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Analysis of Drivers for Development of Common Platform Throughout Supply Chain Management (Concepts, Drivers and Case Study in Auto Industry)

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Abstract: In this research, we studied the causes and effects of the factors that determine the trend of employing Common Platforms (CP) in Supply Chain Management (SCM) of automotive industries. Moreover, we proposed a framework for analyzing Supply Chain Based on Common Platforms (SCBCP) in industries. The research methodology of this study is based on fact finding approach. Therefore, presenting the definitions and concepts of pertinent subjects, a conceptual model is developed for determining various aspects and finding facts regarding SCBCP in automotive industry. Critical factors and important facts in SCBCP have been identified by developing and analyzing the conceptual model. In addition, a triple performance criterion for the evaluation of SCBCP is developed. This study is one of the first to present a framework for SCM based on CP. The main research questions behind this study concern the following three main aspects: understanding, describing and guiding how we can apply supply chain based on common platform in auto industry.

Key words: Common platform, supply chain management, product development, fact finding

INTRODUCTION

Common platform strategy has turned into a critical factor, creating competitiveness in modern industries. This has led to outstanding and remarkable effects on design and development of products along with reciprocal interactions between various elements of a supply chain (Fathollah and Shafia, 2006). Although common platform strategy contains various concepts from software, hardware and management perspectives, the common contemplation amongst all the aspects is to provide a mechanism based on which the most variety in products will be achieved by the use of least possible production elements and resources. Creating sustainable competitive advantages for chain members, this mechanism provides a suitable ground, aimed at meeting market and customers' demand in the long run.

Achieving such an important objective requires purposeful planning for the application of common platform in supply chain. In this research, we will study more on this issue which can play a very constructive role for development, excellence and globalization of various industries such as car manufacturing factories. Accordingly, considering the objectives of automotive industry in this country towards world class manufacturing, it is tried to identify the principles of applying common platform strategy through the supply network of this giant industry by focusing on the existing experiences and practices of global automotive firms regarding CP. Specially when some of the world leading automotive firms have reported and reflected improvements in this field (Muffatto, 1999):

- Increasing flexibility in production as well as possibility of transferring production and technical know-how from one factory to another due to standardization.
- Moving towards cost reduction through the application of limited resources in a vast scale.
- Promoting the level of efficacy and effectiveness due to steep decline in proliferation, etc.

Therefore, it can be said that in today's world, application of an integrated platform approach has turned into a priority for competitiveness in various industries specially car manufacturing. Following the same trend, an increasing number of industrial factories and manufacturing enterprises are now taking advantage of common platform strategies in every aspect (Muffatto, 1999). For further understanding of the ways and whys regarding the effectiveness of common platform strategy throughout the supply chain, key platform performance indicators have been identified in the automotive supply chain. Accordingly, we have tried to take advantage of

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practical experiences gained by both domestic and foreign car manufacturers regarding the effect of CP application in supply chain. The goal is to provide a conceptual framework of success factors in supply chains based on common platforms and extract the related facts in order to provide an implementation basis for local automotive industries.

COMMON PLATFORM CONCEPTS

Various dimensions on the issue of common platform, its advantages and objectives have been published in academic and scientific journals. Based on these articles, various aspects such as strategic, competitiveness, technical, information and organizational have been highlighted. In general, the platform concept undertakes a complete evolution, based on which various dimensions and aspects are posed and/or evolved. Accordingly, based on existing studies, necessities and objectives of common platform as well as its definitions and concepts will be explained and clarified. (Meyer and Lehnerd, 1997). The theory of common platform is inspired by the idea that competitive advantages are gained by producing a wide variety of products based on a limited number of common and standard parts, components and elements. Nowadays, since gaining significant market share, reducing design and manufacturing cycle times, reducing the price of products and increasing quality and flexibility are considered as salient features of production and trade activities, many companies believe that the adoption of common platform strategy is a suitable approach for preserving competitiveness.

Common platform is the combination of common elements that prepare a basis for producing various types of products through a basic production line. This platform is considered as a foundation upon which, product families are produced in accordance with a common configuration and structure (Siddique and Rosen, 2001).

According to Muffatto (1999) common platform is considered as a foundation for producing various types of products, belonging to one family, with the least variety in components, factors and production process. Muffatto (1999) analyzes a platform from a managerial perspective. That is, CP is considered a business strategy which will result in reducing cost and consequently increasing profit. In general, common platform is a product development strategy concentrating on the reduction of cost coupled with timely product delivery (Muffatto and Roveda, 2000). In addition, other studies that have presented definitions for common platform include: Meyer and Lehnerd (1997), Yassine and Wissmann (2004), Farrell and Simpson (2003) and Fathollah and Shafia (2006). Regarding the benefits of CP, some key advantages that are repeatedly reported by researchers are reductions in time, cost and system complexities (Kim *et al*., 2005). Generally, one can say that the development of new products based on common platform will not only improve and ameliorate technical and trade performances, but also produce more profit for industries and industrial practitioners.

DEFINITION OF SUPPLY CHAIN MANAGEMENT

Supply chain includes all procuring and supplying activities that contribute the transformation of materials and goods from the earliest stage of extraction, up to the point of product delivery to end user. Concerted management and monitoring of all these activities and related elements are regarded as a very important key in supply chain management. Hence, supply chain management is defined as a set of practices that carry out these activities and reassure that customers receive their requested products and services with the highest quality, within promised due dates and in an appropriate and economical manner (Chopra and Meindl, 2007). Obviously, the aforementioned objectives have to be accomplished with regard to the interactions and relationships between all chain members, providing value and benefit for all of them (Croom *et al*., 2000; Prasad *et al*., 2005).

RESEARCH QUESTIONS

Today, development and application of both SCM and CP concepts in automotive industries are accelerating, obliging the companies to take critical decisions. The following research study primarily aims at offering a framework for decision making regarding the effects of applying CP concepts and strategies in the supply chain of auto manufacturing factories in Iran. The research methodology of this study is based upon the fact finding approach (Wacker, 1998). Therefore, at first related concepts and definitions are provided and the utilization scope of the subject is identified according to the performed case studies (Meredith, 1998). For modeling relations based on analytical conceptual research aimed at adding more insight to traditional issues through logical analysis, the following study tries to take advantage of experiences and technical know-how for the formulation of relations. It is important to note that in order to evaluate and analyze the issues provided in

present study, firstly a vast effort has been dedicated to study the related published studies. Afterwards, the effects of utilizing common platforms in supply chains of the selected automotive firms have been analyzed by performing case studies and field research. Moreover, by holding numerous interview sessions, opinions of experienced experts have been considered in the process of analyzing the relationships. In order to achieve valid results, experiences of managers and experts of two giant Iranian car manufacturers, Iran Khodro and Saipa, along with published patterns and practices in foreign automotive companies are utilized to develop a conceptual model. Therefore, some key questions regarding the improvement of automotive supply chains based on common platform approach are presented as follows:

- How should a platform be designed and employed through the supply chain considering the complexities of an end product like automobile? Which factors should be taken into account?
- How can we adopt an appropriate strategy for development and application of platform through the supply chain? And how can we evaluate its performance?
- How does the common platform approach influence the interactions and mutual relations between suppliers and auto manufacturers?

NEW PARADIGM IN PRODUCTION AND MANUFACTURING

The new developments in both fields of trade and economy are a result of changes in paradigm and rules envisioned in supra-industrial era. For example in the previous decade, it was the producer who would determine the price of its products or services by adding a percentage of expected profit on the total costs related to each product. But in the present condition, the prices of products are determined by market and consumers. Today's manufacturers tend to take every possible step to satisfy their costumers and therefore to gain more profits, they embark on reducing their costs in every possible way. Based on this approach, application of common platform strategy in the supply chain can be regarded as an appropriate and logical way for the realization of the mentioned objective especially by reducing cost, cycle time and increasing flexibility (Fig. 1).

Platform thinking: The concept of platform and its related topics are primarily regarded from a physical perspective, based on which concepts of product platform

Fixed sales price and/or on the verge of reduction	New paradigm	Traditional paradigm	
Sales price is set by market and customer. To gain more profits, the producer has to reduce costs.	Profit increased	Profit decreased	Sales price is set by producer. It is comprised of both finished cost plus expected profit. Reduction of costs is not a major priority.
	Finished cost Finished cost fixed or on the verge of decrease then expected profit increased	Finished cost Finished cost fixed or on the verge of increase then sale price increased	

Fig. 1: Change of paradigm in pricing products

and production platform, as well as many other hardware aspects are developed. On the other hand, in some cases the scope of platform application has been developed in software and non-physical aspects such as technical know-how, information, processes, etc. In a research performed by Muffatto and Roveda (2000), the software aspects of platform were also taken into consideration. They introduced common platform as a combination of assets which are shared in a product or production and delivery process including components, technical know-how and manpower plus their relations. The platform concept is formed by a comprehensive combination of these factors.

According to Yassine and Wissmann (2004), in applying platform approach, four salient features of a product are shared: Components (when applying platform strategy, components are the most shared elements amongst products), Processes (for example: production and distribution), individuals and their relationships and finally technical know-how. Hence one can say that the platform thinking is the urge to use hard and soft platforms when applicable. It will result in the sharing of resources, risk and profit between and within chain members. Table 1 demonstrates some aspects of hard and soft platforms.

According to researchers and analysts in the fields of business and production more added value is gained in the initial stages of the supply chain. Furthermore, it is believed that in the early stages, supply chain is strictly hinges on soft aspects while moving towards the later stages of production and commercialization, the application of physical and hardware aspects will be increased (Fig. 2).

Table 1: Hard- and soft platforms

Soft platforms
Sharing technical know-how of soft platform
Sharing data and information
Sharing processes and procedures
Sharing engineering designs and ideas
Sharing names, brands and trademarks
Hard platforms
Sharing machinery and production line
Sharing physical elements including parts and components
Sharing materials, tools, equipments and so on
Sharing capital and manpower and so on

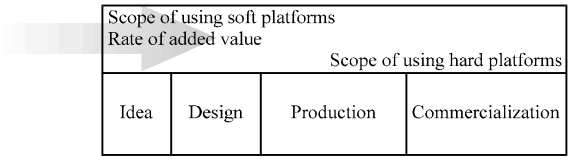

Fig. 2: Comparison of value added as well as application of using soft and hard platforms in supply chains

Thus, we can grasp out that the application of soft platform can produce more added value than hard platforms. In conclusion, it is essential to provide a preliminary foundation for planning and effective management of value creation process by taking advantage of common platform approach in various stages of a supply chain.

SUPPLY CHAINS BASED ON COMMON PLATFORM (SCBCP)

Appelqvist *et al.* (2004) in their research on Design for Logistics (DFL) pointed out that certain strategies such as: commonality, modularity and postponement have to be considered in the product design process so that the new products would be consistent with logistic and supply chain structures. Under such circumstances, we cannot expect the design and development of products to be perused without considering the improvement of supply chain performance indicators. Accordingly, several factors have been proposed for the evaluation of supply chains and platforms for example: Lamothe *et al.* (2006) have enumerated the platform performance criteria as integration, rapid response to environmental changes and flexibility in design and engineering for a family of products. On the other hand, they termed flexibility as the most important feature, having a direct effect in a supply chain. According to Tummala (2006) the reduction of cost, improvement of inventory, amelioration of time and gaining customer satisfaction as well as increasing flexibility are the performance measurement criteria of an SCM practice. A review of these factors reveals that CP can be a good method to improve supply chain performance. Yassine and Wissmann (2004) suggested three success factors for supply chains based on common platform: cycle time efficiency that determines the time needed for various products to proceed from the initial to the final stages in the chain, competitiveness that regards the platform flexibility and its ability to conform to market changes and profit (loss) that indicates the economical benefits versus costs of platform development or in other words the platform effectiveness. Many researchers point out the platform flexibility as the most important factor for success evaluation of a platform based supply chain. However, according to Gonzales *et al.* (2001) the flexibility factor is most critical when designing the new platform. According to the aforementioned, we can conclude that time, competitiveness, flexibility and profitability are the key factors in platform based supply chains that enable the creation of competitive advantages for chain members.

CASE STUDY IN AUTOMOTIVE INDUSTRY REGARDING SCM BASED ON CP-BRIEF REVIEW

In the modern era, reduction of sales volume per vehicle as well as short life cycle of products prevents the auto manufacturing companies and their suppliers from gaining economics of scale in production along with sustaining product variability. Therefore the focus on common platforms and exchangeable product modules seems to be an inevitable effort. The platform approach was introduced in the early 90s as the result of attempts in simplifying product design and development and not long after that, in 1994, it was employed as a key solution in different industries. Mutual sharing of profits and losses between various members of network, development of competitive advantages and cycle time reductions are regarded as the main objectives for the development of platforms throughout supply chains (Muffatto and Roveda, 2000). On the other hand, production of wide spectrum of various products based on different customer needs in market is regarded as the key objective which has been posed in car manufacturer with common platform approach. In automotive industry, production of a wide range of variable products based on different customer preferences is amongst the key objectives of applying CP strategy. According to reports by companies such as Volkswagen, General Motors and Toyota, application of platform strategy in their manufacturing process has resulted in improvements of time and cost factors. According to Simpson *et al.* (2007) sharing the floor part in body of the cars and the chassis amongst different models can reduce the expenditure down to 50%. Regarding productivity in product development, the

platforms enable the diversification of products and at the same time reduction of production elements. Moreover, the platform strategy may cause significant improvements in delivery times enabling a 30% reduction. As far as cars are concerned, the platform technically consists of the floor part of body, the suspension system and the axles, the bottom part of the car floor in front and rear and the space for engine and chassis. In addition, different definitions have also been presented by leading Japanese car manufacturing factories (Muffatto, 1999).

CP in Iran Khodro Co. (IKCO): In IKCO, platforms include automobile parts that are not in direct view of the end consumer. These parts form about 65% value of the whole car and include the propulsion system, dynamic and electrical parts, bottom part and framework of seats and control and ventilation systems. Advantages gained by common platform strategy have convinced IKCO to create the basic designs for the parts of its brand new products upon existing platforms. Main objectives of IKCO in utilizing the common platform strategy are as follows:

- Reducing the cycle times for design and product development in order to improve business performance
- Reducing costs by using economics of scale for shared parts (in both manufacturer and supplier)
- Reducing the costs for design and new product development
- Improving quality levels and standardization in manufacturing or the shared production method of the same line
- Using similar parts in different cars in order to reduce the end price
- Rapid utilization of new technologies using the company's brand
- Diversification of products together with the least possible variety in product parts
- Improving productivity and throughput in production lines and manufacturing facilities

CP in Volkswagen Co: Platform and modularity concepts are the main strategies of VW for improving its competitiveness in the future. The common platform is regarded as the strategic and global viewpoint of VW that includes standardization and diversification of product development and production and supply processes. The company's preference implies the vertical improvement principle in its structure. Benefits of platform strategy in Volkswagen include (Heikkilä *et al*., 2002):

- Diversification of products
- Reducing production costs and increasing profit
- Increasing productivity of production factors by resource sharing
- Facilitating the planning and management of production factors
- Accelerating the introduction of new models
- High flexibility in production of various products
- Improving the relationships with suppliers and customers, etc

CP in GM: Not long ago, GM was pushed down to the verge of bankruptcy by of the tight competitions in automotive industry. The incident obliged its deciders and practitioners to employ new strategies such as common platform, lean manufacturing and globalization as key reinforcements. Increasing its market share and profitability, today GM is amongst the most successful automotive firms in US and around the world. Common platform strategy was pursued in the company from mid 1990s in the forms of common engineering, common processes, common manufacturing systems and common parts and components. In 1997 the concepts were practically being used by organized executive teams and specialized groups. Thereafter, the benefits gained by implementing the CP were reported as follows:

- Reducing the costs related to production elements and operations which lead to the reduction of end price and enhanced profitability
- Responding to production and sales commitments
- Effective use of resources and improving competitiveness
- Facilitation of planning and monitoring production operations
- Standardization and improvement of capabilities related to the replacement and transfer of tools, man power and facilities between factories
- Reducing production cycle
- Increasing flexibility and speed
- Reducing time and costs of engineering changes, elimination of redundant factors and taking advantage of common factors
- Reducing the number of part and component suppliers

Advantages gained by common platform made GM develop up to 90% of the basic designs for its new products based on existing platforms. According to the company policies, when required alterations in components and engineering processes are less that 25%, the changes are applied based on common standards and

unnecessary multiplicities are strongly prevented. From another point of view, commonality resulted in reduction of time and costs in GM to a great extend that the Time to Market (TTM) factor was reduced from 24 to 18 months. Progression times were reduced as well. It is obvious that for a company that has a 5 year plan on reaching the goal of introducing a new product each three weeks, the aforementioned improvements are of great value. Id addition, taking advantage of platform strategies, the company was able to reduce the number of its direct suppliers from 400 to 90 which made a great influence on supply and logistic costs of the company (Alden *et al*., 2006).

PLATFORM THINKING: ANALYSIS OF SUPPLY CHAINS BASED ON COMMON PLATFORM IN AUTO INDUSTRY

Following the introduction of factors affecting SCM based on CP and having observed and studied the practical and academic resources, here, section we will try to analyze the evidences regarding the effects of the identified key subjects in SCM based on CP. At first, a conceptual model is developed shown in Fig. 3. There are four fundamental factors that play an important role in platform based supply chains including soft and hard platform plus SCM and CP strategies (Meyer and Lehnerd 1997; Sheu and Waker, 1997).

Considering these fundamental factors, the Supply Chain Based on Common Platform (SCBCP) can be analyzed by six factors described below:

Modularity and product architecture: Product architecture is defined as the determination of relations between different subsystems of a product and other systems. According to another definition, product architecture is a mapping of operational elements of a product to its physical components. From a technical view, the interactions and relations between platform strategy, modularity and product architecture have to be well considered since they have a very important effect on product development process (Simpson *et al*., 2007). Different and somehow contrasting approaches exist towards product design and modularity. Some companies have made significant efforts in this regards whereas others have made little efforts in modular design. In addition, tendencies towards modularity highly depends upon a more extensive approach towards platform development that supports the platform as a component in products that can be used as a common elements in a wide variety of products. Accordingly two main approaches are suggested regarding product architecture

Fig. 3: Factors affecting on Supply Chain Based on Common Platform (SCBCP)

(Simpson, 2003): The top-down Approach and, the bottom-up approach. Today, product variety is one of the main issues in automotive industry. In the current competitive situation it is an essentiality to introduce a variety of products to consumers. However, the question is how much variety is required in products? Therefore, the profits gained by having a variety of products have to be compared to the costs related to their diversification (Ulrich and Bradley, 2002). Another important issue in product architecture is the emphasis on designing a family of products based on commonality and standardization (Farrell and Simpson, 2003).

Platform architecture: In different industries especially automotive manufacturing, the main issues concern decision making regarding the platform/model ratio, reducing or reproducing platforms, integration of existing platforms, development of new platforms and mixing platforms between models and so on. The main question is How many car models can be originated from a single platform?

Regarding the passenger cars, this proportion for most car manufacturing factories is reported approximately equal to 3 (Muffatto, 1999). Regarding the commercial and multipurpose vehicles, the proportion is nearly 1. In general, the factories that have a more comprehensive definition of platform tend to reduce the number of their platforms. Concerning the reduction or expansion of models, the inclination is definitely towards

expansion, especially for recreational vehicles. The globalization process also leans the companies towards expansion and diversification of their produced models. Hence, based on rapid changes in customer expectations and offering variable products, the factories have a tendency to share the platforms between models especially from passenger cars to sports cars and minivans. In addition, there is an inclination to produce light vehicles from sport car platforms. Therefore, the examples of existing challenges include: manufacturing of sports cars from passenger car platforms or creating giant and heavy vehicles from platforms related to light cars and vice versa.

The platform can also be considered as a module. However, the unity of platform development and modularity seems to be weak due to cost and flexibility issues. The development of a platform with the engine and power transmission system constitutes about 80% of the whole vehicle development costs. Therefore the reduction of total costs by developing modules is not applicable and the initial costs cannot be moderated with the reductions in total product costs. On the other hand, modularity can have several benefits in improving flexibility and simplifying the supply and assembly process. According to Simpson (2003) this will result in the reduction of product development costs and system complexities, as well as improving the ability to increase quality and innovation.

Structurally, the platform strategy has also an impact on product development process and product architecture. Generally, regarding the product development process in automotive industry, the main feature is to divide the development of floor part of the body from the upper part that forms the external shape of the car. In fact, 90% of the floor is developed independently from the top part. This division act enables the distinction between platform development and model development that will reduce the development time to 16-20 months. On the other hand, the platform strategy and part and component sharing will result in structural changes in product bill of materials towards simplification.

Another important point is the relationships between existing and new platforms. There are two important approaches in developing product platforms which are: Active and Passive. In the active approach, the companies design a platform in the first stage of product development process and the product models are designed and developed based on that platform. In the passive approach, firstly the commonalities between a sub set of chosen developed products are identified. In other words, the commonalities in some features of the products are used as a foundation for development plans. (Ghosh *et al*., 2004).

Supply network: Although platform development is not defined as adoption of salient changes in relations with supply network at the first glance, two significant aspects should be taken into consideration in the supply chain. The first case is related to reducing cost through development of platform and commonality while the second case is related to reduction of time throughout the chain.

Cost reduction: This is meant more production through using the very same parts which will result in profitability in economic scale coupled with reduction of cost price and costs as well (Simpson, 2003). Based on this supposition, emergence of mega suppliers is considered as the most important incidents which are happened through merging and possessing large part manufacturers. In the same direction, the number of parts suppliers has been reduced in various chain categories remarkably. For example, the number of FORD Factory's part suppliers and manufacturers was reduced from 2,300 in 1996 to 1,300 in the year 2000. In the year 2005, the said figure was reduced to 600, showing 74% slump.

Time reduction: Changes adopted by development of platform may leave remarkable effect with regard to relation with suppliers. In fact, if model of product development from manufacturing one product and then making revision on it was changed into anticipated and manufacturing model, in this regard, suppliers will be enforced to prepare their parts themselves and set price for them as well. On the other hand, it should be mentioned that common platform approach will result in close participation and partnership between suppliers and manufacturers. Based on this trend, role of each of chain elements has been changed especially in car manufacturing industries (Fig. 4).

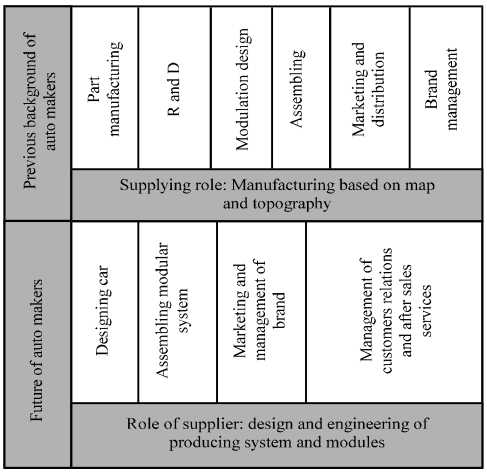

Fig. 4: Manufacturer and supplier roles; new and past

Moreover, some part of production and manufacturing and assembling car will be vested with suppliers. Therefore, suppliers play a very constructive role in supply and production cycle of car (Cullen, 2006). Hereunder are regarded some advantages of using CP strategy in the supply chain:

- Facilitation in supplying and producing independent modules by suppliers
- Possibility of transferring responsibility of quality and performance of each group independently to supplier
- Possibility of establishing independent, common and standard modules in products
- Facilitation of production, assembling, development and promoting products based on independent modules
- Designing modular which make possibility of test and specialized testing in each case of module
- Facilitation of planning on procuring independent modules of parts and groups from various suppliers by car manufacturer
- Possibility of development of specialized suppliers
- Creating value added in the supply chain, with due observance to standardization of parts coupled with distinguishing products
- Reorganization of logistic facilities such as warehouses, transportation and distribution channels, etc
- Standardization of common aspect which will result in adaptability of modules from various generations of products and facilitating their production, supply and assemble so on

Globalization and extended enterprises: Some experts believe that world is on the verge of assimilation. Based on this supposition, world is moving towards integration and unification of products. According to this theory, differences have been reduced remarkably in both national and regional markets. In the same direction, some differences between some products have been eradicated. In such circumstances, CP strategy is posed as a basic and fundamental approach towards the globalization process, using the resources and markets in the global scale. Hereunder are the main factors behind application of the mentioned approach:

- Possibility of employing production resources in various factories due to flexibility and standardization of factors
- Reduction of costs due to using resources in world scale coupled with increasing productivity and effectiveness of factors, etc

In this situation, size of the companies will not determine their success, but rather the way of exploitation from size and scale of the company in the world will be considered as an appropriate criterion. In other words, globalization includes enhancing the relationships with other members of the supply chain as well as relation with other world countries. This issue will result in the development of capabilities in global level as well as possibility of transferring the design process to the world number one suppliers. In the globalization point of view, three major inclinations have been observed in strategies of leading Japanese companies which have enough experience in this regard. They take their decisions regarding the number and type of platforms to be developed in various parts of the world based on the existence or the lack of the platform concentration versus model development, localization and globalization of platforms. Regarding the number and type of platforms to be developed in global scale, inclination is towards reduction in the number of developed platforms in various parts of the world. In the same direction, factories show adoption of congregation policy of platforms especially in Europe and America. The studies made in this regard show that common platforms as congregated in global level will change basis on cost and competition in a way that it has been anticipated that less than 24 platforms with high circulation will contain approx. half of productions of world auto manufacturers up by the year 2008. It should be mentioned that congregation of developed domestic and foreign platforms are considered as a common policy. In the same direction, development of regional private platforms (both in Europe and America) is followed up with law of one region = one platform. Generally, each region enjoys one independent market. This issue requires congregation of existing platforms and partnership of platforms between Japan and other regions. This issue seems more difficult in U.S. market. In this situation applying CP strategy may be affected by some limitations such as: limitations are related to model and platform number and life cycle in SCM.

Common engineering: Focusing on soft elements like engineering knowledge and common technologies, the CP strategy leads to reductions in time and cost related to design and engineering through the chain. Accordingly, some of the basic designs used as platforms are regarded as a foundation for development of further designs for other products.

This commonality proportion for technical and engineering designs is reported up to 90%. The purpose is to standardize the elements in design and engineering, reduce the multiplicity of technical designs and consequently limit and simplify hardware and software elements as well as required knowledge and

technology which would ultimately lead to more profitability. The key impact of commonality of design and engineering in companies is the reduction of cost and time in different stages of design, production and delivery. As a result, car manufacturers will be able to diversify their products besides reducing a significant amount of operation times. The final impact would be the improved effectiveness of production and business. Research shows that when industries approach their design, engineering and manufacturing processes without considering the possible commonalities, their costs will significantly increase (Kim *et al*., 2005). However it is important to note that the platform approach becomes even more important considering the fact the role of the suppliers also change from merely producing the parts to design, engineering, manufacturing and assembly or components and modules.

Common resources: According to Ulrich and Bradley (2002), sharing resources and production processes in a product platform, companies can effectively produce variable products and enhance the flexibility of their production processes. Therefore they will be able to gain more market share by outracing their rivals who produce one product at a time. Accordingly, sharing resources (hardware or software) through the chain can have an enormous impact in improving the operational interactions between chain members and enhancing their agility and integrity. This kind of alliance and collaboration would lead to collective profitability. Regular hardware resources in automotive industry include machinery and equipments. Standardization and sharing the mentioned resources along with reducing their diversity would provide precious opportunities for members of the supply chain. The benefits include facilitation of maintenance planning and operations and limitation of technical specialties needed. The following are some more benefits of using common and standardized resources:

- Easier maintenance and repair operations for machinery and equipment in production and assembly process
- The possibility of optimum utilization of machinery performance and capacity
- Facilitation of procuring spare parts and accessories.
- Specialization of tasks and improving the quality level of products
- Justification of investments on innovative and modern technologies due to their prospective utilization for manufacturing a massive amount of diverse products
- Easier and long term relationships with suppliers and providers of related technologies
- Developing the utilization of industrial automation in the production process due to the possibility of producing an economic amount of distinctive modules of products and parts

IDENTIFICATION OF FACTS IN SCBCP AND CHALLENGES OF IRANIAN AUTO INDUSTRY

In conclusion, having studied the academic resources and presented case studies, the following facts are identified as propositions in supply chains based on platforms (SCBCP):

Fact 1: Modularity, commonality/standardization and differentiation are the key factors in SCBCP

Fact 2: Sustaining the economics of product variation, mentioned key factors lead to the maintenance of the economics of scale for auto manufacturers and suppliers

Fact 3: Time, flexibility and cost indicators have a higher performance in platform based supply chains of automotive industry comparing to industries that do not use the platform approach

Fact 4: In supply chains based on common platforms, the traditional suppliers' role merely manufacturing the needed parts based on existing designs, changes to designing, engineering, producing and assembling of components and modules

According to the aforementioned facts, it can be concluded that Iranian automotive industry is in crucial need of competitiveness. That is, improvement by competing with the leading global automotive manufacturers. This will be achieved by developing policies to connect the Iranian manufacturers to international markets. However, a major requirement is the ability of world class manufacturing, which is a million cars in number. Although the production quantity is a crucial prerequisite, other requirements like improvement of quality, diversification of products and development of sustainable competitive advantages as well as reducing costs cannot be overlooked in the globalization process. Accordingly, implementation of the common platform strategy through the supply network is proposed as a shortcut for Iranian auto industry in entering the global market. Improvements in performance factors of supply chains based on common platforms can be extracted as shown in Table 2- 4. However, accomplishment in this path requires planning and effective management of common platform application in this industry and therefore, it is essential to take appropriate decisions in facing the critical existing challenges. The key challenges that Iranian automotive manufacturers are faced with include the following:

Table 2: Improvement of time through SCBCP

Time factor	Improvement causes
Procurement time	Reducing the number of suppliers and unification and simplification of supplying process caused by reduction in part multiplicity
Inbound and outbound logistic times	Standardization of logistic facilities and transportation systems, reducing multiple transportation times due to reduction in part multiplicity
Production line stoppage time	Preventing part and module deficits due to commonality and the possibility of using standardized items in a wide range of products
Design and engineering time	Savings in design and engineering times due to wide usage of basic designs for common parts in future products
Production alteration and adjustment times	Preventing multiple changes in production plans due to reductions in production elements along with facilitation, flexibility and stability of production planning and control
Production, assembly and set up times	Shortened production and assembly, possibility of using automated manufacturing systems due to economics of scale gained by sharing production elements

Table 3: Improvement of flexibility through SCBCP

Flexibility factor	Improvement causes
Flexibility of products	Due to modular architecture, the possibility of product diversification for covering a wide range of market needs is provided. Development, production and presentation of new products consistent with market needs will also be facilitated
Flexibility of production	Employing standardization and commonality approaches in products and processes will enable the opportune usage of economics of scale and consequently the coordination of production capacities for diversification of products
Flexibility of supply and distribution	Employing standardization and commonality approaches will enhance the supply and distribution of common parts and components via suppliers and producers
Flexibility of logistic facilities	The possibility of using common and standard resources and facilities in supply chain will be provided
Flexibility of design and engineering	The possibility of sharing basic designs and engineering operations in a variety of products will be provided
Flexibility of operational processes	Taking advantage of soft platforms such as sharing of knowledge, information, and procedures will lead to more effective and standardized operational processes

- Decision making regarding which market sector should be aimed for each platform, what are the consumer preferences of each sector and what product features and specifications are of the most importance for them?
- What are the appropriate types of architecture and degrees of commonality that should be applied in producing various types of products in supply chain?
- How can we make a trade off between component commonality and product diversification in the supply chain? What about a balance between the relative shorter product lifecycles versus platform lifecycles?

Table 4: Improvement of cost through SCBCP

Cost factor	Improvement causes
Inbound and outbound logistic costs	Improvements in transportation of common parts and modules that enable the use of standardized logistic facilities in the chain
Costs of ordering, inventory and warehousing	Ordering a higher amount of common components, easier inventory and reduction of safety stocks due to reduction in multiplicity of parts
Costs related to idleness of parts and equipments	Reduction of part proliferation and taking advantage of standardized elements that allow a wider utilization, that result in reduction of idle costs for parts and production elements
Production lines stoppage costs	Improving the capacities and throughput of production assembly stations as well as elision of part deficits that reduce stoppages of production line
Costs of engineering changes and modifications	Synchronization of production lines in order to employ common parts and components that enhance the production line balance and management of engineering changes through the chain
Costs of product engineering and design	Reduction of design, engineering and prototyping costs as well as costs related to design and manufacturing of dies that will be used numerously in future products due to platform approach
Quality costs	Reduction of defects due to dealing with common parts, easier detection of defects and errors, facilitation of quality tests and inspection
Planning and system management costs	Improving flexibility and reduction of system complexities due to less multiplicity in costs and changes in plans
Investment costs	Reduction of investment in machinery, equipment and production factors in the long run
Costs related to suppliers, producers and distributors	Enabling production and assembly processes along with supplying of parts and components to be independent, specialized and in an economic scale
Costs related to reverse logistics and after sales services	Prevention of proliferation in parts and equipments that will lead to high levels of effectiveness and efficiency in reverse logistics and after services
Cost of customers complaints	Timely production of a variety of products with high qualities that will make the customer satisfied and decrease complaints

- How can we coordinate new product development and new platform development processes in supply chain based on common platform?
- Based on which strategies or tactics will time and resource management in SCBCP be realized?
- How should the profits and losses shared between consumers, manufacturers and suppliers in order to promote a perpetual value chain?
- How should we manage inconsistencies and conflicts between traditional SCM approaches and modern world class SCBCP practices?

CONCLUSIONS AND FUTURE RESEARCH

Implementation of the platform strategy is a process still under study and research and in the current situation; companies mostly employ platforms as an approach in developing their competitive advantages. However, there

are significant differences in the definitions provided for the platform and what exactly can be regarded as a platform and therefore the process of platform development and the product architecture structures remain controversial amongst different industries. The performed research demonstrated the high competitive advantages gained by the platform approach in the form of improved performance from time, costs and flexibility aspects. Studies and analysis made in this study also showed that development and combination of common platform approach with SCM concepts or in other words design and development of Supply Chains Based on Common Platforms (SCBCP) can result in a more improved and synergic approach and higher rates in performance factors. Moreover, it was shown that the platforms have a considerable effect on product development process and supply chain design. This has made the decision making regarding product development based on platforms and shared resources a new method in product architecture that takes into account modularity, commonality, standardization and differentiation structures. From this point of view, it is revealed that the definition of SCBCP in automotive industry has to be integrated with the definition of products themselves and every alterations in product architecture have to be considered in relevance with the chain structure of materials, parts and component suppliers.

The study also showed that as a new paradigm in supply and manufacturing, the platform based supply chains have an important role in globalization of production and business. Decreasing the overall number of global platforms together with the development of local platforms has lead to standardization of parts and components. Forming strategic alliances between local and foreign companies based on development of platforms and production of variable products, reducing the number of suppliers, developing the global supply approaches and many other issues perfectly shows the increasing importance of the platform strategy in a network based economy.

Finally, future research in this field may include the cause and effect analysis regarding the practical usages of SCBCP philosophy in different industries, modeling mutual effects of SCBCP performance factors and studying the circumstances of implementing platform based supply chains in domestic automotive industry.

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