Control of Automotive Component Project Development Cost

Jing YU, Rui MIAO*, Hua-feng CONG, Yun-rong ZENG, Xiao-han NING and Xin WANG

School of Mechanical Engineering, Shanghai Jiaotong University, Shanghai 200240, China

*Corresponding author

Keywords: Automotive component, Project development cost, Cost control.

Abstract. With the development of the global automotive industry, the cycle of vehicle replacement is becoming shorter and shorter. The amount of automotive components development project is increasing, but the project development cycle has been shortened. Based on researching the cost structure and actual development task, put forward the cost control method by combining WBS, CBS and OBS can be helpful to speed up the development work and control the development cost.

Introduction

There are more and more new development projects in automotive components enterprises with the vehicle models are changing. New project development cost directly influenced the price of automotive components. It is a critical issue that how to construct a project development cost allocating responsibilities of task during the process of development.

Construction of Project Development Cost

Project development cost during preliminary product research and development includes: Development labor cost: means labor cost when project development team members develop; Validation cost: is used to validate the results of product design and production; Sample cost: includes cost for purchasing, producing and optimizing material; Business cost: means the cost of business travel, visit, investigation and entertainment; Support cost: means support cost for external cooperation, including labor and travel etc; General tooling: It is out of project cost in general, but regarded as investment reimbursement by combining with some projects profit or equipment cost counted into produce cost; Type specific tooling: is a tooling made for a typical project product, cannot be shared with other product. It is often counted into project cost, paid by customer singly or amortized into price.

Way to Amortize Project Development Cost

The cost of product mainly consists of the project development cost and typical tooling, which need to negotiate with customers about how to pay back. Onetime payment cannot be counted into cost share. Otherwise, it should be counted into component cost. There is an example for the amortization counting method as (Table. 1) shows. Basic elements needed are: Lifetime quantity: whole quantity predicted in product lifetime; Gross cost: one-off payment from each development cost directly; Customer share: one-off payment for each development cost from customers; Interest rate: the interest rate of each development cost in reimbursement years; Interest cost: the interest of each development cost in reimbursement years; Amortization quantity: component quantity for shared, it should be less than lifetime quantity. Counting method:

Amortized piece price = \sum \frac{\text{gros cost}+(\text{gros cost}−\text{customer share})\times\text{interest rate}\times0.5\times\text{years}}{\text{amorization quantity}} \tag{1}
Table 1. Development cost and tooling cost amortization.

| Amortization Item       | Gross Cost [CNY] | Gross Cost Share [CNY] | Interest Rate [%] | Yea r | Interest Cost [CNY] | Amortized Quantity [PCS] | Amortized Piece Price [CNY] |
|-------------------------|------------------|------------------------|-------------------|-------|---------------------|--------------------------|---------------------------|
| Development Cost        | 489,448          | 0                      | 5.12              | 7     | 87,709              | 382,500                  | 1.5089                    |
| Validation Cost         | 1,407,026        | 0                      | 5.12              | 7     | 252,139             | 382,500                  | 4.3377                    |
| Sample Cost             | 115,000          | 0                      | 5.12              | 7     | 20,608              | 382,500                  | 0.3545                    |
| Business Cost           | 205,000          | 0                      | 5.12              | 7     | 36,736              | 382,500                  | 0.6320                    |
| Support Cost            | 170,833          | 0                      | 5.12              | 7     | 30,613              | 382,500                  | 0.5267                    |
| Type Specific Tooling   | 764,045          | -764,045               | 5.12              | 7     | 0                   | 382,500                  | 0                         |
| Type Specific Fixture   | 1,912,721        | 0                      | 5.12              | 7     | 342,760             | 382,500                  | 5.8967                    |

Totally Amortized piece price 13.2565

Content of Project Development Process and Plan

Project development has 5 phases, 5 quality gates and 3 kinds of milestones according to general automotive component development process and budget control requirement in automotive industry as (Table. 1) shows.

These 5 project development phases are: concept and acquisition phase, product and process development phase, production preparation phase, production ramp-up phase and mass production phase. The shift of each project phase is controlled by quality gate, and project development budget is shared into each project phases. Each phase must be reviewed one by one at quality gate review meeting. Only all the members of project decision committee agree to close current phase, then the project can be shifted to next phase. It aims to review and close current phase, start next phase and approve the budget of next phase.

These 5 quality gates are: concept and acquisition release, product and process development release, production preparation release, production ramp-up release and mass production release. Quality gate is the key of assessing the status of project for company management.

3 kinds of milestones mean customer milestones, key milestone and secondary milestone, which represents customer key task time point, key task time point and non-key task time point of our company.

Project manager is in charge of all milestones, who should make sure about the situation of feedback of risk assessment, coordinate prevention measures, assess and record risk of each milestone. He or she should coordinate the requirement of milestone release, assess, suggest, decide and record milestone release situation when milestone is recognized.

There are 3 possibilities for milestone release results: milestone released, milestone released under condition and milestone disagree. Project manager should organize related person to make measures and deadline aim at problem solution for the situation of milestone release under condition and milestone disagree.

Figure 1. Project development process.
Usage of WBS, CBS and OBS for Development Cost Management

Above section clarified the task, cost structure of project development and division of responsibility during the project development. In order to plan and control each cost factor, development content and task responsible person together effectively. It needs to combine WBS, CBS and OBS together for project planning and cost tracing.

Description of WBS-Level-5

Combine the WBS, CBS and OBS together, and establish 5 level relationship. There get a working package named as “WBS-Level-5”.

Project code is the first level of WBS structure, while project development phase code is the second, cost center location is the third, and cost center content code is the forth, detail task code is the fifth. All code number is user-defined by company as example (Table. 2) shows.

| XXX Project Code | Level 1 Project Code | Level 2 Development phase | Level 3 Cost center location | Level 4 Cost center content | Level 5 Defined by responsible person | Costs type |
|------------------|----------------------|---------------------------|-----------------------------|----------------------------|-------------------------------------|------------|
| 84. Shanghai RD center | 1. Concept and acquisition phase | 01 PM Task | Project Manager defined | Development labor cost |
| 00. Germany RD HQ | 2. Product and process development phase | 02 Sales Task | Sales defined | Development labor cost |
| 07. Chengdu Plant | 3. Production preparation phase | 03 Product design task | Product designer defined | Development labor cost |
| 08. Wuhan Plant | 4. Production ramp-up phase | 04 Validation task | Validation engineer defined | Development labor cost |
| 09 Project member task | 5. Mass production phase | 05 Purchase task | Purchasing defined | Development labor cost |
| 10 Validation cost | | 06 Quality Task | Quality planner defined | Development labor cost |
| 11 Business cost | | 07 Process design task | Process designer defined | Development labor cost |
| 12 Company prototype cost | | 08 Logistic task | Logistic defined | Development labor cost |
| 13 Customer prototype cost | | 09 Project member task | Project Manager defined | Development labor cost |
| 14 General tooling cost | | 10 Validation cost | Validation engineer defined | Validation cost |
| 15 Type specific tooling cost | | 11 Business cost | Project Manager defined | Business cost |
| 16 General transport cost | | 12 Company prototype cost | Product designer defined | Sample cost |
| 17 Customer transport cost | | 13 Customer prototype cost | Product designer defined | Sample cost |
| 18 Support Cost | | 14 General tooling cost | Product designer defined | General tooling cost |
| | | 15 Type specific tooling cost | Product designer defined | Type specific tooling cost |
| | | 16 General transport cost | Logistic defined | General tooling cost |
| | | 17 Customer transport cost | Logistic defined | Type specific tooling cost |
| | | 18 Support Cost | Product designer defined | Support cost |

At first, the first 4 level cost center should be created and defined responsible person by project manager according to the actual demand of the task and cost. Then, the responsible person can create and distribute the budget level 5. The content of level 5 should contain the responsible person of level 5, deadline and budget etc. One WBS-Level-5 code can show a specific task, budget and lead time intuitively. The whole WBS-Level-5 working package contains all tasks and cost, it is a series working package which can be delegated to some person or team.

Application of Budget

WBS-level-5 package includes the all project task and cost of development project. Budget should be made according to WBS-Level-5, which would be assessed according to each package by team members. PM would apply for budget according to WBS-Level-4 but show WBS-Level-5 when needed. Such a method of accumulative estimation from bottom to top by person related to the work has advantage of accuracy. It will avoid a lot of conflict when budget using.

There is an example of budget application of Phase 2 as (Table. 3) shows.

| WBS Level 4 | Planning working | Budget | Reimbursement | Comments |
|-------------|------------------|--------|--------------|----------|
| 304         | Planning working | Budget | Reimbursement | Comments  |
Reimbursement plan should be in application. It is clear to see the net cost of each task and useful for project decision committee to get the right understanding of actual budget status.

Control of Budget Usage

It has to control the budget when using. The goal of budget control is to control the actual cost within the budget. The usage type of the budget can be divided into 4 kinds.

Development Labor Cost Usage Control. Above WBS-Level-4 tasks from 01 to 09 are labor cost of project members. The control method of labor cost is that: The working package responsible should list and estimate the content and hours before budget application. And project manager should release the working hours to each engineer according to the schedule of the project.

Project Development Cost Usage Control. The cost of project development mainly includes internal cost and external cost.

The external cost is mainly sample cost and outsourcing testing cost. Normally, it is applied by product engineer or test engineer in WBS work packages. And then, start the approval process. The application should define the detail of demand, volume and the complete date of sample or test. The approval process is firstly approved by project manager verifies the necessity and functionality of the sample or test and it is included in the budget application. The second step is that the corresponding purchasing engineer to maintain and confirm the price according to the demand of sample or test. The third step is that controlling engineer confirms the cost type is correct and budget is enough. The fourth step is that project manager confirms the updated cost is still in the budget plan. The fifth step is that the management approves and confirms to start the purchasing work. At last, the applicant can use the budget in one time or several times within the approved amount and time according to actual situation.

Internal costs are mainly test costs and internal sample manufacturing costs. Different with the external costs, the internal cost does not need the support from purchasing department. There just needs the responsible person of the work package to raise the application, the project to approve the necessity and functionality, the project cost controlling engineer to confirm the price and budget is enough and feedback to project manager. After final confirmation of the project manager, the cost of test and manufacturing can be entered into the corresponding WBS working package by the cost center of laboratory or sample workshop.

Business Cost Usage Control. Business costs are mainly travel and business entertainment expenses. The project manager is the person who is responsible for the cost. But all the engineers involved in the project are likely to use the budget when they support the project. For the budget control method, the applicant is required submit an application to his line manager to confirm and approve the necessity of travel or business expense activities. Then the project manager confirms
that the activity is related to the project, which belongs to the project cost and is included in the budget plan. After that, the applicant can travel and entertain business after approval. At last, according to the reimbursement process of M company, the project manager needs to confirm the WBS work package code in the reimbursement process for the financial accounting.

**Budget Change**

The contents of budget change are generally divided into the following categories:

**Budget Change at Current Phase.** Each WBS-Level-5 work package can be changed by project manager and WBS-Level-4 responsible person. There is no necessary to get approval when the total budget amount of WBS-Level-4 is not increased. Otherwise, for the different WBS-Level-4 in the same cost element, the project manager and the corresponding WBS-Level-4 responsible person can apply to change WBS-Level-4 budget. For example, there is a design engineer optimized the design and apply more standard parts or carry over parts. It requires to increase labor cost in WBS-level-4 "03 Product design task". At the same time, it reduces the development and management work of the other engineers.

**Budget Transfer in Different Location.** As a global company has some RD center and plants in each region around the world. They can use the resources from other branches when the resource is limited in the process of project development. At this time, the project budget needs to be transferred from one location to others. As the example in the phase 2, since the company CAD and test capacity are not enough, Project team decide to delegate some drawing works and test to Germany. The transfer of work content also means the transfer of some WBS-Level-4 work package. The part design task budget of Shanghai (XXX-2-84-03) transfers to the design task budget of India (XXX-2-00-03). And the part validation budget of Shanghai (XXX-2-84-10) transfers to the validation budget of Germany (XX-2-00-10). The transfer of budget in different location involves the influence of laws of each location and currency exchange. It should be considered about the preparation of relevant document and the loss of additional cost. In principle, if the total budget amount doesn’t increase, there is no necessary to get the approval of management.

**Budget Transfer in Different Phase.** In the process of project development, there is a situation that some long-term work needs to be started in advance. Of course, it is also delayed because of the development schedule. For example, one tooling lead time is much longer than other tooling. The budget cost originally planned and used in phase 3 should be pull ahead to phase 2. In principle, budget transfer isn’t allowed to increase cost. But the budget ahead will impact cash flow and financial costs. Therefore, the approval of project decision committee is required.

**Conclusion**

The cost control ability of automotive components project development is closely related to the maturity of the project management. Combined with the company own situation, making reasonable and effective cost control method of project development can provide great help for the operation and development of company.

**Acknowledgement**

The authors gratefully acknowledge the financial support of the National Natural Science Foundation, China (No. 51435009) and the innovation practice program of Shanghai Jiao Tong University (IP15054).

**References**

[1] Jiang E D. Discussion of cost control in automotive component enterprise. Economic[S].2016(20): 52-53.
[2] Huang B. Analysis of automotive component cost control. Technology innovation and application, 2013(09): 62-63.

[3] Yang S.J, Analysis of cost control in automotive component enterprise. Economic[S], 2012(01): 70-71.

[4] Otávio Próspero Sanchez, Marco Alexandre Terlizzi et al. Cost and time project management success factors for information systems development projects. International Journal of Project Management, 35 (2017) 1608-1626.

[5] Sevilay Demirkesen, Beliz Ozorhon. Impact of integration management on construction project management performance, International Journal of Project Management 35 (2017) 1639–1654.

[6] Filipe Ferreirab, José Fariaa, Américo Azevedo, Ana Luisa Marques. Product lifecycle management in knowledge intensive collaborative environments: An application to automotive industry. International Journal of Information Management, 37 (2017) 1474-1487.

[7] Mladen Radujković, Mariela Sjekavica. Project Management Success Factors. Procedia Engineering, 196 (2017) 607-615.