RESEARCH ON ORGANIZATION AND MANAGEMENT FOR OPTIMIZED PARTS SUPPLY
FROM THE EARLY PHASE OF DEVELOPMENT AND PARTS QUALITY CONTROL
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Abstract

Organization and management are becoming more important factors for the sourcing of automotive parts since R&D of Automotive new product becomes ever more complex. It has to consider many subjects including fuel consumption (CO2 reduction etc.), fuel economy, and safety and weight reduction. This leads to a high workload over a compressed time and thus a reduced "thinking time" for cost, investment reductions and parts quality control by production. This research introduces a method for profit improvement, investment reduction and quality control for safety. This is from the view point of organization and schedule management of "Monozukuri" for early stages of development.

Keywords: Organization, Schedule, Cost, Investment, Quality and Safety

Introduction

In recent years, Automobile development is facing more strict regulations coming from social demand on emission (CO2 reduction), fuel efficiency (weight reduction), safety improvement (protection of passengers and side traffic) or as conditions or rules of regulations which could, when not kept, result in raising the cost of ownership or segment vacancy. On the other hand, these forces can become a negative impact on productive power. Raw material cost is also rising and product development is struggling with the changing condition of FOREX (Foreign Exchange), fuel cost rise, etc. Therefore demand for profit improvement is becoming very important for automobile makers and parts suppliers. Furthermore, the rise of new competitors in Korea, China and India is making it more difficult than ever and shorter development time for product is required.

As a way of meeting the demand for shorter development time, IT is introduced in digital analysis for production trial to reduce cost. In Europe, America, and Japanese, makers have been making efforts. However, with above strict conditions automobile makers are studying the solution for the optimized way of product development.

One of the approaches is known as Architecture Theory proposed by Ooshika et al[1] which is based on considering automobile parts as a whole. The conventional way of OEM is still a strong trend among automobile manufacturing, which stresses the importance of protecting the manufacturing processes which are based on integral development. This is considered as a way which is vital in enabling the automobile to have added value in order for the product to exist as a brand rather than the automobile as a tool of movement (commodity).

In this work, we study an organizational theory and management for optimized purchasing of parts, material, etc. with consideration of consumer and market requirements and restrictions; the cost rise of raw material; fuel and negative FOREX impact; in additional to engineering requirements such as safety and so on, to maintain a certain sales price and thus profit.

Furthermore, ensuring parts quality of a completed product lies in the importance of the quality of supplier product. The automobile accidents throughout the past is summarized into two types: one is the those which are caused by a unit of parts, or by the components in a part, the other is those caused by such faults in system components which are in fact the error of automobile itself and human errors. In above errors, the responsibility in former one is on automobile maker and parts supplier. Assuming studying the measurement by utilizing the optimized organization and management at the early phase of development focusing on the parts supply, if parts suppliers are not properly selected, it is easy to assume the development cycle will have problem. In this study, the parts supplier selection is inspected throughout the study of optimized management.
Background of an organization for pursuing success

In manufacturing of a product X, consideration in most cases, is that of the specification, drawing, manufacturing, supplier chain. However, into produce a hit product which draws attention, the above 5 aspects are not considered the most important, but the members or the organization which produces the product is most valued.

It is well known that the good sale is not because of a good product but because of "how" the product is produced. Now let's see what does "how" refer to. Here "how" refers exactly to the organization itself. In our discussion of how organization creates effect in Monozukuri we referred to the 4 statements of organizational theory about the power of product which is described in the work of Fujimoto and Clark et al [2]. In this paper, we studied and analyzed their organizational theory and used it as the base of our work, and applied our study to the product of "automobile" by clarifying its shortcomings and the measurement of improving it.

When searching for famous examples of success stories of organizational concept, we picked up IBM for its successful experience from planning through the sales of the product of laptop computer. IBM, as an IT company, has developed its new business on top of its large mainframe computer business. What did IBM laptop mean to IBM Corporation? The IBM laptop was managed independently from the headquarters in a different place 1,000 km away. Why was it necessary to build the business at a physical distance of 1,000 km? It was analyzed by Fujimoto and Clark in their work of product development power which is described in the figure of "autonomous team structure" [2] as below (see Figure 1).

The characteristic of this organization is that different departments are composed as different business units. Project managers are from higher level personnel with higher power. The whole organization is composed of smaller ventures. Its merit is that of wide range responsibility and higher motivation and concentration. And because it is independent from the headquarter, there are more freedom in decision makings without being monitored or interrupted by high level authorities, therefore unique ideas which are not restricted by conventional thinking can be proposed and carried out. However, it also comes with a flaw which is that when profit is not achieved, it becomes hard to continue the business by original organization and their decisions. Therefore, if the milestone is clarified at the beginning it would be very hard to revise during later.

![Figure 1 Autonomous Team Structure](image)

The project manager has 5 roles of description. [3]
1. Direct market interpreter
2. Multilingual translator
3. "Direct" engineering manager
4. Program manager "in motion"
5. Concept infuser

We studied the following 2 issues which are considered as the defects of the organizational theory of autonomous team structure. The method we use in evaluation is that of seeing the difference with conventional way as the gap against the target.
1. "Organizational theory" for sustainable operation.
   When target profit is not achieved, the conventional organization will prevent the new organization from functioning.

2. Measurement for the change following "clarifying of milestone"
   Since the project manager has most of the responsibilities, it is necessary to consider measurement against possible delay which is hard to recover afterwards.

Innovative Organizational Chart of Monozukuri

As to our organizational theory, we took an experimental organization of a project with a close relation to current project, and used actual data of persons in the real project in our research.

Figure 2 shows "Early stage of development" is this research point.

![Figure 2 Monozukuri schedule image](image)

Figure 3 shows brief overview for different organizations. Specifically, to the Figure 3-b which shows the conventional organization of 3 separate unit of "Monozukuri team" (mainly consisted of Engineers), "Project team" (consisted of project managers), "Marketing team" (consisted of marketing and design department) based on Autonomous Team Structure and Figure 3-a which doesn't exist at the early stage of development, we have added "Monozukuri team" and Engineering (planning) and purchasing which manages cost and investment as shown in Figure 3-c.

As this organization is at the early stage of development (before the circulated draft plan, the purchasing and production management and logistics departments are not included.

![Figure 3-a Organization and Responsibility](image)

(Conventional organization before project approve)
The characteristic of this organization is that the factors required for a product can be included by the activity carried out by members who have excellent layout planning engineering skill in weight and emission control and purchasing skills in cost and investment planning. This enables the detailed management of "Monozukuri". Also by the member of veteran staff it is possible to reduce unnecessary work and reduce the workload of study time.

Meanwhile, in order to prevent issues or concern to be caused due to insufficient work by younger engineer whose knowledge is based on ordinary simple work manuals, utilizing veteran engineer and their experience can be considered significant at the preparatory stage of project development. Especially, research is carried prior to development so that to ensure a higher possibility of success when the project starts and it is required that all of the existing cost reduction data being utilized. Also some vital data which must be studied prior to the project must be recognized and utilized among the kept-but-not-used data.

The engineer who is responsible for planning should be one who can carry out not only the planning but also the study of every commodity of parts. In most of the cases, younger engineers are not able to design all of the parts necessary for a whole vehicle, because the engineering of automobile parts can have 60 to 100 different fields and the engineer’s responsible field is usually limited to certain commodities in order to make the best of his knowledge, experience and workload and efficiency.
The relationship between the work required to be done at the early stage of development and schedule

Conventionally, the important point of “Monozukuri” is regarded as people, objects and capital. In this study, we regard the important points of a successful “Monozukuri” as the following.

1. Setting of target (subject) centering on business
2. Management which is based on milestone setting
3. Setting of specific measurement

We combine the concept of time into above 3 points and take it into the separate phases of project study phase and usual development phase after project circular draft plan.

Specifically, we think the “activity schedule phase” and “organization which carries out activity” are important. The contents of organization activity at early development stage, as shown in Figure 4 is that the engineering and cost/investment planning teams get together to study and judge the specification submitted by marketing team and the profit plan submitted by project team based on cost and investment study which is carried out twice for the risk management by specification change from market demand. And by this study, a feasible plan can be proposed in the project circular draft plan.

![Figure 4 Management at early stage development](image)

As a specific method, we now discuss the following 10 items.

1. Quietness
2. Acceleration
3. Riding comfort
4. Handling and Braking
5. Easy of riving operation
6. Fuel economy
7. User friendliness
8. Utility
9. Roominess and amenities
10. Fit and finish, materials

Those study for specification relate cost, investment and weight for the each part.
What is the "work which is required to be done"?

What "Monozukuri" should focus are specification, weight, cost and investment. Because these are primary, after project circular draft plan, the fact that each engineer can freely carry out the design concept of their responsible parts highly influences the weight, cost and investment. Therefore, in our research, we make a policy which does not let engineers to make design "freely".

In order to verify, we have taken 2 personnel and installed them into the organization. These 2 personnel are veteran engineers and have purchasing knowledge, understand engineering development process, and also can work in the phase from engineering planning to specific parts engineering. We also analyzed the management objective from conventional data, evaluated the part-by-part cost centering on weight reduction, and globally selected parts suppliers who can embed the technology into the product.

And we carried out the concrete plan in following order, acquiring competitor data about current product, analyzing it and summarizing concept of the new product. We made very detailed specific notes in order to make it understandable even with less engineering experiences. Some items are shown in Figure 5.

**Figure 5** The method of making the part

After the new product concept is ready, we conduct the weight reduction part-by-part to reduce the material cost and achieve cost reduction. As an example, we conducted the current product situation appraisal and top-down target setting of new product bench-marking to make technical backing (proving). Figure 6 shows an example.

**Figure 6** Weight Analysis

Next, we analyzed the weight reduction technology and confirmed its influence on the cost and investment, and set up a well-balanced technological concept. Here we also considered suppliers who can actually supply the parts in order to make a model of actual possible supply. This is shown in Figure 7.
As a result of above analysis, we could consider the cost of automobile based on the weight which is a technological unit. Specifically, we could unify the design of part and the purchasing information immediately after a project is approved.

The specific measurement is described as follows.
1. The Engine and Powertrain must meet the regulation of a country and must be designed based on the vehicle weight, specification (Acceleration, emission and etc.) in accordance with the cost and investment condition which is decided by the sales price of vehicle.
2. Exterior parts must be designed to match the market needs at a reasonable cost in line with certain brand.
3. Interior parts are similar to exterior parts in terms of above condition but must be suited to the specification designed for certain country or area and match the market and affordability.

In order to meet the above conditions, the design of vehicle parts must be based on the relationship of specification and cost and must be sourced among several parts suppliers to have cost competitiveness so that to achieve cost and quality effect. And the tooling must be sourced from leading competitive countries (LCC) and must consider utilizing the effect coming from reusing or copying existing die and mould.

Additional to above, a "Carry Over and Carry Across (COCA)” utilization of current (existing) model parts must be studied with a target of achieving more than 80% of COCA, it’s mean a new project control new parts for additional for investment.

Parts quality control based on part supplier evaluation

As described in the paper by Chuang, Kawabe et al [4], based on this thinking that the relativity between individual supplier’s important evaluation items and ISO/TS16949 Standard evaluation; Table 1 and Figure 8 can be reviewed we have carried out candidate supplier selection by parts cost and tooling cost analysis using RFI (Request for Information, i.e. sourcing for suppliers) and based on the features of production process selected candidate suppliers for new parts.

Table 1 Property analysis of ISO

<table>
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<tr>
<th>Total item</th>
<th>Quality</th>
<th>Manufacturing</th>
<th>Purchasing/ Finance</th>
<th>Sales</th>
<th>Engineering</th>
<th>SCM</th>
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<td>8</td>
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<td>11%</td>
<td>6%</td>
<td>14%</td>
<td>14%</td>
<td>2%</td>
</tr>
</tbody>
</table>
Result and Discussion

In this research, based on analysis of existing data/materials, we have set up a hypothesis, and made measurement study to the weak points of conventional studies and stated our practical method of organization and management which is based on automobile projects. The method is shown in Figure 9.

Figure 9 Design concept sheet form

Layout planning engineer have to study the design concept for whole vehicle based on specification, cost, investment and weight. And layout planning engineer have to explain each design engineer for those success factor. The parts cost and tooling investment result is shown in Figure 10 and Figure 11.

Figure 10 The condition of cost analysis

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Part-by-part cost is reduced to 400 Yen from the early 1,000 Yen, and expanded the management scope from Figure 10. The tooling investment is also reduced 19 Million yen from the early 30 Million yen of the conventional management method, and this covers 85% of all management area from Figure 11.

Above analysis is same as the items of A, B and C and if an agreement can be reached based on the condition that existing parts tooling cost be amortized within certain period, then managing only the 85% of the B section (sub-main area) would be enough. However, in the case of European method of management of tooling cost, all of the analysis method of A, B and C (non-main area) must be carried out.

In reality, as 100% is required to be managed, by managing the 80% of the COCA part, we can control the scope of the management to attain the possible level.

As a result, compared to the conventional method of activity based on circulated draft plan or the new method for the main parts before the circulated draft plan of a project which is under study, we have achieved following result (see Figure 12).

The red line is the conventional method, the green line included the pushing forward the activity, and the blue line added the organization change.

1. Target achievement:
   Pushing forward the activity: -10% improved
   Organizational change: -20% improved

2. Workload reduction:
   Compared to conventional way: -20% improved
   (time reduction: -34%, workload up: +15%)

Figure 11 The condition of tooling investment

Figure 12 Result
We can judge from above result of our study to say that to the target of the project, the achievement and the gap has become zero by the blue line. This point is the start point for new project. If the previous management have 10 to 30 points over for budget.

We enabled to apply the data (the study result of how to manufacture the parts, parts cost, and investment, candidate supplier information, absorbing of FOREX, raw material cost change, logistics cost reduction, etc.) which is useful for engineering plan and some individual parts design for the next process of engineering and purchasing departments.

We will continue our study of the method for the activity at the early stage of development based on more data.

The issue which needs to be dealt with is that in the development of a model which requires long period will sometimes the market needs will be misunderstood and give way to a wrong development direction and this kind of issue must be managed well. Automobile is a product which is based on the methodology of “matching” (or “adjusting”) and required to make best adjustment (alignment) between vehicle parts to attain the optimized condition. Therefore the cost of the parts will become high and at the phase of producing a trial model, the specification and cost will be high. This research is an attempt to propose a solution.

Conclusion

The proposal research is new organization and management for the sourcing of automotive parts since R&D of Automotive new product becomes ever more complex. We used the real new project of Nissan, and the result got 30points cost reduction based on conventional method.

We will continue our study to a more detailed deep level to apply to the “Monozukuri” of automobile and other products.

By utilizing the results of this study, we would like to construct the “organizational theory and management” which is based on the view of Monozukuri cost and investment.

References


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