any given characteristic is present in the vehicle) which is actually required, given that such mix appears compatible with the disposable income for a vehicle. For example at the beginning of the motorisation process, over one century ago, consumers were willing to give up comfortable vehicles, both because the relevant standard was still represented by a trip in a horse-cart, and because it seemed much more urgent to have a reliable vehicle (always with respect to the standards of that time) rather than a comfortable one, and because with the then available technologies a high level of comfort was hard to acquire, and also very expensive. Later on, when a reasonable reliability of vehicles appeared as a given, the elasticity of demand began to appear higher towards other characteristics. The stages which are presented below are built upon significant changes in the elasticity of demand with respect to product features.

4. Competing on the standardisation / low price pair (Fordism)

As it is widely known the first stage of motorisation (in Europe and in the USA) takes shape at the beginning of the XX century through an automobile demand which is particularly focused on the availability of a reliable product (in relation to the technologies available at the time) at a low

price. The winning reply on the supply side determined a process of standardisation of the product and of production methods, which is typified in Fordism[8]. The supply strategy of Henry Ford, represented by the T model (with respect to product standardisation) and by the assembly line (with respect to the manufacturing process), represented the most adequate solution to satisfy the automobile demand which was prevailing at that time[9].

5. Competing on the segmentation / model year pair (Sloanism)

A few years after the extraordinary success of Fordism there is a profound transformation of automobile demand right in function of the huge diffusion of the Ford T. Already at the end of the 1920s in the USA the share of demand for replacement began to become relevant compared to the share of first-purchase demand (quite dominant at the time). Such transformation comes along many others, including a significant improvement in the standards of living, the development of urbanisation forms, the improvement in routes, the tighter and tighter link between personal status and ownership of a vehicle, etc. As a consequence demand becomes more and more sensible to the choice of non standardised products. At the same time all the technological and organisational learning following the introduction of Fordism has shown new possibilities to exit rigidly standardised schemes without excessively penalising the manufacturing cost of a supply articulated on a wide range of models.

Then there matures a different elasticity of demand towards the customisation of the product, and it is the 'Sloan' model of General Motors[10] to establish through the development of a supply capable of following the segmentation of demand which was taking shape through the offering of a wide range of products, differently from the 'unique model' of Ford, and a continuous renovation of the product, even if relatively superficial (model year).

6. Competing on lean production (Toyotism)

The 1970s are the years of the oil shocks who mark the gradual move to a new structure of automobile demand, much more careful compared to the past, to a product which meets higher reliability standards (product quality) and which allows the introduction of vehicles that albeit innovative have lower manufacturing and marketing costs. On the supply side this mainly implies to rationalise a production process which the strong growth of motorisation after World War II did put aside. Clearly this does not mean just to develop vehicles with higher fuel efficiency in order to reduce fuel consumption, but also to avoid any form of waste given the inflationary process and the scarcity of capital triggered by the oil shock.

Starting in the 1980s there emerges a new manufacturing model oriented towards a new stage of production rationalisation typified by Toyotism and based upon the elimination of a multiplicity of waste throughout the whole automobile supply chain, from product design to supply and inventory management, from final assembly to distribution logistics[11].

7. The new competitive challenge: time-based competition (Extended Enterprise)

In the current stage of the demand maturation process the high quantitative development of motorisation (Exhibit 1) has triggered a profound and radical process of qualitative change in the social composition of automobile demand, hence in the needs expressed by the whole of consumers.

Exhibit 1 – Motorisation rate (cars and vehicles for every 1,000 inhabitants)

	1950	1960	1970	1980	1990 (1)		2000 (1)	
	Cars	Cars	Cars	Cars	Cars	Vehicles	Cars	Vehicles
USA	226	320	414	546	578	752	480	787
Germany (2)	11	73	216	417	479	512	532	577
France	37	111	232	417	422	495	475	574
United Kingdom	43	32	167	312	409	454	475	526
Italy	6	98	210	330	499	507	563	629
Japan	0	3	68	203	299	456	414	573

(1) From 1990 one must take into account the whole of vehicles given that, as in the USA and in Japan, a growing share of vehicles classified as commercial vehicles are used as cars. In the USA such process is so advanced to mark a decrease in the density of cars given the registration of *pick-ups* and SUVs which are considered *light trucks*.

(2) The 1990 and 2000 data refer to unified Germany

Source: our elaboration from OCDE and Anfia

In summary these transformations have been:

a) A strong increase in the heterogeneity of vehicle buyers. While in the 1960s demand was concentrated on wealthier families, over the years the widening of buying classes has determined also a high degree of internal differentiation: growth of buyers located in rural areas, growth of female and senior buyers with the development of a preference for variety (high market segmentation) which was unprecedented in all durable goods markets.

b) Another phenomenon tightly linked to the previous one is the multi-motorisation of families. This has also determined the emergence of specialised purchases for the second and third vehicle (small city car, leisure vehicle, etc.), with the valorisation of market niches.

c) The increased importance attributed by drivers to innovation, reliability and quality of service among the decision variables, with the development of buying behaviors which reward makes and models with the best performance/price ratio with respect to such characteristics.

d) High randomness in automobile demand which on the one hand can be stimulated only by highly innovative products and on the other hand is heavily affected by negative stages of the economy since the family already has one or more vehicles, and can easily postpone the change of 'older' vehicles, waiting for more favourable economic conditions[12].

8. The contents of time-based competition

Facing the new structure of automobile demand in the advanced motorisation countries, the strategic response of supply which appears most effective requires a time-based competition. This means to be able to carry out, without a significant increase in the prices of the models, the following objectives:

a) To be faster than the competition in introducing vehicles with innovative features in the marketplace. Such outcome can be mainly obtained through two levers:
   - the shortening of the *product life cycle*;
   - the reduction of the *time-to-market*.

b) To be faster than the competition in offering to the individual customer a vehicle defined according to his/her specific requests. Such objective can be reached through the integration of the whole supply chain based upon:
    - the launch of assembly orders for vehicles according to a specific order of the end customer: *Build-To-Order* (BTO);
    - the activation of a supply chain based upon forms of just-in-time (JIT).

9. The conditions for an effective time-based competition

The implementation of a strategy capable of effectively competing on time requires a profound adjustment in the organisational structure of the whole automobile supply chain. It is a true organisational revolution, of which only the largest elements are evident at the moment, since its completion will require a long stage of adjustment and refinement of the most effective solutions through a trial and error process. Such revolution will be even more important and long-ranging than the one described by Alfred D. Chandler[13] in 'Strategy and Structure' with reference to the rise of the multi-divisional firm typified by General Motors of Alfred P. Sloan.

To describe the characteristics of the new organisational structure based upon the competition on the time factor brings along many problems, however it is already evident that such new competitive stage will require firms to adopt a set of new organisational solutions capable of favouring the creation and diffusion into decision points of skills targeted to the speed of response to market stimulation. In other words this will mean to:

a) develop 'flat' and flexible structures;

b) prepare people to change by integrating the whole of the firm objective;

c) integrate the cycle of creation, measurement and diffusion of information;

d) integrate the decision processes of most complex problems;

e) automate easier decisions;

f) integrate decisional and operational procedures both on the information chain ranging from the order of the end customer to production ('upward' information flow), and on the logistics chain of the manufacturing and assembly stages towards final assembly and handover to customer ('downward' physical flow of materials).

It is easy to understand that the most relevant aspect of the new organisational structure will not relate to the inside of individual companies but rather to the relationships among firms across the whole supply chain[14] above mentioned at the point f). Such type of organisation already has a name: 'Extended Enterprise' since the hardest challenge to accomplish such complex design consists in managing that all firms operating in the automobile supply chain, juridically and economically different with respect to economic objectives and interests, act as if they were a single player. In other words this implies to overcome the contradiction which lies at the roots of the distinction operated by Williamson[15] between 'hierarchical coordination', carried out among entities belonging to the same integrated firm and 'market coordination', carried out among entities of different firms, with a supplier-customer relationship[16].

10. The organisation of the Extended Enterprise

As one can easily understand this implies to solve a complex equation of elements which are partly contradictory also because, as it has been previously pointed out, the current transformation

process of automakers moves through a significant reduction in their degree of vertical integration hence in a considerable complication of the control system in the whole supply chain which became much more complex, as it is articulated on a multiplicity of hierarchical layers.

This implies that the increased division of labor induced by the current reorganisation raises the level of complexity lying in time-based competition, since the reduction of lead times is strictly linked to forms of high integration between the stages both in the design (previous point a) and in the manufacturing stage (previous point b). In other words the search for higher levels of effectiveness and efficiency in the introduction of product and process innovation, through increased sharing of responsibilities among players in the supply chain, makes it more difficult their integration towards the objective of a faster competitive response. This because such response is linked to coordination processes of actors not only different from the juridical and organisational standpoint, but also bearing interests which are not necessarily the same, but linked to the OEMs by relationships with traits similar to those intrinsic in an 'agency relationship', and therefore subject to free-riding type behaviors.

In reality we are facing an even more complex problem than a *principal-agent* type relationship since the component supplier, differently from the agent, is necessarily involved in investments with sunk costs which make it highly more complex its own economic decision. Moreover, having to hold systematic cooperation relationships both with the automaker (customer) and other co-suppliers, it is exposed to the risk that important information on its own specific competences and the results of its own research and development activities on new products are taken away. In conclusion the supplier is subject to forms of risk sharing with its own customer over which it has limited scope for control[17].

11. Cooperating without ruling out competition

To make the framework of relationships between every individual OEM and its own Supply Chain even more complex, one must add that the cooperating relationship is to be re-discussed at least at every launch of a new model, since an integration for an indefinite time frame between the OEM and the individual supplier would clash against two difficulties. On the one hand free-riding behaviors could be more likely, since the option/threat of being replaced for a more efficient supplier would soften if not vanish. On the other hand, even without assuming a reduction in the commitment by the individual supplier towards innovation and manufacturing efficiency, it is anyway possible that the former is less innovative than another supplier, previously evaluated as less efficient by the automaker. In fact the risk linked to innovation is always very high and one cannot rule out that a component manufacturer is overcome by one of its competitors who undertook studies and research on different technological areas. It must also be said that the automakers' choice to 'strip off' many R&D and manufacturing activities derived right from the fact that the choice from time to time of the most innovative supplier and, among the most innovative, of the one capable of supplying at the most competitive price, is based just on such flexibility of choice which allows to take advantage each time of the supply which is believed to be most attractive. Such operational flexibility would have been missing in situations of higher vertical integration due to the obvious 'stickiness' of organisation towards the favouring of 'internal supply'[18].

12. Solving the dilemma: a reversible Extended Enterprise

To summarise: the problem facing automakers in the development of their own competitive strategies lies in accomplishing an unprecedented integration process, between each one of them and their respective partners in the automobile chain, both on product and on process innovation,

without such integration being irreversible. On the contrary, such integration should be replaced by forms of integration which are at last as efficient and as deep with suppliers other than the previous in all cases in which[19] the latter appear more innovative or more productive, at a given price.

There is no doubt that the road to solve such apparently contradictory dilemma is a process of organisational innovation mainly based upon the most powerful available tool of integration: information in general, and *Information and Communication Technology* (ICT) in particular.

In such sense ICT are seen as the tool capable of creating a stable information network of integration. Given that a stable integration among subjects cannot be maintained, one must build a tool which is constantly capable of allowing the turnover of individual partners (if needed) without affecting the correct functioning of the individual subjects operating within the Extended Enterprise. In other words the objective of automakers has become to replace a standardisation of relationships among themselves and the suppliers (what previously happened in an almost 'natural' way through the presence of vertically integrated suppliers) with a standardisation of the information medium which links them to potential suppliers. Once the technological status of a potential supplier is ascertained, its integration would be almost automatic through its capability to connect through the standardised medium proposed by the automaker.

13. Build-To-Order as the backbone of the reversible Extended Enterprise

The most representative aspect of an Extended Enterprise-type organisation is based upon the idea to strictly link the manufacturing system to a *pull* logic, directly triggered by automobile demand through a *Build-To-Order* (BTO) system. In an advanced automobile market the old *push* logic (moving the metal), based upon production according to market forecast only and sales according to available stock (Build-To-Stock, BTS) clashes against many difficulties which, on the one hand, do not allow to serve the final customer in an appropriate way and, on the other hand, force to initiatives of incentivising the sale of vehicles that have already been built and are stocked at the distribution network, through costly forms of sales incentives[20].

In theory a Build-To-Order[21] logic eliminates the need for the vehicle to be 'unsold stock', with the clear advantages which this brings along, from many standpoints. Such a process would determine, on the whole, a coexistence of stages of make to stock, make to order and build to order according to the needs/opportunities to privilege, for example, the manufacturing pace and plant saturation, rather than product customisation or stock reduction.

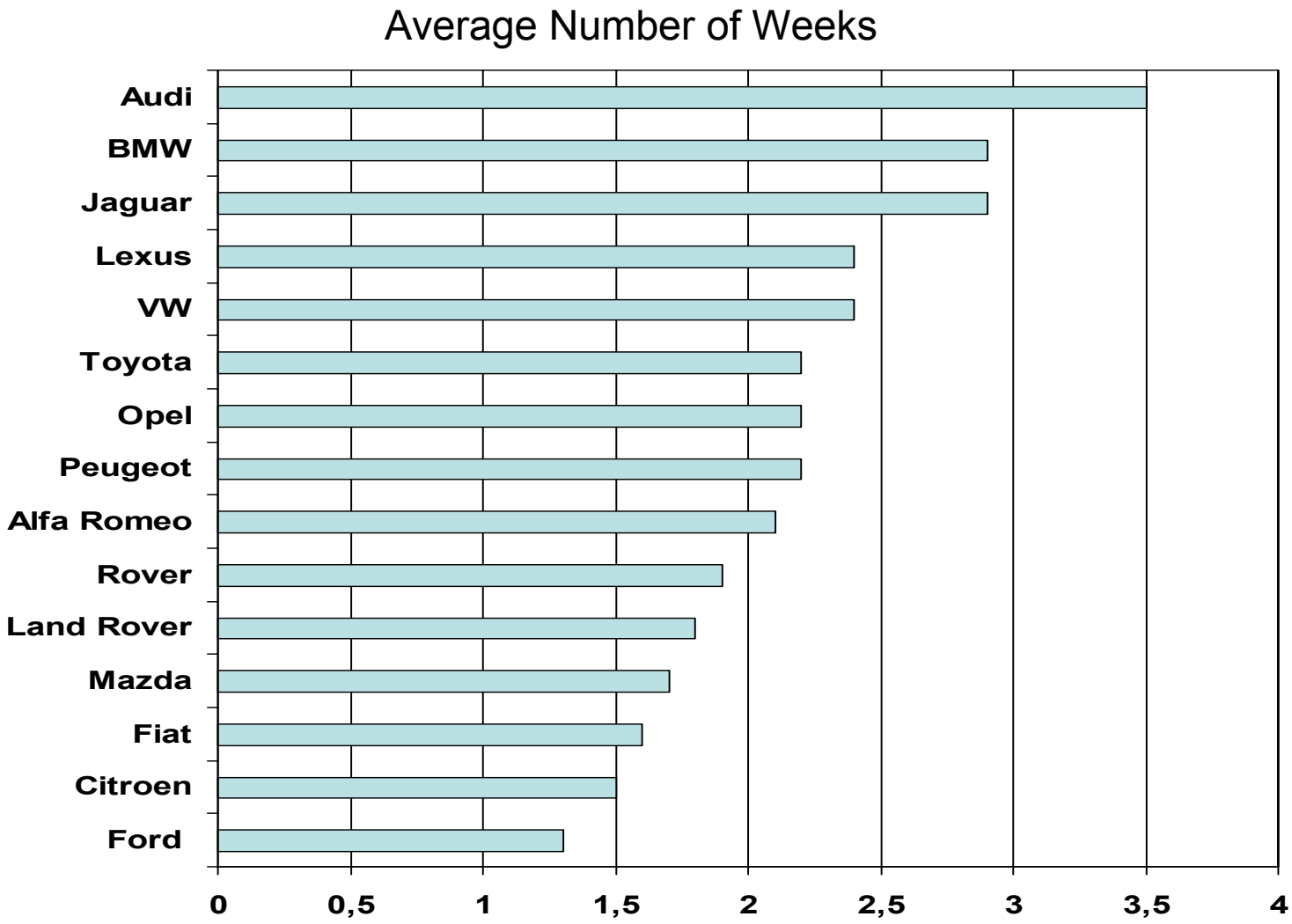
According to a study carried out by the 3DayCar Programme with European automakers, the lead time which is considered 'ideal' to serve the final customer (Order-to-Delivery Time) varies among the different automakers, but can be quantified on average at two weeks (Exhibit 2).

Always according to 3DayCar Programme calculations, the development of a BTO system would allow a substantial competitive advantage estimated at about 10% of total turnover (Exhibit 3).

Clearly this is an approximate calculation, however there is convergence across studies carried out on this subject on the opportunity to achieve considerable savings[22] starting from the reduction of the bullwhip effect[23] which is the first cause of an increase in the variability of orders moving upstream from the consumer to the manufacturer and its suppliers, which leads to the accumulation of high stock levels (Exhibit 4).

In an hypothetical situation in which all the required manufacturing stages are carried out by a single entrepreneurial subject, the decision on which programming logic to adopt in each stage (in simple terms, to decide when producing on a push or on a pull logic) could be based upon a decision referring to a single objective, that is the efficiency/effectiveness of the process as a whole. In such a situation the 'force' expressed by the needs of the final customer is that it constitutes the end point of such efficiency/effectiveness. But the stages are carried out by independent subjects,

Exhibit 2 – "Ideal" Order-to-Delivery Time by Make



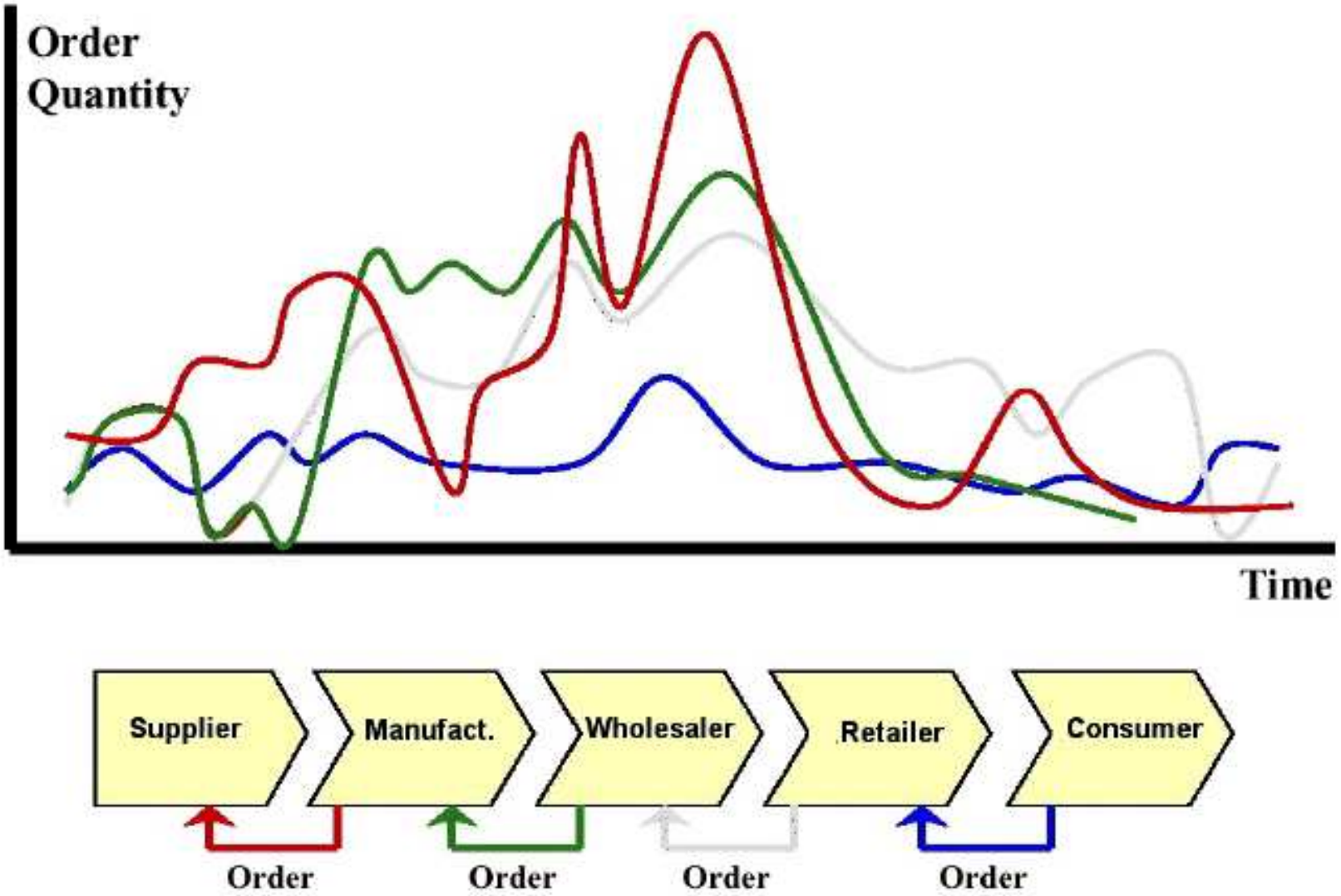
Source: 3DayCar Research

Exhibit 3 – Overall profit potential derived from BTO

Cost Savings	
Interest cost of inventory	1.85%
Inbound logistics, stock and material handling	0.15%
Finished vehicle storage and maintenance costs	1.80%
Dealer transfers	0.05%
Process improvements – time involved in sale, order wholesales, etc.	0.50%
Subtotal A	**4.35%**
Margin Potential	
Removal of additional discounts on ageing stock	1.85%
Removal of additional discounts on alternative specification	0.45%
Removal of old model stock problems	0.80%
Reduction in lost sales	0.10%
Sale of more profitable product mix	2.00%
More efficient revenue management	1.00%
Improved ability to supply 'right' cars due to better forecasting	0.40%
Subtotal B	**6.60%**
Investment	
IT hardware and systems throughout the supply chain	1.00%
Logistics capacity or environmental impact mitigation	0.10%
Production capacity in assembly	0.05%
Subtotal C	**1.15%**
Operations	
Outbound logistics	0.10%
Manning increase	0.20%
Subtotal D	**0.30%**
Overall Profit Potential (A+B-C-D)	**9.50%**

Source: 3DayCar Research

Exhibit 4 – The Bullwhip Effect



as it usually happens, and each player will try to adopt the programming logic which is more appropriate according to its own objectives, which depend upon the features of its own manufacturing process and upon the needs of its own customer (which is not the end customer). As a consequence, the firms who carry out process stages featuring a high share of fixed costs will try to pursue plant optimisation; on the contrary, the firms who are influenced by the pressure of a variable and unstable demand will try as much as possible to link their own order fulfilment cycle to an actual purchasing order[24].

The Extended Enterprise must somehow convey into a single integrated process the needs and the requirements of the various stages of the process. The problems arising in such sense are at least of two types, one 'technical' and one 'political'[25].

14. The 'technical' difficulties linked to the introduction of a model of reversible Extended Enterprise

First and foremost one must underline how the organisation of a system based upon BTO (even if not 'absolute' as previously defined[26]) appears a difficult and complex task, but achievable (and for some aspects also inevitable since a necessary condition to achieve a higher rationalisation of the manufacturing stages of the supply chain), thanks to the availability of the new information and communication technologies linked to the internet. Without the innovations made available by the Information & Communication Technology (ICT) an integrated organisation of the whole supply chain process would be technically impossible.

However one cannot hide that there are many issues to resolve for an effective exploitation of such technologies. Firstly, the objectives to achieve for the integration of a BTO system mainly consist in the achievement of:

a) an integrated communication system, shared among all actors of the supply chain, capable of supplying the necessary information support to synchronise separate and different processes;

b) a system of production programming (in its broad sense) which is shared an coherent (synchronised) for the actors involved in the supply chain.

The difficulties in implementing such objectives stem from problems linked to different forms of standardisation: standardisation of organisational models of firms operating across the automobile chain, and standardisation of the ICT systems linked to them.

With respect to the problems of standardisation of organisational models of the supply chain we have already mentioned the fact that there is not a single possible configuration of organised flow according the BTO model, but on the contrary there is a wide range of intermediate forms between a 'pure push' system, and a 'pure pull' system. Therefore it is normal that different automakers are incline to use different BTO models, according to the specific traits of the models sold. Such differences can be linked to a set of factors:

a) A first factor restraining the adoption of a standardised organisational model based upon BTO stems from the choice of where to position the cut-off point between the share of supply chain which one intends to manage with a pull logic, and that to be managed with a push logic, since it is not possible (due to cost and information integration needs) to develop a pull approach on the whole product considered in its maximum level of detail.

b) A second factor restraining the adoption of a standardised supply chain model relates to brand positioning. In fact it is known that specialty car producers have less difficulties in having their customers accept longer lead times, since the buyers show a higher inclination towards customised products[27]. On the contrary volume automakers believe that a BTO model is applicable only if it has a order-to-delivery time lower than two weeks, as

otherwise the customer prefers shopping-around looking for a competing model with faster delivery.

c) However a single automaker can decide (and as a matter of fact it is happening[28]) to begin applying some solution shaped around the 'pull' logic to just some of their models or in just some plants, depending on the fact that such models or such plants are more suitable to the experimentation of the new organisational model. This allows to highlight a second factor restraining the standardisation of organisational solutions as a same automaker would operate with hybrid situations on different models or plants, and the same would apply to the interested suppliers. Moreover a same component when shared across more models or more plants, could be required according to BTO or BTS forms with the consequent complications.

d) Finally one cannot hide the fact that suppliers play very different roles with respect to the specific traits of the product. Some are suppliers of completely standardised materials (MRO Materials), others are suppliers of components manufactured by catalogue, but partially customised, and others (as the suppliers of parts related to internal and external body) are suppliers operating in co-design mode with their own customer. Hence the positions of suppliers cannot be standardised, as they are involved in various forms by the automaker[29].

In conclusions one must underline that such multiplicity of positions makes the suppliers very reluctant to accept mechanisms of logistics and information integration since the solutions which are and can be adopted by the various automakers appear highly different and therefore cannot be standardised with the obvious need that a supplier of more customers would be involved in adopting a multiplicity of information models with effects which can be easily imagined with respect to its own organisation and to the investments for the different types of information tools.

At the same time the development of the software[30] to manage the activities within the individual firms in the whole automobile supply chain, including the automakers themselves, must face two alternatives of dramatic relevance from the standpoint of investments and of the preparation of the corresponding skills: to choose customised solutions with all the related advantages, but also with all the related cost disadvantages, or rather to choose standardised solutions, clearly cheaper but inevitably more rigid. The same applies to the communication system among the actors of the supply chain. The use of a truly integrated system implies the development of a common standardised language for all the players in the supply chain.

On this point as well there are many perplexities, mainly linked to the fact that the potential offered by the various forms of communication (multiplicity of EDI versions and internet) feature evaluation parameters (costs and potential) which are still difficult to assess, hence the various actors are reluctant to carry out the necessary investments required by such systems. To top it off, in this case as well, the various automakers have already launched partial systems with own features and this, lacking a single recognised standard, would force suppliers to adopt a plurality of systems, with all the necessary consequences in terms of investments and complexity in organisation and human resource training. The most evident case of such disparity of positions is represented by the coexistence of the different portals to manage virtual marketplaces. If on the one hand there has been some convergence by some automakers towards the Covisint marketplace, which however has some difficulties in taking off, on the other hand there is the entry of many other marketplaces, some activated by automakers[31], some by large component makers[32].

15. The 'political' difficulties linked to the introduction of a model of reversible Extended Enterprise

The 'political' problems linked to the development of a model of Extended Enterprise relate to the fact that its implementation implies to compose interests which are often different or

contradictory, so that the supply chain operates according to an integrated rationality rather than as the sum of many separate rationalities, that is operating what we hereby refer to as *strategic integration*. In summary, the problems are due to the fact that such logic:

a) Can modify existing relational equilibria and determine the need to renegotiate the terms of relationships according to the different degree of contribution (early involvement, innovative capacity of the supplier, risk-sharing);

b) Can determine the giving up to control prerogatives (of information, of process stages, of decisions, etc.), as well as to a lower flexibility in the relationships with the actors (higher idiosyncrasy);

c) Requires an 'end customer orientation' to all actors of the automobile supply chain, also to those who are not directly in touch with it, because their contribution is key towards customer satisfaction, even if any critical aspects raised by customers cannot immediately be associated to their own responsibility.

16. Conclusions

In conclusion the whole of the forces represented by: the strong competitive tension in the international automobile industry, the uncertainties over the technical solutions to be adopted with respect to ICT tools, and the political difficulties to compose the cooperation and competition mechanisms among partners along the manufacturing chain, make it necessary a process of strategic integration among the actors in order to improve the service for the end customer by reducing costs at the same time, process which is however complex and uncertain over the forms to be followed.

Therefore the solutions which can be adopted are different and will be naturally influenced by the competitive conditions in which the individual automakers are operating. It is clear in fact that an automaker with an exclusive brand (models at the top of the range) will have to operate different choices than an a volume producer.

However there seems to be no doubt that it is the automakers' task, being them the strong partners in the chain, to develop an 'operational proposal' oriented towards the other actors in the supply chain based upon:

- A process of standardisation of information and organisational languages;
- The introduction of safety tools which reassure the suppliers on the fact that the forms of information transparency required by the process of strategic integration are not one-way and are not managed as a sort of 'Damocles' sword' on the head of suppliers.

Without the introduction of forms of safety and protection the diffusion of models of Extended Enterprise is due to encounter systematic behaviors of passive resistance, with damage for the whole supply chain.

Bibliography

Abernathy W.J. [1977], *The Productivity Dilemma – Roadblock to Innovations in Automobile Industry*, The John Hopkins Press, Baltimore.

Asanuma B., Kikutani T. [1992], *Risk Absorption in Japanese Subcontracting*, in "Journal of the Japanese and International Economies, n.1.

Auto Business [2003], www.autobusiness.co.uk.

Bardou J.P., Chanaron J.J., Fridenson P., Laux L.M. [1977], *La Révolution automobile*, Albin Michel, Paris.

Camuffo A., Volpato G. [1997], *Nuove forme di integrazione operative: il caso della componentistica automobilistica*, F.Angeli, Milano.

Chanaron J.J. [2002], Les *relations entre le cœur et la peripherie du système automobile euro*péen, 10th GERPISA Colloquium, 6-8 June, Paris.

Chandler A. [1962], *Strategy and Structure – Chapters in the History of the American Industrial Enterprise*, The MIT Press, Boston.

Deutsche Bank Global Auto Team & Roland Berger Strategy Consultants [2000], *Automotive e-commerce*.

Freyssenet N., Mair A., Shimizu K., Volpato G. (eds.), [1998], *One Best Way? – Models of the World's Automobile Producers*, Oxford University Press, Oxford.

Freyssenet M., Shimizu K. Volpato G. (eds.), [2003-a], *Globalization or Regionalization of the European Car Industry?*, Palgrave-Macmillan, Houndsmills, Hampshire, 2003.

Freyssenet M., Shimizu K. Volpato G. (eds.), [2003-b], *Globalization or Regionalization of the American and Asian Car Industry?*, Palgrave-Macmillan, Houndsmills, Hampshire, 2003.

Gerli F. [1997], *Partnership, rischio e incentive: un'analisi del caso Fiat*, in Camuffo A., Volpato G., *Nuove forme di integrazione operative: il caso della componentistica automobilistica*, F.Angeli, Milano.

Hirschman A.O. [1970], *Exit, Voice and Loyalty*, Harvard University Press, Cambridge.

ICDP [2003], *Linking Supply to the Customer*, Research Report 02/03.

Kawasaki S., McMillan J. [1987], *The Design of Contracts: Evidence from Japanaese Subcontracting*, in "Journal of the Japanese and International Economies, n.1.

Kraljic P. [1983], *Purchasing Must Become Supply Management*, Harvard Business Review, n.5.

Lung Y., Volpato G. [2002], *Redesigning the Automakers-suppliers Relationship in the Automotive Industry*, in International Journal of Automotive Technology and Management, n.1.

Nishiguci T. [1993], *Strategic Industrial Sourging: the Japanese Advantage*, Oxford University Press, Oxford.

Sako M. [1992], *Prices, Quality and Trust: Inter-firm Relations in Great Britain and Japan*, Cambridge University Press, Cambridge.

SAP [2001], *Managing the e-supply Chain in the Automotive Industry*, Vol.1 and 2.

Shimizu K. [1999], *Le toyotisme*, La Découverte, Paris.

Sloan A.P. [1968], *My Years with General Motors*, Sidgwick & Jackson, New York.

U.S. International Trade Commission [2002], *Industry & Trade Summary – Motor Vehicles*, USITC Publication 3545, Washington, DC.

Volpato G. [1983], *L'industria automobilistica internazionale*, Cedam, Padova.

Volpato G., Stocchetti A. [2002], *The role of ICT in the strategic Integration of the automotive supply-chain*, in "International Journal of Automotive Technology and Management", 2 (3/4), pp. 239-257.

Volpato G., (ed.), [2002-a], *Vertical Relations and Modularisation in the Automotive Industry*, Actes du GERPISA, n.33, Mars, Paris.

Volpato G., [2002-b], *The OEM-FTS Relationship*, Tenth GERPISA International Colloquium, Paris,

Williamson O. [1975], *Markets and Hierarchies – Analysis and Antitrust Implication*, The Free Press, New York.

Williamson O. [1985], *The Economic Institutions of Capitalism,* The Free Press, New York.

Whiteman J., Williams G., Tongue A. [2001], *The Car You Want When You Want It – A Summary of the 3DayCar Programme*, International Car Distribution Programme (ICDP), Solihull.

Womack J.P., Jones D.T., Roos D. [1990], *The Machine That Changed the World*, Rawson Associates, New York.

Footnotes

[1] For a detailed description of these transformations in place see the two volumes edited by Freyssenet, Shimizu and Volpato [2003-a and 2003-b].
[2] On these aspects see: Camuffo, Volpato [1997], Volpato ed. [2002].
[3] Following the prevailing jargon in the automobile industry literature, an Original Equipment Manfucacturer (OEM) is an automaker who markets vehicles with an own make.
[4] Original Equipment Suppliers (OES) are first-tier suppliers in charge of coordinating design, manufacturing and supply of complex compoments also through the activation of a range of sub-suppliers. Such players are also referred to as First Tier Suppliers (FTS).
[5] On the phenomenon as in a) and in later points see: Lung and Volpato [2002], Volpato [2002-a] and Chanaron [2002].
[6] A Supplier Park is constituted by a set of suppliers located in close proximity to a final assembly chain of an automaker, with the aim of assemblying macro-components (modules) in a synchronous just-in-time way. In 2003 there are 23 Supplier Parks in Europe. The Volkswagen group (Audi, Seat, Skoda, VW) has the highest number of Supplier Parks (8), followed by the Ford Group (Ford, Jaguar, Volvo) with 7 and by GM with 3. See Auto Business [2003].
[7] It must be noted however, for a later reconsideration of the subject, that the transformation mentioned above has determined, among other things, a profound process of outsourcing of design (R&D) and manufacturing (machining and assembly) activities by OEMs to OESs with a subsequent considerable reduction in the degree of vertical integration of OEMs.
[8] Scientific production on fordism is endless. For a historical perspective on the issue see in particular: Bardou et al. [1977], Abernathy [1978], Volpato [1983].
[9] There clearly was a elitary demand with a higher disposable income who expressed different needs, but how it is known, only the automakers structured to supply a mass demand did emerge as winners in the competitive confrontation.
[10] Sloan [1968].
[11] On Toyotism and on the different meaning to give to Lean Production see: Womack et al. [1990], Freyssenet et al. [1998], Shimizu [1999].
[12] It must be considered that when calculating the average annual rate of growth of automobile demand over the decades: the 1950-59 and 1960-69 stage feature a strong and stable trend (an increase of 13.70% and 13.77% respectively), followed by a decade of stagnation (average annual growth rate equal to 0.27%) also due to the two oil shocks in 1973 and in 1979, with some reprise in the 1980-89 decade (+ 4.61%) and a new average stagnation in 1990-99 (+0.61%).
[13] Chandler [1962].
[14] See Camuffo and Volpato [1997].
[15] Williamson [1975 and 1985].
[16] Camuffo and Volpato [1997].
[17] On this complex isssue see: Hirschman [1970]; Kraljic [1983]; Kawasaki, McMillan [1987]; Asanuma, Kikutani [1992]; Nishiguci [1993]; Sako [1992]; Gerli [1997].
[18] As it is widely known all main automakers with relevant internal component manufacturing have since long chosen to outsource such activities on behalf of independent component makers who compete as other potential suppliers to acquire purchasing orders. That is the case for example of Delphi (previously a GM division) and of Visteon (previously a Ford division).
[19] In particular in cases of restyling of a previous model or of the launch of a new one.
[20] See Whiteman et al. [2001].
[21] The definition of BTO in its 'absolute' form implies that it is the order of the end customer to activate not only the final assembly process of the vehicle by the automaker, but also the production of the necessary components, managing however to reduce the lead time between the order and the vehicle handover to a few days. Such extreme version of BTO appears currently impossible to achieve, even excluding the lead times for transport of the final product from the assembly plant to the dealer. On the contrary between such 'extreme' alternative and that of BTS there are many intermediate solutions. For example one can imagine a BTO limited just to final assembly with a BTS for components which would be delivered by the supplier in a just-in-time mode. A more advanced solution would be to extend BTO to the assembly of 'modules' by first-tier suppliers, adopting a BTS for second-tier suppliers.
[22] For example see the study jointly developed by Deutsche Bank Global Auto Team & Roland Berger Strategy Consultants [2000].
[23] The "Bullwhip effect" is a pervasive supply chain problem whereby order variability grows as demand signals propagate upstream. Essentially demand spikes as the order flows back from a retailer to a distributor to an OEMs to tier-one suppliers and so on. Variability is the key nuisance of any system and in a supply system the main outcome of large order swings is increased inventories and reduced service levels.
[24] Currently all automakers are developing programs of information integation aiming at BTO. However, since they do not rigorously specify the type of BTO which they intend to achieve the declared lead time is not directly comparable.

Nissan is reportedly aiming for a 14-day car in Japan and Europe, with less ambitious targets for the U.S. markets. The company is currently running at 25-30 days in Japan and 40 days in the United States. BMW is aiming for a 12-day turnaround on orders, and projects it will trim that figure to 10 days by 2003. Mitsubishi of America has a form of BTO in place, where dealers are responsible for forecasting, up to 90 days in advance, what vehicles they need on their lots. Mitsubishi can deliver dealer orders on a 5-week lead time. GM reports that its current order-to-delivery time has been reduced from 70 to 47 days. GM is expected to launch BTO in North America with its Saturn division. U.S. International Trade Commission [2002].

[25] See on this topic Volpato and Stocchetti [2002].

[26] Cfr nota n.21.

[27] See ICDP [2003].

[28] It is for example the case of BMW who is adopting a BTO-type solution for '7 series' vehicles, waiting to develop the necessary competences to extent the approach to lower product lines. Similarly Mercedes Benz and Volkswagen are experimenting forms of pull organisation on their respective top-line models (Maybach and Phaeton).

[29] On this aspect see in particular Volpato [2002-b].

[30] For example the Enterprise Resource Planning (ERP) systems. See SAP [2001].

[31] For example VW has launched the portal VW Group Supply Com, and BWM the BMW Exchange.

[32] See for example the SupplyOn Exchange portal promoted, among others, by Bosch.