How does Cross-regional Supply Chain Function in the Global Auto Manufacturing

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Abstract. This paper presents a study on the inter-regional supply chain which helps company to manage the flow of components among regions of affiliate’s and Joint Ventures. Using a type of mode named as IRF (Inter-Regional Flow), the company will be able to create simplified supply chain network and reduce complexity for operation. Other resulting advantages include centralization of capacity management, utilization of sharing of parts from common and modified supplier tooling, and reduction of logistic and manpower cost for the receiving region in purchasing, manufacturing and supply chain management.

Keywords. Supply chain management, Capacity allocation, Logistics, Risk management.

1. Introduction
A supply chain can involve different scenarios with different products, co-ordination structures, production strategies and locations. Enterprises need to model supply chain scenario complexities and evaluate the performance of scenarios before implementing them [1]. Therefore, Supply chain layout in automotive industry becomes more and more important. It is well known that one vehicle is assembled by more than 10,000 components. The efficiency of components procurement plays a critical role for most of the auto makers. How to create an intelligent purchasing model and supply system became a key especially when the company runs multiple manufacturing sites across the world. In this paper, we take company F (a worldwide famous auto company operating in four regions) as an example, investigate its experience in inter-company supply chain network, organisation co-ordination structure, and propose a new method for supply chain layout scenario by considering multiple influence factors. The case is studied to demonstrate how the model can be applicable in automotive industry. The system dynamics and co-ordination are also analysed for this new supply model.

2. Problem Description
Truly effective supply chain management is planned and purposive. A value-driven supply chain that is coupled to the strategic priorities of the firm is the result of deliberate management action and strategic corporate investments aimed to procure, develop and configure the appropriate resources, processes and metrics that define that firm’s supply chain [2]. In a typical automotive manufacturing company, supplier base could be very complicated (up to 1,000 suppliers), suppliers from domestic region or foreign region could supply various parts to different manufactory sites at the same time. For example, as a worldwide auto manufactory company, F has its manufacturing network covering NAFTA, EMEA, LATAM and APAC region. Since all the regions share the same vehicle platform, many parts are designed the same in order to be used by different region on the global platform cars.
In the original supply model, one supplier could supply Europe, China and USA at the same time. The business flow directly linked supplier and each company branch, which may be located in different region. Each branch needs to create vendor codes, sign the commercial contract, release the order and make the payment to this certain supplier. The same workload used to triple during the commodity purchasing. Furthermore, the tooling’s shared among different regions often bring many problems when supplier fails to forecast the usage rate precisely and timely. Communication with each customer region about tooling issue also takes long time and occasionally cannot reach agreement easily. Therefore, suppliers kick off duplicated tooling for each region to avoid conflicts, the tooling cost also triples in some cases.

Consider from supplier’s perspective, in order to supply one common component, they need to deal with domestic customer and multiple forging branch which is not always a good option for them. Especially when the export volume is much less than domestic volume or when the supplier is not willing to deal with the risk caused by export business (currency inflection, logistic risk and duty problem). Besides, the supplier also faces the difficult situation when the volume forecast from different company branch is not accurate and aligned, the uncertainty often affects the parts production, sometime even delays the final assembly line in F company site.

3. Proposals and Solutions
In order to solve the multiple problems mentioned above, a new supply system model called IRF (Inter-Regional Flow) has been invented in company F to manage the flow of components among regions, Affiliate’s and Joint Ventures. IRF is managed by the department of supply chain management and supported by functional departments of purchasing, supplier quality, engineering, finance, and business development. Typical flows include common tooled components (one set of tool supporting multiple regions) and modified tooled components (some portion of tooling is common). Capacity and change management oversight is required to ensure alignment on demand and proper allocation when demand exceeds. By utilizing this new cross-regional supply system, it brings the following benefits to the global networked automotive manufacturing:

(1) Create simplified supply chain network, reduce complexity and cost. (figure1 vs. figure2).
(2) Logistics optimization.
(3) Control the sharing of parts from common and modified supplier tooling, avoid unnecessary tooling investment.
(4) Improve speed to market (reuse of tooling).
(5) Ensure consistent voice to supplier (single engineer and buyer, for common part).
(6) Enable centralized management of capacity and change management.
(7) Reduce manpower for the receiving region (SCM, Manufacturing, Purchasing).
(8) Contract terms with the supplier are based on global standard, not necessarily the receiving region (i.e. warranty), enhance the global standardization.

![Figure 1. Original logistics and information flow.](image_url)

![Figure 2. Logistics and information flow with IRF.](image_url)
3.1 Simplified Supply Chain Network / Reduced Complexity and Cost
Structure of supply networks has been framed in three dimensions: formalization, centralization, and complexity. The three structural dimensions affect one another progressively, and the cost consideration appears to be the key that shapes the supply-network structure [3]. Look at F company, one primary goal for IRF is to simplify the current supply model and generate saving. With this framework, one IRF pole acts as the supplier to each region, streamlining flow and communications are shown as in figure 3. Regional IRF teams linked in order to ensure the import/export of the shared components enhance thinking regional and act globally. As we can see from the figure 3, IRF manages to distinguish the regional flows and inter-regional flows. Compared with the original supply chain, the network becomes more simplified and efficient. IRF pole takes the role of information consolidation centre, information release window and needs to response for all the delivery issue to the customer region. Under IRF framework, it not only makes sure company F to keep the consistent voice to suppliers (single engineer or buyer as window person for common part) but also helps F to reduce manpower and relevant cost for the receiving region (in SCM, purchasing and manufacturing). Furthermore, the IRF model keeps the same contract terms with all suppliers based on the global standard, not just the receiving regions (i.e. warranty requirement), this helps to enhance the global standardization among all regions, which is very important for a global automotive company.

3.2 Logistics Optimization on Both Shipping Cost and Lead Time
Oversea logistic will impact the purchasing cost for many automotive components, especially the ones with heavy weights and big size (such like the transmission system, steering & suspension system and wheels). But due to program needs, the over sea shipments are often required when the localization of components is not available. The transport economics of long distance movements whereby there may be significant cost economies achievable by dispatching in larger quantities and this would tend to increase cycle stocks [4]. In the original supply model, each supplier responses for the delivery to over sea customer region. Due to the limited quantity of the orders, the cargo container is not fully loaded at most of time. Premium freight often be charged in the international logistic cost when the order is small. If we change the original supply model to IRF system, we can easily consolidate the different component delivery together. Cargo container cost thus reduces as a result. Take Supplier A as an example, the following figure 4 shows that after applied IRF system, the international logistic cost will reduce from 5.03 USD to 1.28 USD. This is a very critical advantage generated by this new supply model. At the same time, some complicated logistic routing can also be considered as an improvement area. A study shows in company F that: there is at least 0.5 MioUSD logistic cost could be avoid by changing the shipping routing: the original APAC parts distribute to EMEA will need to go through NAFTA first, but
after applied IRF system, delivery routing from APAC to NAFTA and APAC to EMEA will be separated.

![Figure 4](image)

**Figure 4.** Supplier A logistics saving after applied IRF.

Lead time for the over sea shipping is another risk in export business. Most of small / medium size suppliers outsource the export process to a service agency, which helps suppliers to finish all the process such as, ordering the cargo, negotiating the pricing and terms, completing the paper works. Most of the time suppliers do not have a strong negotiation power when they need to talk with the cargo company on both pricing and shipping schedule. Back in year 2018, one supplier complained to company F that he needed to wait for 7 months to ship the components since Hanjin announced bankrupt at that time, and they have limited resource to find another cargo company with a better offer on pricing and shipping schedule. If we change the approach to a scenario that company F consolidate all the requirements and go through IRF for the logistic and commercial negotiation, things will be much easier. Because compared with individual supplier, company F is having a much stronger negotiation power based on its background in automotive Industry. Therefore, lead time risk caused by shipping schedule delay could be reduced as well as the uncompetitive shipping cost.

3.3. Control the Sharing of Common Supplier Tooling, Enables Centralized Management of Capacity and Change Management

‘How to source globally’ has become a critical strategic decision for companies competing on a global basis. Extant literature points at the critical importance of developing and sharing knowledge in multinational companies [5]. Components from shared tooling on global platform program is very common in automotive industry. Every year the auto maker designs few new vehicles to meet the market requirement, the development investment for a new car is very costly, therefore every new model normally will be on board for different regions; which means the common parts will be shared globally. Internal study showed there are more than 20k shared parts in company F’s 68 exporting programs. To manage the common-tooled components for the same vehicle produced in different regions requires global capacity/change management. IRF model could provide better controls on the tooling compare to the original supply model. Typical flows include common tooled components (one set of tools supporting multiple regions) and modified tooled components (some portion of the tooling is common); as a key to ensure success, The Cross-regional Capacity Control (C³) System has been raised as a powerful tool to solve this problem. Firstly, agreements are captured in the Cross-regional Capacity Control (C³) System, once the buying region makes the decision to buy or sell a part, C³ will provide means of capturing agreements and terms of prioritization of parts. As shown in the figure 5.

![Figure 5](image)

**Figure 5.** An example of Cross-regional Capacity Control (C³) System.
It can be seen that, the exporting region validates availability of open capacity and requirements (cost/timing for additional capacity tooling) required to meet global weekly demand.

Primary Function of C³ for IRF Part Flows,
1. Store the buyers committed (borrowed) and purchased weekly capacity.
2. Support the validation process of new or adjusted requirements.
3. Used in conjunction with regional capacity management to identify risk to production programs.
4. Allows company F to maximize existing tool capacity and investment.
5. Enables global capacity management.

4. Standard Process of IRF
Take the APAC IRF pole in company F as an example, we can understand the process better by looking at the detail procedure (Below process flow is for the component which suppliers own the tool, or China Join Venture own tool but they authorize IRF approaching to suppliers directly).

Process flow for handling components as follows in the figure 6:
1. RFQ on adding new component into APAC IRF scope.
2. IRF receives request/analysis and distributes to APAC commodity team with terms and condition.
3. Commodity team approaches supplier for quotation and signs general terms and condition with them.
4. Commodity team receives quotation and confirms EXW price then provides to IRF PM;
5. IRF PM officially quotes by pricing scheme to end-user region for approval. After end-user approval, IRF operation team builds item card in system for final P.O creation.
6. APAC purchasing team creates the P.O in system and release to suppliers.

Figure 6. APAC IRF Sourcing Process.

5. Challenges and Risks
Increasing competitive pressures, and market globalization are forcing firms to develop supply chains that can quickly respond to customer needs (Douglas J. Thomas and Paul M. Griffin 1996). The 21st Century Logistics framework study, developed at Michigan State University shows supply chain competencies do lead to improved performance. Supply chain competencies appear to be employed in different ways to create different performance advantages across the various business environments [6]. As mentioned in the previous sections, IRF brings multiple advantages for company F in different aspects. However, as a worldwide organization, IRF operates still under a cost plus model. Customer
region needs to pay for extra managing cost generate by the IRF service (financial cost and other overhead). As the final price compared with original supplier quotation might not be competitive in some case, it surely brings negative impact to each individual region, although it could be benefits for the whole company. Therefore, this becomes a big challenge for IRF organization to balance profit rate and competitiveness at the same time: if the Margin is not meeting the expectation, then IRF can’t gain any profit from the program, this internal organization will have limited space to grow. But if they put too much margin, then the IRF price will not be competitive compare to the original flow, if the company use IRF to supply, it may lose money afterwards. In addition, currency fluctuation is another risk for IRF, we can see the Ex-rate for USD vs. RMB changes dramatically from beginning of 2018 to 2019 partially driven by the US-CHINA trade war: ‘Memorandum of Trade with China’ signed on 2018, March 22. US dollars start to go strong right after that. After compare the currency trend, we can see the current 2020 EX rate compare with 2018 Q1 increased more than 11%. As a result, company F needs to absolve the currency impact as well as tariff impact by its self after change the original flow to IRF model. Coordination with supplier on risk allocation needs to be explored carefully.

6. Conclusions
A relevant issue for the global sourcing organisational design is the assignment of responsibilities to different purchasing departments and subsidiaries: central purchasing organisations, purchasing departments of global plants or business units, and international purchasing offices [7]. In terms of Company F: The Inter-Regional Process is designed to manage the flow of components between individual regions, Affiliate’s and Joint Ventures. Making use of this process, the company will be able to create simplified supply chain network and reduce complexity for operation; centralize the management of capacity and change management; control the sharing of parts from common and modified supplier tooling; reduce logistics cost and manpower for the receiving region, such as SCM, Manufacturing, Purchasing. Study shows Larger affiliates are more likely to engage in intrafirm trade [8-9]. This supply model also can be used in other industries, especially for the Larger affiliates with global networked manufacturing: such as mobile phones, robots, medical equipment, computers and so on. However, different types of supply chain and products could be very different, so we need to revaluate and study further.

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