Proposed Strategy of Heavy Equipment Overhaul: Case Study of a Coal Mining Contractor in Indonesia

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ABSTRACT

The ICE Newcastle’s coal price jumped sharply to an all-time high in the first half of 2022 at $440 from $50 during the peak of the COVID-19 pandemic in Q3 2020. Indonesia took advantage of the situation, not only the government and mining owners (mining license holders) which are preparing all the resources to rapidly increase capacity, but also the mining contractors who serve mining owners are forced to pursue this opportunity. The opportunity must be followed by the preparation such as manpower, infrastructure, and heavy equipment. All companies are doing the same way to compete in increasing their capacity, so the problem is the availability of heavy equipment that is limited in bullish conditions. Overhauling the existing heavy equipment is one of the solutions because instead of ensuring the heavy equipment availability, the overhaul maintenance also gives a benefit for a cheaper price upfront (50%-70% of the new heavy equipment). However, that condition impacted too on the overhaul maintenance such as the difficulties in planning the number of overhauls, lack of preparation manpower, the material rarity, etc. Meanwhile, overhaul execution requires several resources that are ready at the time before the start of execution, so the preparation of the overhaul maintenance in fluctuation conditions is challenging. Determine the proposed strategy for overhaul maintenance to tackle the issue in the future and how to implement should be defined to prevent obstacles for mining contractor business, especially in overhaul maintenance for company Alpha.

Keywords: business strategy, heavy equipment, maintenance strategy, mining contractors, overhaul maintenance.

I. INTRODUCTION

No one can predict the coal price would enormously increase in the first half of 2022. The price was recorded as a new all-time high ($440 per ton, with the Newcastle index). The price was affected by a delay of the five years of coal’s commodity cycle, acceleration of recovery from post-pandemic COVID-19, and the conflict in Russia-Ukraine causing a European (NATO) embargo on Russia’s energy product (natural gas) that increased demand to operate the coal-fired plant.

Indonesia, as one of the highest coal producers in the world, took advantage of the situation that would not come in twice to produce more coal. The government and private sectors prepared all resources to increase capacity rapidly. The mining contractors who serve the mining owner (mining license holders) are forced to pursue this opportunity.

Moreover, the preparation of the resources for increasing the production capacity such as manpower readiness, material readiness, and equipment readiness is the key for the mining contractor to get the opportunity. The mining contractors facing the problem are the availability of heavy equipment that is limited in bullish conditions. Overhauling the existing heavy equipment is one of the solutions for ensuring heavy equipment availability. The condition of the increased required number of overhauls should follow extra resources that are not easy to reach them. In addition, the problem is when the required number suddenly decreases that impacted how the management of the resources that exceed.

The ups and downs of mining contractors should be realized as a strategy for making a strategy for overhaul maintenance. Sometimes it would be an opportunity to grow or just to be extinguished of business.

II. BUSINESS ISSUE

At the beginning of investment in heavy equipment, the mining contractor should estimate how much price it spends and how long the equipment can support the operation. The cheaper price to buy the equipment and the longer the equipment’s lifetime will be better for the company. Unfortunately, for each piece of equipment, the company needs the cost overhaul of 50%-70% of its new investment. While overhaul itself costs around 30-40% of the whole cost of the mining contractor’s business, and also one month of the shutdown of repair, which is used to extend heavy equipment's lifetime up to almost two times from the factory’s standard. In addition, when the company is too late to execute the overhaul, it potentially increases the probability of heavy equipment breakdown during an unscheduled time (BUS). That condition is something strongly avoided by the company because it generates a potential extra cost and loss of opportunity to generate revenue.
In general, the impact for the company when not doing an overhaul, the company should prevent the new investment equipment from replacing the existing equipment. The problems are that new investment is guaranteed will be higher cost of around 30%-50% and the company is exposed to the risk of uncertainty in the availability of the new equipment. On the contrary, with the overhaul, the company will get the best performance from the equipment with the new one.

An overhaul is a process when the demand for overhaul meets between equipment to overhaul and the availability of resources for an overhaul in the time execution. In addition, a successful overhaul is when the schedule is accurate and meets the quality of the overhaul.

This research aims to determine the proposed strategy for overhaul maintenance to tackle the issue in the future and to prepare for implementing the proposed strategy. The questions which will be explored in this research are:

1) What would be the proposed strategy for the mining contractors, especially in overhaul maintenance to tackle the issue in the future?
2) How should the mining contractor implement the proposed strategy for overhaul maintenance?

III. THEORETICAL FOUNDATION

Overhaul maintenance is one of the biggest costs in the mining industry and with the complexity of equipment availability when the overhaul execution, a company should have a strategy to manage it.

A. Overhaul Maintenance

High maintenance performance is still required due to demands for higher product quality, faster throughput times, and improved operating efficiency in a continually shifting consumer demand environment. According to Parida and Kumar (2009), maintenance expenditure accounts for 20–50% of the production cost for the mining industry depending on the level of the company indicated in its production volume.

The maintenance should start with the forecasting and planning of the maintenance activities. Better forecasting and planning could generate efficient maintenance operations. Based on Duffuaa and Al-Fares (2009), forecasting and planning are divided into two types: scheduled-based maintenance and breakdown un-scheduled maintenance. One of the objectives of forecasting and planning is for the company to determine the preparation of its resources to support maintenance.

The planned maintenance services budget should identify the primary and alternative means for achieving its objectives and the number of resources needed for each alternative (Mirghani, 2009). The resources for the overhaul maintenance should include:

1) Types and quantities of materials and spare parts
2) Labor skills by headcount
3) Support services
4) Training and manpower development
5) Maintenance equipment and facilities.

B. Contract of Material Supply

The contract is key to ensuring the material for overhaul maintenance is available and can be executed. The problem is that the company has not had any contract with any suppliers so that impacted the execution of the overhaul maintenance taking a longer time.

The approach to defining how the best practices of the contract process in the company are diverse and influenced by the company's policy and maturity. However, in general, referring to Macbeth (2012), the stages of a contract that is divided into seven stages:

1) Identification and requirement specification
2) The decision to make or buy and if buy then its strategy sourcing
3) Sourcing process and contract award
4) Initiation and implementation of the contract
5) Operation and improvement
6) End-game option
7) Lesson learns.

C. Manpower Management for Overhaul Maintenance

Manpower management topic is evolving into how to recruit manpower, develop the manpower, and design its job to tackle monotonous work. Regarding Haroun & Duffuaa (2009), the maintenance organization structure is the way various part of the maintenance organization is formed including defining responsibilities and roles of units and individuals. There are significant factors that must be considered while designing the maintenance organization. The factors to consider are maintenance capacity, centralization versus decentralization, and external or internal maintenance (third party).

Nowadays, it is generally acknowledged that businesses should do more than only choose and hire employees; they should also support initiatives and offer resources for their continued education and training to improve individual competency and supply candidates for supervisory and senior positions. Referring to Haroun & Duffuaa (2009), the guidelines for developing and assessing the effectiveness of training programs:

1) Evaluate current personnel performance
2) Assess training need analysis
3) Design the training program
4) Implement the program
5) Evaluate the program’s effectiveness.

IV. METHODOLOGY

To optimize the proposed strategy for overhaul maintenance, the research is held in company Alpha, one of Indonesia's biggest mining contractors with owned more than 3,000 heavy equipment including 400-tonne class excavators and 200-tonne class dump trucks.

The research design with the qualitative method starts by collecting primary data and secondary data. The primary data is based on interviews which were held from three clusters. The clusters consist of the first cluster from the plant organization of the internal company as an executor, the second cluster from the non-plant organization of the internal company as a customer and support, and the third cluster from the external company as support from the third party.

The research involves how to combine the two data (the primary data and the secondary data). The first process is selecting the highest issues from the quantity of the primary data stated by the number of respondents in the interview
process (Namey et al., 2008). After that, the next process is finding the correlation between selected issues from the primary data with the items from the secondary data.

To get the root cause, the research involves the Current Reality Trees (CRT) to identify the root causes of several issues that are related. According to Fredendall et al. (2002), the CRT uses a set of clearly defined rules for its construction, validation, and interpretation. The CRT starts with defining the Undesirable Effects (UDE), the next process is defining the intermediate effects, and the last process is defining the root causes.

The scenario document will be delivered to the company as a recommendation that includes 5W+1H (what, why, when, who, where, and how). This research is only focused on the preparation of implementing the recommendations because the objectives of the research are to determine the proposed strategy for overhaul maintenance to tackle the issue in the future and to prepare for implementing the proposed strategy.

Fig. 1. Methodology of research.

V. RESULTS

A. Defining Issues in the Future and Root Causes

From the eight respondents involved in the research, the top-rank issues in the future (Fig. 2.) consist of material availability, accuracy in number (planning), manpower management & support, resource planning, and on-time duration overhaul. The top rank is mostly stated minimum of 75% of respondents (6 persons), stated by more than 16 frequencies per each from all respondents, and stated 97 frequencies from the total 217 frequencies (45%). All the top ranks were categorized into the overhaul's resource management and project management. In addition, all top ranks from the primary data have an interconnection with the secondary data (internal company data).

Material availability is the most issue in the future as stated by respondents. The overhaul's material itself consists of components, spare parts, and other materials. The respondents thought the issue material in the future is varied. One is presuming obsolete equipment models are something that will become an issue in the future. Second, the respondents highly emphasized competition with competitors in bullish conditions to get the materials.

The issue of planning accuracy number tends to the accuracy in the how many of the overhaul's activities required in the year. The issue was raised because the quantity number will implicate the number of resources that are needed. Optimizing the planning process requires manpower skills and tools to calculate accurately and fast.

The operation management has a lower rank than others because of the nature of its business (overhaul in the mining industry) focus on how to prepare the overhaul for the shorter breakdown time. On the other hand, operation management such as safety and standards are something mandatory as workmanship in the mining industry so that obtain not a big concern for the respondents.

Top-rank issues are set as the undesirable effects (UDE), and after that develop a causal connection from each UDE with the line and possibility to cross for each cause-and-effect chain to get the root cause.

The root causes of the first UDE that issue with the material not being available consist of eleven root causes (Fig. 3). The second UDE is resource planning is not proper is has similar root causes to the first UDE. The booth starts with the same intermediate effects which are no orders, and the vendor cannot supply. So that the derivative connection to the root causes is the same. The rest of the UDE, the third is about planning accuracy, the fourth is manpower management is not proper, and the last UDE is about over time-duration has six to seven root causes. The root causes concerning is high demand, planning, and manpower related. The manpower-related and high demand are the root causes impacting all UDE. This is due to the overhaul maintenance is required manpower to operate the process itself and so far, there is no intention to replace manpower with other technology, so how to recruit, develop, and design the job will impact all UDE.

Eight of the twelve root causes are categorized as controllable for the internal company, the rest are categorized as non-controllable (beyond the internal company control) such as obsolete models, high demand, nature of the job (overhaul), and mining environment. Hence, the non-controllable root causes are eliminated for the next process in the research and the next analysis is focused only on controllable root causes.

B. Defining the Strategies for the Overhaul Maintenance

Related to the topic of research that focuses on issues in the future (probably not all the issues will happen) and regarding Mintzberg’s (1987) five Ps framework of the strategy, then defining the strategy as a plan should be more relevant rather than the others. In the beginning, the root causes are categorized into three main clusters consisting of contract material, planning accuracy, and manpower management.

The company should have a strategy with the root causes of limited capacity production (material) related to the process of deciding to make or buy and its sourcing strategy, such as the first strategy is implementing multi-vendor that uses the product of the substitute vendor. The second strategy is to strengthen the internal company's rebuilt center to tackle the dependence of the company on the sole agent. With the own made strategy, the company takes many benefits such as

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ensuring the material supplies, cheaper prices, and developing skills and capability with internal research & development.

The third strategy as a quick win to tackle that issue is to develop a contract committee to focus on and accelerate the process of the contract. The committee aims to centralize the process of planning, controlling & monitoring, and evaluating the process contract that should have the capability to manage the contract that involves cross-function (not only procurement function).

The last root cause in the main cluster of contract material is contract strategy & policy. As we know, commonly each vendor has a different contribution to the company and the capability of its supplies, how to approach them is one of the key strategies to ensure the company’s supply. In the beginning, the company should be mapping all vendors such as into its segmentation of transactional vendor, tactical vendor, collaborative vendor, and strategic vendor. After the vendors are categorized into their segmentation, the company should define the parameters to control & monitor each vendor segmentation and how to approach them. The team is implementing the scenario and will be evaluated periodically. The process is called an approach vendor by its segmentation and that is the fourth strategy. The fifth strategy is the contract renewal strategy. The contract renewal would be crucial when the company doesn’t have any scenario to manage.

<table>
<thead>
<tr>
<th>Super Category</th>
<th>Category</th>
<th>Sub Category</th>
<th>Sub Sub Category</th>
<th>Respondent</th>
<th>Sum</th>
<th>Qty of Respondent</th>
<th>Rank for Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning</td>
<td>Accuracy in number</td>
<td>CL1-01</td>
<td>CL1-02</td>
<td>CL1-03</td>
<td>CL2-01</td>
<td>CL2-02</td>
<td>CL2-03</td>
</tr>
<tr>
<td>Quality</td>
<td>Healthier equipment</td>
<td>CL1-01</td>
<td>CL1-02</td>
<td>CL1-03</td>
<td>CL2-01</td>
<td>CL2-02</td>
<td>CL2-03</td>
</tr>
<tr>
<td>Cost</td>
<td>Competitive cost</td>
<td>CL1-01</td>
<td>CL1-02</td>
<td>CL1-03</td>
<td>CL2-01</td>
<td>CL2-02</td>
<td>CL2-03</td>
</tr>
<tr>
<td>Delivery</td>
<td>On-time start overhaul</td>
<td>CL1-01</td>
<td>CL1-02</td>
<td>CL1-03</td>
<td>CL2-01</td>
<td>CL2-02</td>
<td>CL2-03</td>
</tr>
<tr>
<td></td>
<td>On-time duration overhaul</td>
<td>CL1-01</td>
<td>CL1-02</td>
<td>CL1-03</td>
<td>CL2-01</td>
<td>CL2-02</td>
<td>CL2-03</td>
</tr>
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<td></td>
<td>Material availability</td>
<td>CL1-01</td>
<td>CL1-02</td>
<td>CL1-03</td>
<td>CL2-01</td>
<td>CL2-02</td>
<td>CL2-03</td>
</tr>
<tr>
<td></td>
<td>Manpower availability</td>
<td>CL1-01</td>
<td>CL1-02</td>
<td>CL1-03</td>
<td>CL2-01</td>
<td>CL2-02</td>
<td>CL2-03</td>
</tr>
<tr>
<td></td>
<td>Manpower management &amp; support</td>
<td>CL1-01</td>
<td>CL1-02</td>
<td>CL1-03</td>
<td>CL2-01</td>
<td>CL2-02</td>
<td>CL2-03</td>
</tr>
<tr>
<td></td>
<td>Manpower skilled</td>
<td>CL1-01</td>
<td>CL1-02</td>
<td>CL1-03</td>
<td>CL2-01</td>
<td>CL2-02</td>
<td>CL2-03</td>
</tr>
<tr>
<td></td>
<td>Manpower development</td>
<td>CL1-01</td>
<td>CL1-02</td>
<td>CL1-03</td>
<td>CL2-01</td>
<td>CL2-02</td>
<td>CL2-03</td>
</tr>
<tr>
<td></td>
<td>Days availability</td>
<td>CL1-01</td>
<td>CL1-02</td>
<td>CL1-03</td>
<td>CL2-01</td>
<td>CL2-02</td>
<td>CL2-03</td>
</tr>
<tr>
<td></td>
<td>Supporting tools availability</td>
<td>CL1-01</td>
<td>CL1-02</td>
<td>CL1-03</td>
<td>CL2-01</td>
<td>CL2-02</td>
<td>CL2-03</td>
</tr>
<tr>
<td></td>
<td>Availability manpower or service contract</td>
<td>CL1-01</td>
<td>CL1-02</td>
<td>CL1-03</td>
<td>CL2-01</td>
<td>CL2-02</td>
<td>CL2-03</td>
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<tr>
<td></td>
<td>Procedure availability</td>
<td>CL1-01</td>
<td>CL1-02</td>
<td>CL1-03</td>
<td>CL2-01</td>
<td>CL2-02</td>
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<tr>
<td></td>
<td>Procedure implementation</td>
<td>CL1-01</td>
<td>CL1-02</td>
<td>CL1-03</td>
<td>CL2-01</td>
<td>CL2-02</td>
<td>CL2-03</td>
</tr>
<tr>
<td></td>
<td>Improvement process</td>
<td>CL1-01</td>
<td>CL1-02</td>
<td>CL1-03</td>
<td>CL2-01</td>
<td>CL2-02</td>
<td>CL2-03</td>
</tr>
<tr>
<td></td>
<td>No incident</td>
<td>CL1-01</td>
<td>CL1-02</td>
<td>CL1-03</td>
<td>CL2-01</td>
<td>CL2-02</td>
<td>CL2-03</td>
</tr>
</tbody>
</table>

Fig. 2. The rank issues of the primary data.

Fig. 3. Root Cause Analysis by CRT.
With these conditions of the root causes planning based on empirical data and planning using manual tools, the company should have a strategy to tackle the two root causes, that is automatic planning calculation as the sixth strategy. The strategy is categorized as a technological innovation. The strategy is not only focused on the technology, but the most important is the capability of the manpower to implement the strategy and how the company consistently does research & development to increase the accuracy of the planning. The strategy also includes other actors outside the company to develop the system getting better among others are the manufacturer, university, and IT consultant. The company should have several programs such as demonstration of products, joint development, and open innovation to involve the actors in research & development projects.

The last main cluster of manpower management consists of three root causes, recruitment policy, development policy, and job design of the overhaul maintenance. The strategy formulation starts with the job design to generate job requirements for the overhaul maintenance, the next process is the strategy for recruitment and development of the manpower. Regarding the job requirement by the number of manpower, based on Haroun (2009) it reflects consideration of the factor maintenance capacity, centralization versus decentralization, and internal versus external maintenance (third party). So that the company should define the policy of capacity for maintenance that covers the fixed number of maintenances that is categorized as a leveling strategy. The rest, the up-down conditions covered by the third party, are categorized as a subcontracting strategy. The job requirement by skills of manpower should be considering the model equipment that is planned to overhaul. The different model equipment to execute impacted different skill levels and duration to execute. Both (the number of manpower and the skill of manpower) generate a job requirement and the appropriate profile of manpower to fulfill the overhaul maintenance.

The next key process is a gap analysis between the job requirements and current conditions. Once the company detected the gap in job requirements through the assessment process that chooses, the company should focus to fill the gap whether by developing manpower or recruiting manpower. In conclusion, the seventh strategy is the proposed strategy for manpower management for overhaul maintenance which includes job design, development, and recruitment.

C. Implementation Strategy in Company Alpha

The framework of five phases of strategy implementation (Pearce & Robinson, 2007) that are used to measure the gap analysis of the seven strategies proposed and summarized. The first strategy is about using a substitute vendor, currently, company Alpha is using several substitute vendors with the same product for getting a cheaper price. The first strategy is categorized into completed to implement all phases, but the challenge is how company Alpha could improve implementation by monitoring & adapting to get more impressive the using of the substitute vendor. The strategy of strengthening the internally rebuilt center is categorized into preparation to harmonize the infrastructure & strategy. The categorization of its strategy is referred to the current capture of company Alpha whereby has the existing infrastructure but with a limited capacity based on infrastructure.

<table>
<thead>
<tr>
<th>No.</th>
<th>Strategy</th>
<th>Capture strategy implementation phase in company Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Using a substitute vendor</td>
<td>Alignment of initiatives, Alignment of structure &amp; strategy, Engagement of staff</td>
</tr>
<tr>
<td>2</td>
<td>Strengthen the internal rebuilt center</td>
<td>Alignment of initiatives, Alignment of structure &amp; strategy</td>
</tr>
<tr>
<td>3</td>
<td>Develop a contract committee</td>
<td>Alignment of initiatives, Alignment of structure &amp; strategy</td>
</tr>
<tr>
<td>4</td>
<td>Approach vendor by its segmentation</td>
<td>Alignment of initiatives, Alignment of structure &amp; strategy</td>
</tr>
<tr>
<td>5</td>
<td>Renewal contract strategy</td>
<td>Alignment of initiatives, Alignment of structure &amp; strategy</td>
</tr>
<tr>
<td>6</td>
<td>Automatic planning calculation</td>
<td>Alignment of initiatives, Alignment of structure &amp; strategy</td>
</tr>
<tr>
<td>7</td>
<td>Proposed manpower management for the overhaul process</td>
<td>Alignment of initiatives, Alignment of structure &amp; strategy</td>
</tr>
</tbody>
</table>

Fig. 4. Summary of capture strategy implementation phase in the company.

The third strategy defined as developing a contract committee will impact the fourth strategy and the fifth strategy because of their dependencies. Meanwhile the fourth strategy for approaching vendors by its segmentation, company Alpha has a segmentation plan to categorize preparation to engage the staff to implement the strategy. Different conditions for the fifth strategy, its strategy is commonly running in the company Alpha. The problem is when the renewal process duration is too long although the process is ordinary so that is categorized into need improvement for optimizing by monitoring and adapting phase.

The automatic planning calculation is categorized into alignment budget & performance. Its strategy has been formulated for the initiative in the company Alpha and now the process to develop the system & structure. The process of implementing its strategy is probably the most expensive than another strategy, so the company should be detailed in its preparation to optimize the result. Despite the expensive condition, the strategy to increase planning accuracy would greatly impact the overhaul maintenance, its stakeholders, and the company.

The last strategy is about the proposed manpower management for overhaul maintenance that is categorized into the process of the harmonization between structure and strategy. The primary data is not specifically stated the difference between general manpower for maintenance and manpower for specific process overhaul. Whereas the difference in the object and work environment between general maintenance and overhaul maintenance is crucial because of the different levels of repetition of the work. Never though, with the current condition, company Alpha should be prepared to optimize the implementation of the strategy to tackle manpower issues in the future, especially in overhaul maintenance.

The following is the summary of how to implement the proposed strategy when implemented in the company Alpha.

VI. CONCLUSIONS AND RECOMMENDATIONS

The strategies proposed in the research consist of seven strategies from the three main clusters, contract material, planning accuracy, and manpower management for overhaul maintenance. The following is the detailed strategy implementation based on the timing to deliver the strategy:
The company should have a standing point to face overhaul maintenance in the future. When the company realized the overhaul as a strategy the company should prevent with the several strategies that concluded in the research. However, even though company Alpha has not decided what the standing point is, the strategies that are categorized as "low-hanging fruit" should be able to implement immediately.

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**CONFLICT OF INTEREST**

The authors declare that they do not have any conflict of interest.

**REFERENCES**


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**Fig. 5. Summary of how to implement the strategy in the company Alpha.**

1) Immediately (1st strategy and 5th strategy)

Consist of using substitute vendor and renewal contract strategy. Both strategies have been implemented, the challenge is how to improve the strategies to get optimize for better the process of overhaul. Hence, the consistency of improving these strategies will give benefits for the company Alpha such as cheaper prices of the material and lean processes to procure.

2) 1-3 Months (3rd strategy, 4th strategy, and 7th strategy)

Consist of developing a contract committee, approaching the vendor by its segmentation, and proposing manpower management for overhaul. The three strategies are planned to be delivered in one to three months. All strategies are not yet fully implemented in the company but if they implement that does not take a long time to execute because the process does not require extra or additional resources from company Alpha.

3) >3 Months (2nd strategy and 6th strategy)

Consist of strengthening the internal rebuilt center and developing an automatic planning calculation. Both strategies require a huge investment to execute and do not instantly develop. Company Alpha should plan carefully whether the strategies are fully executed, partially executed, or not.

The strategies are defined as the time when they will execute depending on the decision that must be made first, their dependencies, and their duration. The strategy that required the decision first is for the second and sixth strategies because require extra or additional resources, so the strategy will start in the second month, assuming the decisions are made in the first month. On the contrary, the strategy that optimizes more when another strategy is implemented first such as in the fourth and fifth strategy. Both strategies (the fourth and the fifth strategies) are implemented after the third strategy (developing a committee contract) is implemented in the second month. The summary is shown below.

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**Fig. 6. Implementation plan of strategy in the company Alpha.**