LOCALIZATION OF AUTOMOTIVE PLASTIC INJECTION PARTS WITH LOCAL SUPPLIERS

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Abstract: Localization is an activity that creates opportunity for both consumers or end users, and to local suppliers or manufacturers. It creates a new business opportunity for the local suppliers or manufacturers, especially if the product or part is not commonly manufactured locally and needed to be imported. Although it is a common supplier, the customer company needs to ensure that the parts being produced and delivered must meet the standard requirements that is fixed. The objective of this paper is to complete the fabrication of plastic injection mould and checking fixture, achieve above 95% Off-Tool Sample for all 7 parts, and finally to reduce cost and save time. The process starts from selecting and finalizing supplier from Value Analysis/Value Engineering (VAVE), dispatching relevant data and drawings, then series of Supplier Parts Tracking Team (SPTT) Audits, and lastly Logistics and Packaging analysis. Finally, the conclusion of this paper is all the mould and checking fixture has been fabricated, Off-Tool Sample for all parts has been achieved and both cost and time has been successfully reduced more than 10%. Localization just not creates high profits, but also increases their possibilities to expand their business. For consumers or end users, it is one way for them to cut down cost and time to import those parts.

Keywords: *Localization, Off-Tool Sample, Supplier Parts Tracking Team, Mold and Fixtures*

1. Introduction

Procurement Engineers oversea the purchasing of technical goods and services for an industrial operation (Abhijeet, 2018). They have a very detailed knowledge and information of their equipment, materials, and their suppliers that being used and identify the companies that sells them. Another job aspect of procurement engineer is to evaluate their existing suppliers while adopting new suppliers. It is also to negotiate the purchase agreements and maintaining the inventory of supplies.

It is not possible for every project that Company T implement goes straight for fully localization. The projected volumes for an auto component parts should justify the investment for the supplier and the company itself. Technological challenge and quality are the main concern in localization concerns. If a car maker uses certain quality of components which are not available in the local makers, they tend to keep some amount of components to be imported to keep the quality of the automobile high and large amount of the components are localized to keep the overall cost of automobile low and competitive. It is also important that the local suppliers can produce the highest-level quality of parts that meets the standards being set with the oversea suppliers.

1.1. Problem Statement

Localizing is a process to eliminate the purchasing of parts or services from an overseas supplier and procuring from the nearest suppliers in the local area. The main concern of localizing is to minimize the costing involved to procure parts from oversea, and to reduce the time taken for the parts being delivered. For many years, Supplier NT (oversea supplier) has been supplying injection moulding parts to Company T, such as cover spare switch hole, clips, cowl side fender seal, and door dust proof seal.

To cut cost and save time, Company T took an initiative step to localize these parts to Supplier NM (local supplier), which is situated nearby to the company. Few steps and process involved to ensure not just matter of time and cost, but quality of the parts must meet the Standard Requirement (SR) of Company T to successfully implement localization to Supplier NM.

2. Literature Review

To execute this project, it is important to know the reason on localization of a service or product. We need to identify the standards and procedure of selecting a supplier, evaluating, and ensuring the supplier can meet the International Standards Requirements. The challenge in this project is about the time to fully identify the potential, ability and ensure the parts and process provided by the suppliers meets those requirements, in which most of the problem factors are man and method itself. Thus, conduction research to gather information on and the related topic is vital. The sources of the literature review are extracted from journals, article, website, department SOP and knowledge sharing from department seniors and supervisors.

2.1. What is localization?

Localization is the adaption of an industries (also related in other fields such as language, culture, or a population desires) product or services provided by local industries into their business. It can strongly show that a finished goods is a successfully localized service or product has been developed within the local culture itself. Industries going global are upending the way localization supply chains are managed (Abhijeet, 2018). They need to do localization at higher speeds and volume, in which to intensify as the world demands more. Qualifying, on boarding, training, and assigning the right resources at the right time is no small feat. The ways in which supply chain managers build, classify, and assign their resource pools will be key in the future of localization.

i. More resource transparency
ii. Increased demand for new types of resources
iii. Requirement for fast, on-demand resourcing
iv. Continuously improve

2.2. Supplier Parts Tracking Team (SPTT)

For Procurement Parts Engineering Team (PE), they need to conduct a Supplier Parts Tracking Team (SPTT) Audit/Meeting Activity whenever there is a new project of improvement/upgrade project (Kwan et al., 2019). The activity is essential to ensure parts that being procured by local suppliers meets the Standard Requirement (SR) and suppliers can deliver the parts continuously and consistently. The team will start with SPTT Kick-off

Meeting, where to officially inform the project master schedule and its requirement to all concern parties especially to supplier project members. It is also the communication platform between company and supplier management on the expectation of production preparation related issues.

After conducting kick-off meeting, both supplier and engineers will conduct a SPTT-1 to agree tooling and production preparation plans for the parts to be supplied for a new project. It usually takes place after Supplier production drawing or *Request for Design and Development* Parts (RDDP) release and *Tooling Order/Letter of Intent* (TO/LOI) is issued. SPTT-1 is the first series of SPTT meetings that are needed to be held throughout the production preparation stage for a part. Next, SPTT-2 is conducted between supplier and engineers to confirm the quality of the *Off-Tool parts* (R&D Learning Promotion Dept, 2016). The supplier must produce the parts according to SR by confirming parts *Engineering Change Instruction* (ECI) implementation status, *Off-Tool Sample* (OTS) parts against drawing and CAD data.

After that, engineers from supplier company will conduct SPTT-3 meeting, which is to confirm quality of suppliers for *Low Volume Production Trial* (LVPT) parts which will be supplied to supplier's first production trial (*1st Goshi* [1G] trial at supplier production plant). The engineers hold responsibilities to check the progress of production preparation and countermeasures (mass-production process flow, facilities, process readiness, evaluation result). Finally, engineers will conduct an SPTT-4 audit to determine the supplier production line capacity (cycle time and line loading) and stability (reject rate & process repeatability "error prevention / poka-yoke") running in High Volume production. SPTT-4 takes place before the supplier's *Mass Production Trial* (MPT).

2.3. Injection Moulding for Automotive Parts

Injection moulding is one of the most used production for plastics. Consistency, safety, and quality are the outmost importance aspects in automotive industries for injection moulding. In early days, the entire car is made up of metal, which were heavy and difficult. Slowly in 1940's where use of polymer begins to erupt in the market. And in the early 2000's, the plastic structural component was introduced and becomes the dominant production methods (David, 2007).

The injection moulding starts from a molten plastic material is injected into a mould cavity, and the plastic then cools and hardens, and removed from the mould cavity. Though the mould design process is critical and challenging, injection moulding itself is reliable method for producing solid plastic parts with high quality finish. The advantage of injection moulding is that it has high repeatability to consistently produce identical parts, highly scalable process whose overall cost decreases as the more parts are made, and high precision and surface finish quality which is essential for automotive parts.

In the automotive sector, injection moulding is one of the predominant methods used for forming plastics parts. Under the hood of a car, some of the parts are made by metals has been transitioned to plastics (David, 2007). Parts such as cylinder head covers, and oil pad are produced by injection moulding. For exterior parts, it includes fenders, grilles, bumpers door

panels and more. This protects the car from road debris and minimize splashing. Where else for the interior, instrument components, dashboard faceplates, door handles, air vents and decorative elements are made by injection moulding.

2.4. Checking Fixture (CF)

Checking fixture, or inspection fixture is the tools used to make a quality inspection for a part or product (Paul, 2019). A highly skilled person is required to make this CF because its way more complex than a shape of the part or product. CF is used to locate and hold the part with a 3D surface area. This ensures the quality and tolerance are checked, which is useful to monitor the quality issue, which is mostly needed in automotive industry. Besides that, CF serve the purpose to verify geometric feature, dimension, and tolerance according to the design specification. It defines the accurate of design dimension, surface geometry and correct position of the surface. The CF should also be easy to use, reliability, low cost, and simple construction service. Its main important aspects in a CF is the specific element needed to check the size according to design specification, the parts are produced in standard shape and size, and high accuracy of the final product.

Generally, there are 2 types of CF available in automotive industries manufacturing, which are gauging fixtures and measuring fixtures. Gauging fixture is used to inspect a part against of standard size, whether the part will pass through the fixtures follows the standard part. If the part is too large or small, it will not fit into the fixture. It is using concept "GO" and "NO-GO". In the other hand, measuring fixture is used to ensure that how much the part will be detected out of tolerance. The part will be located on the centre of the fixtures, and locator will be used to ensure that the datum and tolerance at higher inspect. The CF consist of gauging fixture, locating, clamping, and mounted elements in the body.

2.5. Value Analysis / Value Engineering (VA/VE)

Value Analysis (VA) is a process of improvising and cut cost on an existing product using problem solving system implemented with specific set of techniques, knowledge and skills (R&D, 2016). Where else, Value Engineering (VE) is mostly concerned with new products or services, which is mostly applied during development. It is an organized creative approach which purpose the efficient identification of unnecessary cost. That cost neither provides quality or usage, life, appearance, and features. When applied to products, this approach assists in the orderly utilization of better approaches, alternative materials, newer processes, and abilities of specified suppliers. But when applied to services, the approach assists in more precise determination of "what are we trying to do?"

The system identifies and deals with the factors that cause contributing cost or effort in products, process, or services, and potential localizing products or services that are currently imported and can be planned in the local area. It uses all existing technologies and knowledge to efficiently identify costs or efforts that do not contribute to the customer's needs and wants. The VA/VE problem solving system contains four different types of thinking, those are;

i. Information and assumption searching
ii. Analysis
iii. Creative thinking
iv. Judgement thinking (minimize disadvantage, maximize advantage)

3. Methodology

In this localizing project, it involves many steps that has been standardize by Company T and Headquarters at Thailand (Thai-HQ). The standard process starts with Value Analysis Value Engineering (VAVE) proposal for localization request, issuance of Engineering Change Instructions (ECI) together with 2-Dimensional drawing (2D) and 3-Dimensional Computer Aided Drawing Data (3D CAD Data), and surrounding data if required Checking Fixtures (CF). After all the data has been dispatched, suppliers will study the data and will begin the tooling progression of injection mould and CF. Once done, they will trial run the process and perform required testing and evaluation on the parts that has been produced, which is mandatorily required by Thai-HQ.

3.1. Parts to be Localized

For this localization project, there are 7 parts to be localized to supplier NM, which are;

i. Clip
ii. Cover, Spare Switch Hole
iii. Retainer, Outside Moulding
iv. Seal, Door Dust Proof (1)
v. Seal, Door Dust Proof (2)
vi. Seal, FR Fender to Cowl Side, RH
vii. Seal, FR Fender to Cowl Side, LH

3.2. Fabrication Process for Injection Mould and Checking Fixture

i. VA Proposal Request

The process of localization begins with Value Analysis (VA) proposal from Company T. Procurement Buyer (PS) will fill-in the VA proposal, as they will study on the selection of supplier, supplier's capability, costing differences between overseas supplier and local suppliers, time required for tooling of injection moulding and parts production, and sustainability of the selected supplier to ensure they can perform at their best level for a prolonged time.

ii. VA Engineering Change Instruction (ECI) and Data Dispatch

After the approval of VA from Thai-HQ to localize the selected parts to Supplier NM, the PIC from Thai-HQ designers will issue out Engineering Change Instructions (ECI) to both Supplier NT and Supplier NM. Along with the ECI, the 2D drawing and 3D CAD data that has been given by Thai-HQ designers will be issued in the system.

iii. Supplier Parts Tracking Team (SPTT) Audit – Pre-SPTT and SPTT-1

After all the required data has been dispatched to the supplier and they study on the required development process, Supplier NM will set a Pre-SPTT event. Pre-SPTT is a short informal meeting where the supplier will acknowledge to Company T's PE about their capability for the new part development, how much of time do they required, and what are the kinds of equipment, tooling and raw materials do they need to produce this part

After conducting Pre-SPTT event, SPTT-1 event will be conducted. During this event, representative of Procurement Engineers, Quality Engineers, and Logistics Engineers from

both company and supplier will attend this event. SPTT-1 is usually for PE, QE and LE to know and understand what process, lead time, tools, data and equipment needed during the fabrication of mould until the part trial sample. Supplier can revise again these documents, but they should acknowledge to company on the changes. Upon all the verified conformation, company will issue out "Tooling-GO" notice to officially start the tooling fabrication process.

3.3. Parts Off-Tool Sample

After all the fabrication of tools, mould, checking fixture is done, and the trial run to produce the part sample, supplier will inform to company's PE on the success rate and the accuracy of the part achieved. Mostly for 1st trial (T0 is done at mould maker, T1 and thereafter at supplier) the parts that has been produced has low accuracy, such as flashing, flow lines, or wrapping issues. The supplier will send back to mould maker for countermeasure the problems. This will normally take a week, then will be tested again. The part that produced must meet the SR that is mentioned in the drawing and must meet above 95% accuracy. After the parts have been measures in terms of weight, dimensions, force test, and other relevant test that is mentioned in SR is achieved Off-Tool Sample (OTS) 95% accuracy, supplier will now have to fill up all the required documents with the latest updates before conducting SPTT-2.

i. Supplier Parts Tracking Team (SPTT) Audit – SPTT-2

The main purpose of SPTT-2 is to confirm the Off-Tool Sample (OTS) parts against drawing and CAD data, and the ECI implementation status. Both Procurement Engineering (PE) and Quality Engineering (QE) need to perform various checking and inspection to ensure all the parts fully comply with SR requirement. All quality requirement documents must be completed, then a SPTT-2 Audit date will be set accordingly.

During the SPTT-2 Audit, supplier will present the documents to company for crosscheck all the documentation is correct before proceeding to parts checking. During part checking, QE will crosscheck all the parts against documentation, with the help of measuring tools of checking fixture (if required) to ensure whatever has been declared by supplier are correctly documented. LE also will check their palletizing and logistics planning, although their proposal and planning are the same (carry over from common palletizing and logistics) or new proposal. LE plays important role to ensure parts are sent without damages and the packaging can be recycled and environmentally friendly.

3.4. Logistics and Palletizing Plan

Logistics Engineering (LE) team from both Company T and Supplier NM will plan for the proper method to deliver the parts to production warehouse. Since current parts from Supplier NT is being delivered by Multi Supply Parts (MSP) and changing to Local Supply Parts (LSP), they need to plan on how each different part needed to be delivered by using long life reusable packaging system.

Each poly-box, trays, and racks are build using recycle-able items, long lasting and maintenance free material. In this way, it's possible to cut down unwanted expenses on repairing or buying new boxes or trays in the future. LE also plans and calculates the timing required for company production floor to plan when Supplier NM needs to deliver the parts,

which is using Just-In-Time concept (JIT). From here it is possible to calculate the difference timing between MSP routing and LSP routing.

4. Results and Discussion

To achieve the objective of this project, the localization project is kicked-off by dispatching all relevant documents to supplier and start the tooling progression of injection moulding and checking fixture. Once done with the tooling, the parts data and testing results are collected and ensure gain above 95% OTS results and passed SPTT activity. Finally, the value of cost and time reduction is gained.

4.1. Completion of Tool Fabrication

Supplier NM have completed all the tooling of injection mould for all the 7 parts and checking fixture for selected parts. It roughly takes 2-3 months to complete the mould and CF fabrication. Once the mould maker completes the mould, the 1st trial run (T0) is either run by the mould maker or the supplier themselves. During this time, any problem found on the mould or injected parts will be identified and the mould will be resent for repairing. Problem on the injection parts such as flow marks, flashing, and on the mould such as ejector problem or parameter settings will be identified and countermeasures that needed to be taken. Multiple adjustments and trial runs will be conducted to achieve part accuracy above 95%. The part accuracy includes dimensions, part weight, markings, colour, and appearances.

Supplier NM have also completed the tooling for checking fixture based on the given tooling surrounding data. The checking fixture will then be used to perform fitting and gap checking of the injected parts. Once all trial run and both injection mould and checking fixture is working perfectly, the parts accuracy will be measured. The project milestone has been achieved although delayed in certain activity due to multiple trial run to maximum achieve accuracy results.

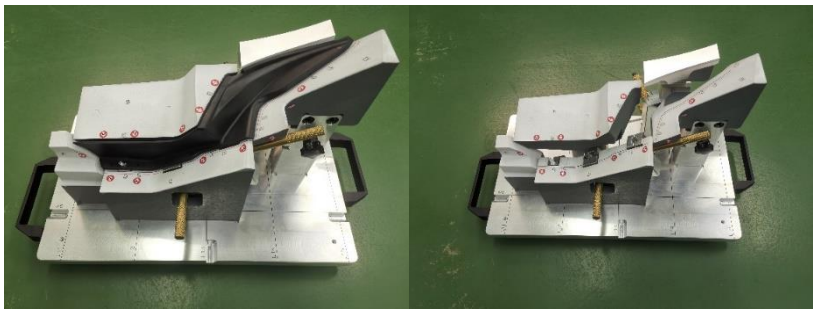

Figure 1. Checking Fixture for Seal, FR Fender to Cowl Side, RH/LH

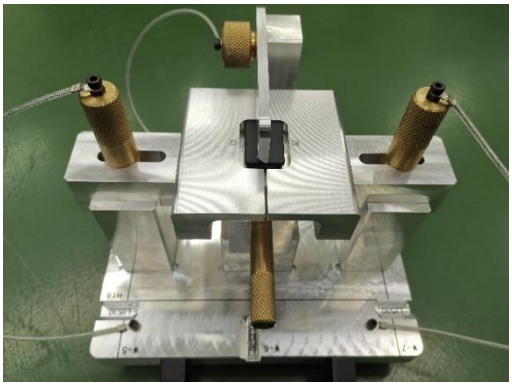

Figure 2. Checking Fixture for Cover, Spare Switch Hole

4.2. Parts Off-Tool Sample (OTS)

After the parts that have been injected and the measurements are completed, QE team will perform the parts measurement and visual checking, and data will be recorded. The points for measurement, part weight, appearances, and marking location can be found in the 2D drawing. Other required testing such as flammability, smell test, colour aging, and durability test will be conducted either by the supplier or by Thai-HQ if required. Parts performance testing will be done using together with other parts combined or assembled, and then sent for Local Parts Evaluation (LPE) to Thai-HQ. As for this localization project, all the testing and measurement has been completed and all the parts accuracy has been achieved more than 95%. Parts sent for LPE has completed performance testing and the test has been completed.

Figure 3. Seal, FR Fender to Cowl Side, RH/LH

Figure 4. Cover, Spare Switch Hole and Clip

Figure 5. Seal, Door Dust Proof (1) and Retainer, Outside Moulding

Figure 6. Seal, Door Dust Proof (2)

4.3. Calculation for Cost and Time

Cost and time are one of the important factors in this localization project. For costing, the calculation is not just based on materials, but consideration on logistics and packaging. When procuring parts from overseas, the currency exchange rates, packaging and delivery charges, and logistics plus warehousing expenses are calculated together. This causes the parts to be slightly more expensive than its original price.

Commonly for parts that are from overseas or Multi-Supply Parts (MSP) will usually take up 3~4 days (roughly 85 hours). This includes supplier producing parts, packaging, delivery and receiving at docks, then delivering to plant warehouse and sorting. Different parts from various suppliers will be packed and send at the same time, which requires time to sort the and placed in the specific warehousing location. For Local-Supply Parts (LSP), the process is very fast, efficient, and cost savings too. LSP are delivered to warehouse in milk-run system. They use reusable packaging such as trays and poly-boxes that are specially designed to ensure no damages on parts and easy to handle. Company T adopts Just-In-Time (JIT) system, where during final 10 vehicles is being out, information will be sent to suppliers on details such as parts needed to be delivered and its quantity.

Table 1. Overall Summary for Project Progress

No	Part Name	Fabrication Of		Off-Tool Sample (OTS) Results	Cost Reduction	Time Reduction
		Injection Mould	Checking Fixture			
1	Cover, Spare Switch Hole	✓	✓	100%	12.5%	67%
2	Retainer, Outside Moulding	✓	N/R	100%	16.4%	67%
3	Clip	✓	N/R	100%	13.9%	67%
4	Seal, Door Dust Proof (1)	✓	N/R	100%	15.0%	67%
5	Seal, Door Dust Proof (2)	✓	N/R	100%	14.6%	67%
6	Seal, FR Fender to Cowl Side, RH	✓	✓	100%	20.0%	67%
7	Seal, FR Fender to Cowl Side, LH	✓	✓	100%	18.8%	67%

5. Conclusion

Localization is a process where all the tools, equipment, and materials are obtained or produced locally. In which means the raw material, machines and additional components parts is owned or purchased locally. Supplier NM had successfully fabricated and produced plastic injection mould and checking fixture by the help of local mould makers and precision tool makers. The mould and checking fixture have a lifespan of more than 5 years, and basically the model life of a specific variant vehicle is also around 5 years. This gives more benefits for the suppliers and continuous business to customers. Plus, since the design of the parts are common for all vehicle variant and future design vehicle, this gives more benefits for both customers and suppliers.

Upon completion the fabrication of mould and checking fixture, the parts Off-Tool Sample (OTS) has been produced and achieved accuracy above 95%. With that achievement, the parts produced by Supplier NM has comply to the standard requirement of Standard Requirement (SR), in terms of material quality and performance, parts dimension and physical appearance. Finally, more than RM63,000 of costing by this localization has been saved, and around 57 hours of time has been shortened for parts being produced and transported from Supplier NT.

5.1. Recommendation

There are still various parts and equipment's that can be localized not just in automotive sector, but also for various other sectors. This creates big opportunities for business expansion, investment, employment, and profits for the local industries. Localization must be done with controlled conditions to ensure the quality and performance of the localized parts or equipment's are always at the best quality.

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