

CHAPTER 6

DEVELOPMENT OF KNOWLEDGE-BASED COLLABORATIVE LEAN MANUFACTURING MANAGEMENT (KBCLMM) MODEL: STAGE 2 (DESIGN)

6.0 Introduction

This chapter focuses on the detailed development of the KBCLMM Model for the Stage 2 as shown in Figure 6.1. It explains all levels in the design stage of the structure of the KBCLMM System as described in Chapter 4.

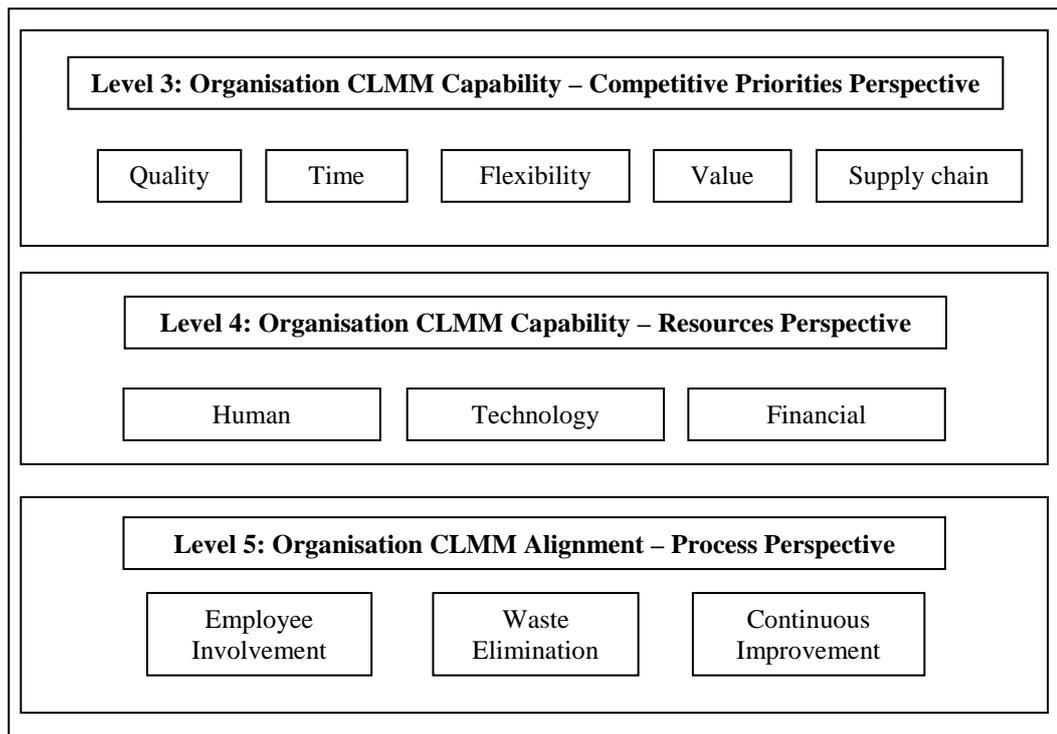


Figure 6.1: Structure of KBCLMM System – Stage 2

This discussion covers the details contained within modules, including the production rules and process flow of the system. The perspectives covered in this stage are *Organisation CLMM Capability - Competitive Priorities* (Level 3), *Organisation CLMM Capability - Resources* (Level 4), and *Organisation CLMM*

Alignment - Process (Level 5). Each of the perspectives will be described in the following sections according to their corresponding level in the structure of the KBCLMM System.

6.1 Level 3 - Organisation CLMM Capability - Competitive Priorities Perspective

The *Organisation CLMM Capability – Competitive Priorities Perspective* consists of five modules: *Quality, Time, Flexibility, Value* and *Supply Chain*. The function of these modules is to discover the current organisation capability towards CLMM in terms of these five competitive priorities as discussed in Chapter 4. The detailed structure of this perspective is shown in Figure 6.2 with five modules used to analyse the respective competitive priorities.

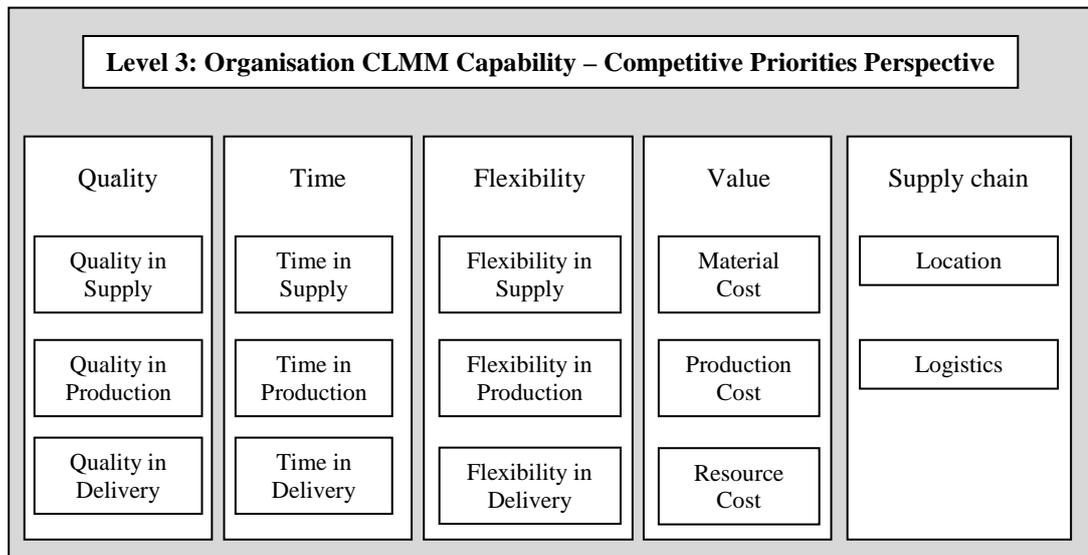


Figure 6.2: Detailed Structure of KBCLMM- Level 3

Each of these modules consists of aspects or activities such as *in Supply, in Production, and in Delivery* for *Quality, Time, and Flexibility* modules. For *Value* module, *Material Cost, Production Cost, and Resources Cost* are the aspects contained. Lastly, for *Supply Chain* module, two aspects are involved:

Location and Logistics. Each of these modules is described and explored in the corresponding sections.

6.1.1 Quality Module

In order to produce a high quality product to market, the organisation needs not only to have quality in production but also to work closely and effectively with upstream and downstream players in the supply chain [Stamatis (2004), Udin (2004)]. On the one hand, the quality of supply from suppliers needs to be controlled in terms of its raw materials and specification in order to guarantee the production output. On the other hand, the quality of delivery needs to be assured to meet or exceed the customer satisfaction. The flowchart of this module is shown in Figure 6.3.

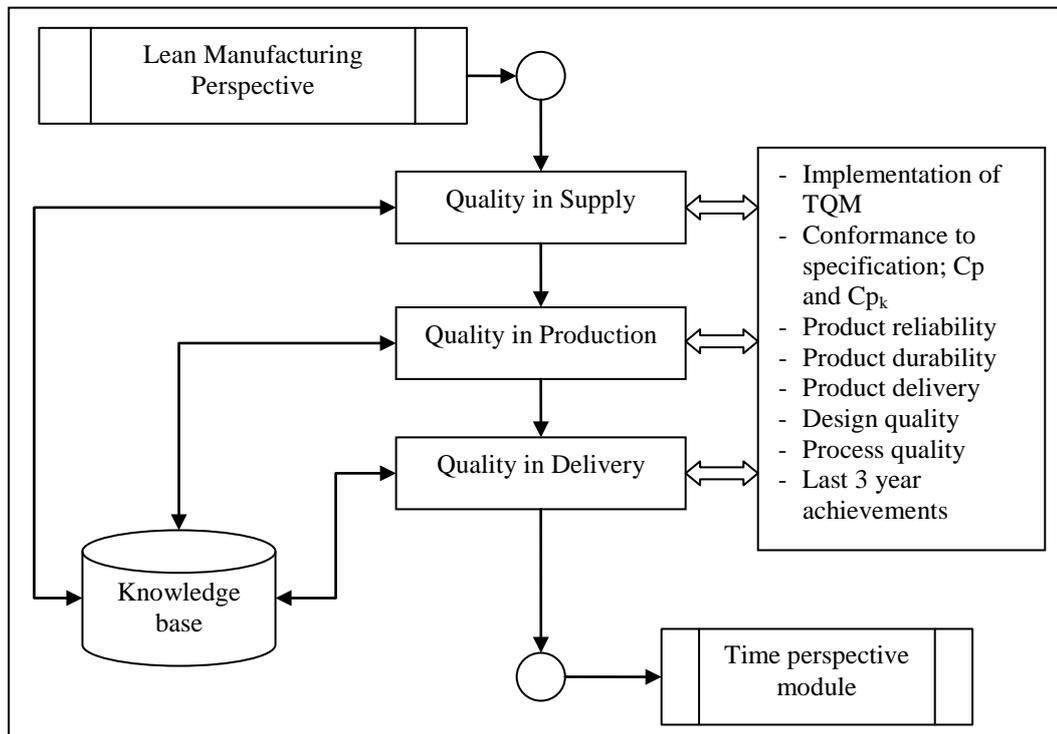


Figure 6.3: Flowchart of *Competitive Priorities - Quality Perspective Module*

Quality is the first module in *Organisation CLMM Capability – Competitive Perspective*, developed to assess the quality from upstream to downstream of the automotive lean chain as shown in Figure 6.3. The example of rules implemented in the *Quality* module used for deducing the condition of management commitment to TQM implementation is listed as follows.

IF *the top management committed to implement TQM (Yes: GP; No: BP, PC1)*
AND *the top management committed to increase customer satisfaction (Yes: GP; No: BP, PC1)*
AND *the top management committed the necessary resources to implement TQM (Yes: GP; No: BP, PC1)*
AND *the top management shared the same vision of fulfilling TQM implementation with all employees (Yes: GP; No: BP, PC1)*
AND *the top management hold clear visionary goals for TQM (Yes: GP; No: BP, PC1)*
AND *the top management developed a detailed implementation plan for TQM (Yes: GP; No: BP, PC2)*
AND *the top management identified the necessary Champions for the implementation of TQM (Yes: GP; No: BP, PC3)*
AND *the top management ensured a clear definition of TQM to all employees TQM (Yes: GP; No: BP, PC2)*
THEN *the top management team has taken necessary actions to ensure the TQM implemented successfully*
OR *the implementation of TQM is poor and needs top management full commitment to implement TQM*

From these rules, it is mandatory to the organisation to have full commitment of top management to implement TQM in achieving CLMM. Hence, in the KBCLMM, the absences of commitment to increase customer satisfaction, resources, shared vision with all employees, hold clear definition and so on indicate that the organisation has serious problems in this module.

6.1.2 Time Module

In order to assess the time from the upstream to downstream of the supply chain, three levels that correspond to dimensions of time are evaluated, and these are *Time in Supply*, *Time in Production* and *Time in Delivery*. The flowchart of this process in the KBCLMM System is shown in Figure 6.4.

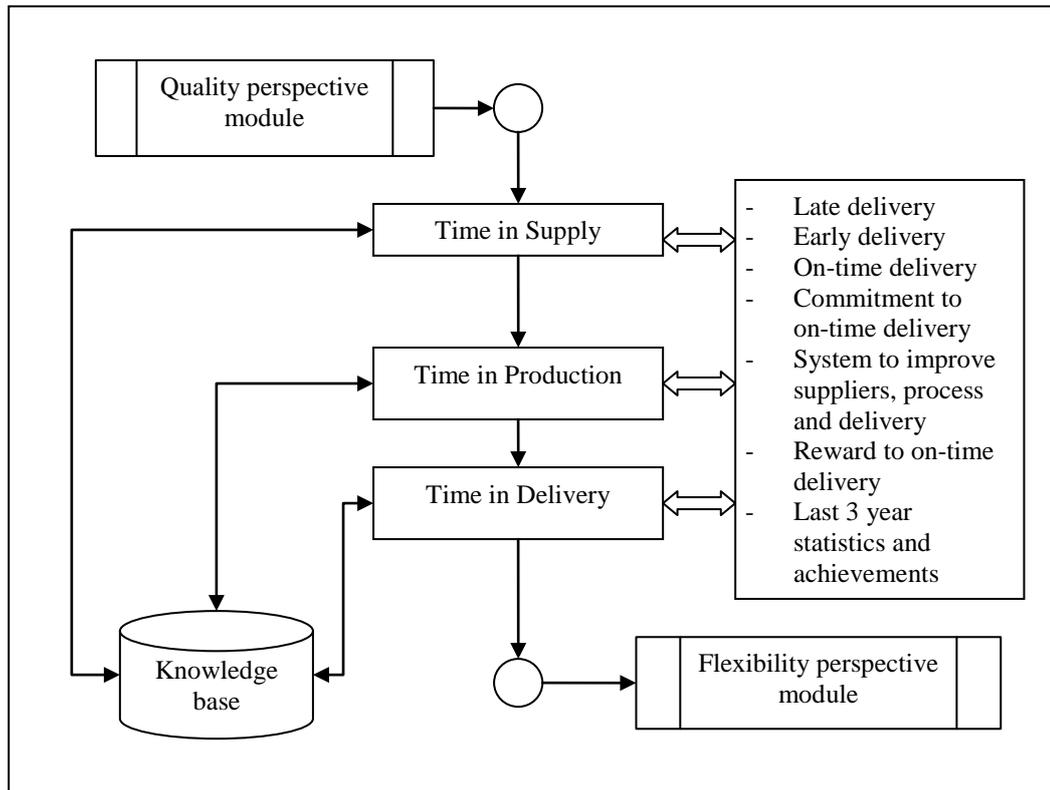


Figure 6.4: Flowchart of *Competitive Priorities - Time Perspective Module*

For each level, there are three factors of time to be assessed in this module, late, early, and on-time. The rules are used to deduce the data from the user in assessing aspects such as importance of time delivery, incentives and commitment of organisations. An example of rule-base implemented in this module to deduce the achievement in *Time in Supply* is shown in the following section.

- IF** *the organisation emphasises the importance of on- time delivery to the suppliers to gain competitiveness (Yes: GP; No: BP, PC1)*
- AND** *the organisation has a system to penalise suppliers for late delivery (Yes: GP; No: BP, PC2)*
- AND** *the organisation has a system to improve suppliers for late delivery (Yes: GP; No: BP, PC1)*
- AND** *the organisation has a system to reward suppliers for on-time delivery (Yes: GP; No: BP, PC3)*
- AND** *the organisation has a system to adjust the early delivery from the suppliers (Yes: GP; No: BP, PC2)*
- AND** *the organisation measures the number of on-time delivery (Yes: GP; No: BP, PC1)*
- AND** *the average number of on-time delivery from suppliers for last year is > 99% (Yes: GP, PC5)*

AND *the average number of on-time delivery from suppliers for last year is < 80% (Yes: BP, PC1)*
AND *the average number of on-time delivery from suppliers for last year is 80 - 89% (Yes: BP, PC2)*
AND *the average number of on-time delivery from suppliers for last year is 90- 95 % (Yes: BP, PC3)*
AND *the average number of on-time delivery from suppliers for last year is 95 - 98 % (Yes: BP, PC4)*
THEN *the suppliers to the organisation achievement in the on-time delivery is good and capable to improve competitiveness*
OR *the organisation needs to review its suppliers' achievement in the on-time delivery for further improvement*

From these rules, it can be seen that the organisation needs to emphasise the importance of on-time delivery to the suppliers. Since CLMM itself is based on JIT technique, the absence of commitment to supply materials on-time is considered as a serious problem. For example, in the above rules, KBCLMM with the embedded GAP Analysis categorises it as PC1 if the organisation has no system to improve suppliers if they have problems with late delivery.

6.1.3 Flexibility Module

In order to produce a competitive product to market, the organisation needs not only to have quality and on-time delivery capabilities, but also be flexible in production, supply, and delivery. Flexibility is the ability of the organisation's operations system to respond quickly to the demand changes from customers which is needed to avoid inefficiencies in the CLMM. The flowchart of this process in the KBCLMM System is shown in Figure 6.5.

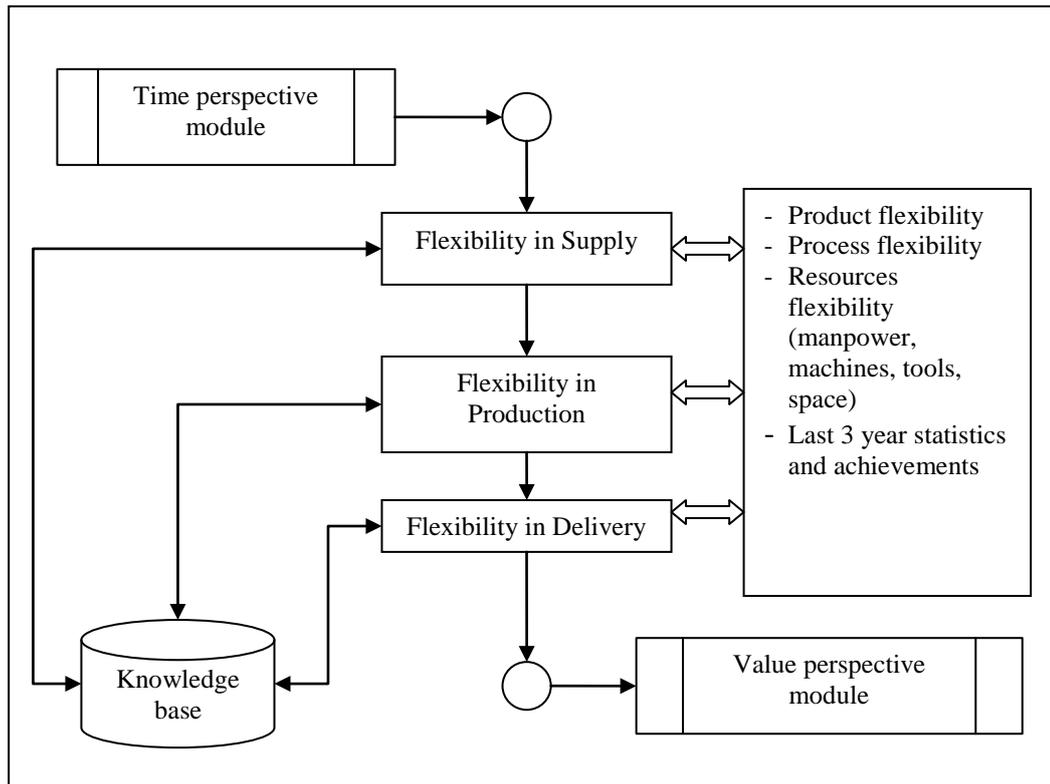


Figure 6.5: Flowchart of *Competitive Priorities - Flexibility Perspective Module*

Three areas that correspond to dimensions of flexibility are evaluated, and these are *Flexibility in Supply*, *Flexibility in Production* and *Flexibility in Delivery*. An example of rule-base implemented in this module is briefly shown as follows.

- IF** *the organisation emphasises the importance of product flexibility within the organisation (Yes: GP; No: BP, PC1)*
- AND** *the organisation emphasises the importance of product flexibility to the suppliers (Yes: GP; No: BP, PC1)*
- AND** *the suppliers are flexible enough to meet product requirement (Yes: GP; No: BP, PC1)*
- AND** *the organisation emphasises the importance of process flexibility within the organisation (Yes: GP; No: BP, PC1)*
- AND** *the organisation emphasises the importance of process flexibility to the suppliers (Yes: GP; No: BP, PC1)*
- AND** *the organisation emphasises the importance of resources flexibility within the organisation (Yes: GP; No: BP, PC1)*
- AND** *the organisation emphasises the importance of resources flexibility to the suppliers (Yes: GP; No: BP, PC1)*
- AND** *the suppliers are flexible enough to meet any changes in your production requirements with short notice (Yes: GP; No: BP, PC1)*
- AND** *the organisation has collaborative programme with the suppliers to improve product flexibility (Yes: GP; No: BP, PC2)*
- AND** *the organisation has collaborative programme with the suppliers to improve manufacturing process flexibility (Yes: GP; No: BP, PC2)*

AND *the organisation has collaborative programme with the suppliers to improve resource flexibility (Yes: GP; No: BP, PC2)*

AND *organisation has a programme to improve product flexibility (Yes: GP; No: BP, PC1)*

AND *the suppliers are able to meet the organisation order changes with short notice (Yes: GP; No: BP, PC1)*

AND *the organisation is able to meet customers order changes with short notice (Yes: GP; No: BP, PC1)*

THEN *the organisation achievements in assessing the competitive priority flexibility perspective module is good*

OR *the organisation needs to review the competitive priority flexibility to identify the problem*

From the above rules, it can be seen that the KBCLMM categorises it as a serious problem of PC1 if the organisation does not emphasise on the importance of product, process and resources flexibilities within the organisation and also to the suppliers. Besides, the collaborative programme is essential for both organisation and suppliers to improve these flexibilities. On the one hand, suppliers must be flexible enough to meet their customer (the organisation)'s order changes with short notice. On the other hand, the organisation also needs to be able to meet customers order changes with short notice. The absence of any or both of these shows that the flexibility level is not up standard to achieve CLMM and considered as a serious problem with PC1.

6.1.4 Value Module

This module assesses the organisation's concern on CLMM Manufacturing Competitive Priorities in terms of value. Products gain some value when they pass through all value-adding activities of the chain in order and at each activity. Three criteria are considered in this module; *Material Cost*, *Production Cost*, and *Resources Cost* as shown in Figure 6.6.

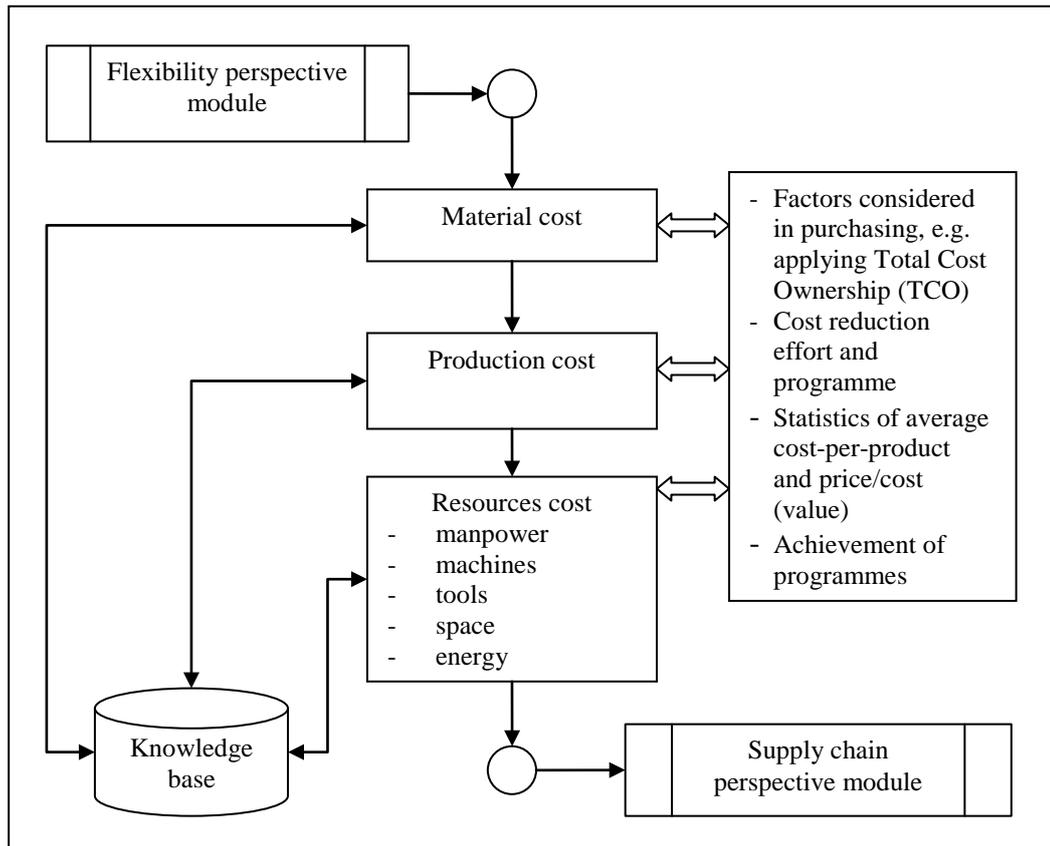


Figure 6.6: Flowchart of *Competitive Priorities - Value Perspective Module*

The example of rule–base that implemented for *Production Cost* in this module is briefly shown as follows.

- IF** *the organisation emphasises to reduce non value adding activities in production (Yes: GP; No: BP, PC1)*
- AND** *the organisation emphasises to improve value adding activities in production (Yes: GP; No: BP, PC1)*
- AND** *the organisation develops cost-per-product metrics to help control costs and boost cash inflow (Yes: GP; No: BP, PC2)*
- AND** *the organisation calculates price-to-cost ratio for each type of product to make sure the product could make profit (Yes: GP; No: BP, PC2)*
- AND** *the organisation stops the production of products that can not be adjusted to be made profitably (Yes: GP; No: BP, PC1)*
- AND** *the organisation does have program to reduce cost in the production by streamlining material movement (Yes: GP; No: BP, PC2)*
- AND** *the organisation does have program to reduce cost in the production by improving manufacturing process (Yes: GP; No: BP, PC2)*
- AND** *the organisation does have program to reduce cost in the production by improving overall inventory turnover (Yes: GP; No: BP, PC2)*
- AND** *the organisation does have program to reduce cost in the production by improving communication within and between organisation (Yes: GP; No: BP, PC2)*
- THEN** *the organisation achievement in assessing the competitive priority of production cost is good*
- OR** *the organisation needs to review the competitive priority of production cost to identify the problem*

Since CLMM stresses the importance of non-value adding reduction activities, the KBCLMM identifies whether the organisation has emphasised on both reducing non-value adding and improving value adding activities in the production. The System categorises it as a serious problem of PC1 if there is no emphasis to these activities. In addition, the KBCLMM also considers that the measurement of cost-per-product and also price/cost for each product are essential in ensuring the organisation could make profit. The absence of this metric is also considered as a serious problem under PC2. The KBCLMM will conclude that the organisation achievement in assessing the competitive priority of production cost is good if all the above rules are satisfied by the user's answers.

6.1.5 Supply Chain Module

This module assesses the organisation's concern on CLMM Manufacturing Competitive Priorities in terms of supply chain. Information about location of organisation relative to its customers and suppliers will give insight on how lean the supply chain and cost associated with it. Logistics of the organisation which include warehousing, shipping and transportation are also play important roles in improving the CLMM supply chain. These two criteria *Location* and *Logistics* are considered in this module and shown in Figure 6.7.

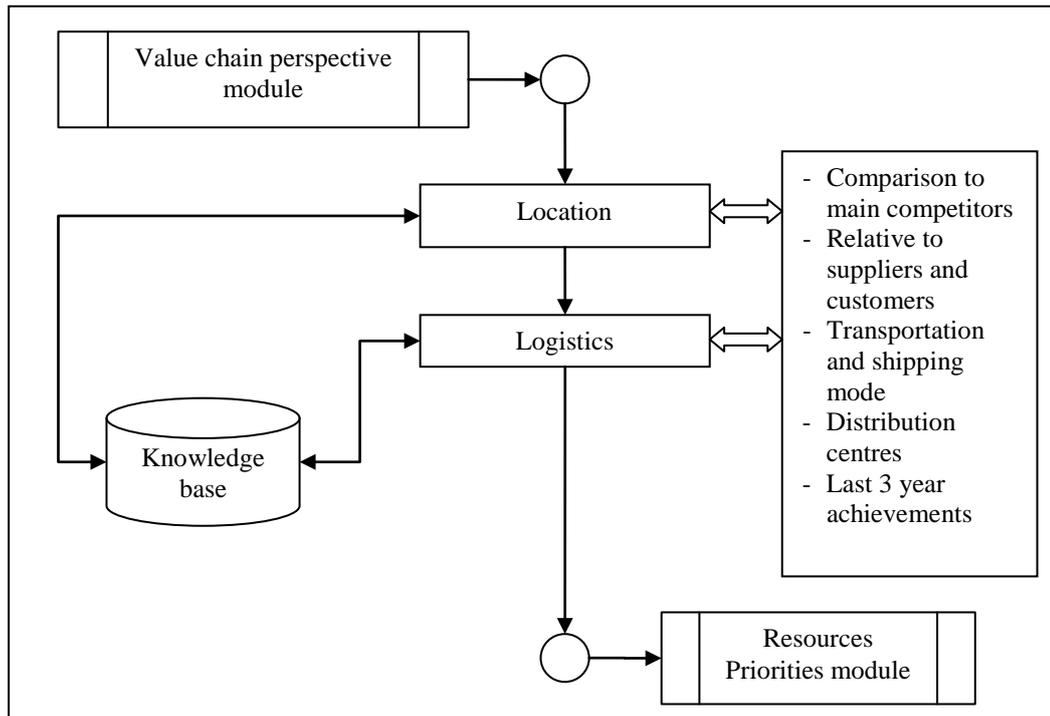


Figure 6.7: Flowchart of *Competitive Priorities Supply Chain Perspective Module*

The example of rule–base that implemented in this module is briefly shown as follows.

IF *the organisation is located in the good location for operations (Yes: GP; No: BP, PC1)*
AND *key suppliers are well located relative to the organisation (Yes: GP; No: BP, PC2)*
AND *key customers are well located relative to the organisation (Yes: GP; No: BP, PC2)*
AND *the organisation location competitiveness is continuously evaluated (Yes: GP; No: BP, PC1)*
AND *the organisation is located in same industrial compared to the main competitor (Yes: GP; No: BP, PC5)*
AND *the organisation is located in better location compared to the main competitor (Yes: GP; No: BP, PC1)*
AND *the organisation transportations mode is continuously evaluated and optimised (Yes: GP; No: BP, PC1)*
AND *the distribution centres are continuously identified and evaluated (Yes: GP; No: BP, PC1)*
THEN *the organisation achievements in assessing the competitive priority of location and logistics is good*
OR *the organisation needs to review the competitive priority of location and logistics to identify the problem*

Based on the user responses, the KBCLMM uses the above rules to identify the competitiveness of the organisation in term of location and logistics. For example, if the key suppliers and key customers are well located relative to

the organisation then, the System categorises these as *Good Points*. Otherwise, they are considered as serious problems of PC2.

It should also be highlighted that in the KBCLMM, the answer might be in the category of PC5, which means that it is not really a *Good* or *Bad Point* as explained in Chapter 3. The problem only could be revealed in the following question. For example, if the organisation and its main competitors are not in the same area, then the KBCLMM categories it as PC5 as in the question of “*is the organisation located in the same industrial area when compared to the main competitor?*” The problem could only be revealed in the following question of “*is the organisation is located in better location when compared to the main competitor?*” If the user answer is *No*, then KBCLMM concludes that this is a serious problem under PC1, since the organisation needs to be located in the best place.

6.2 Level 4 - Organisation CLMM Capability - Resources Perspective

The *Organisation CLMM Capability – Resources Perspective* consists of three modules: *Human Resource*, *Technology Resource*, and *Financial Resource*. The function of these modules is to discover the current organisation capability towards CLMM in terms of these three resources as discussed in Chapter 4. The detailed structure of this perspective is shown in Figure 6.8 with three modules used to analyse the respective resources priorities.

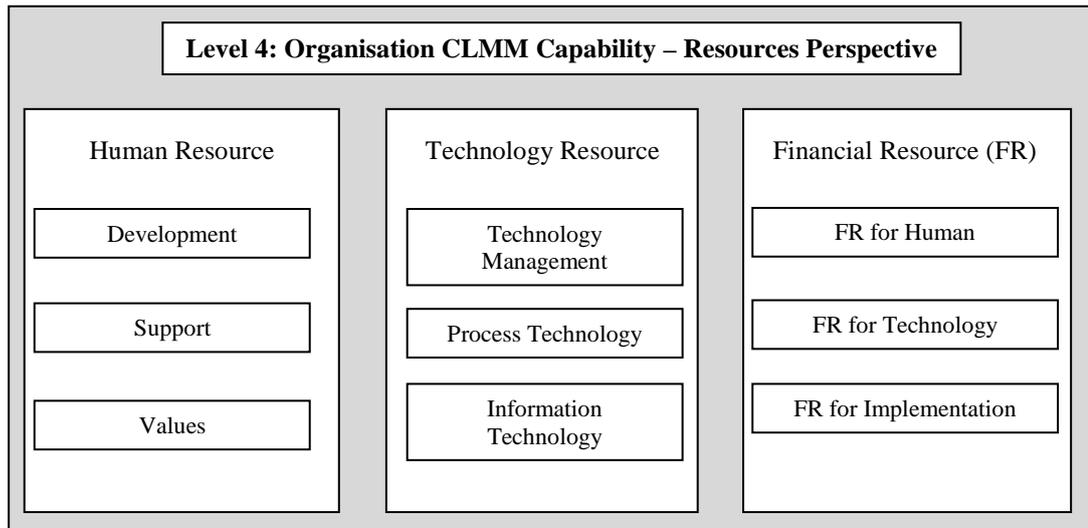


Figure 6.8: Detailed Structure of KBCLMM- Level 4

Each of these modules consists of aspects or activities such as *Development*, *Support*, and *Values* for *Human Resource* modules. For *Technology Resource* module, *Technology Management*, *Process Technology*, and *Information Technology* are the aspects contained. Lastly, in the *Financial Resource* module, three aspects are involved: *Financial for Human*, *Financial for Technology*, and *Financial for Implementation*. Each of these modules is described in the corresponding sections.

6.2.1 Human Resource Module

Human resources capability is important in developing a good relationship internally and externally for improving the effectiveness of the lean manufacturing. There is a need for organisations to emphasise this development such as in training programme, team development, management support, and development of organisation value, in order to improve the human resource capability in the lean manufacturing. Furthermore, there is a need to identify the status of human resources development in the organisation that relates to CLMM operation, in order to make an improvement to the needed factors or activities in

human resources development. Chase *et. al.* (2006) consider human resources as the most expensive resources even though many organisations put more emphasis on other resources.

There are three perspectives that deal with human resources: *Development, Support* and *Values*. The process flow of *Organisation CLMM Capability – Human Resource Perspective* module is shown in Figure 6.9.

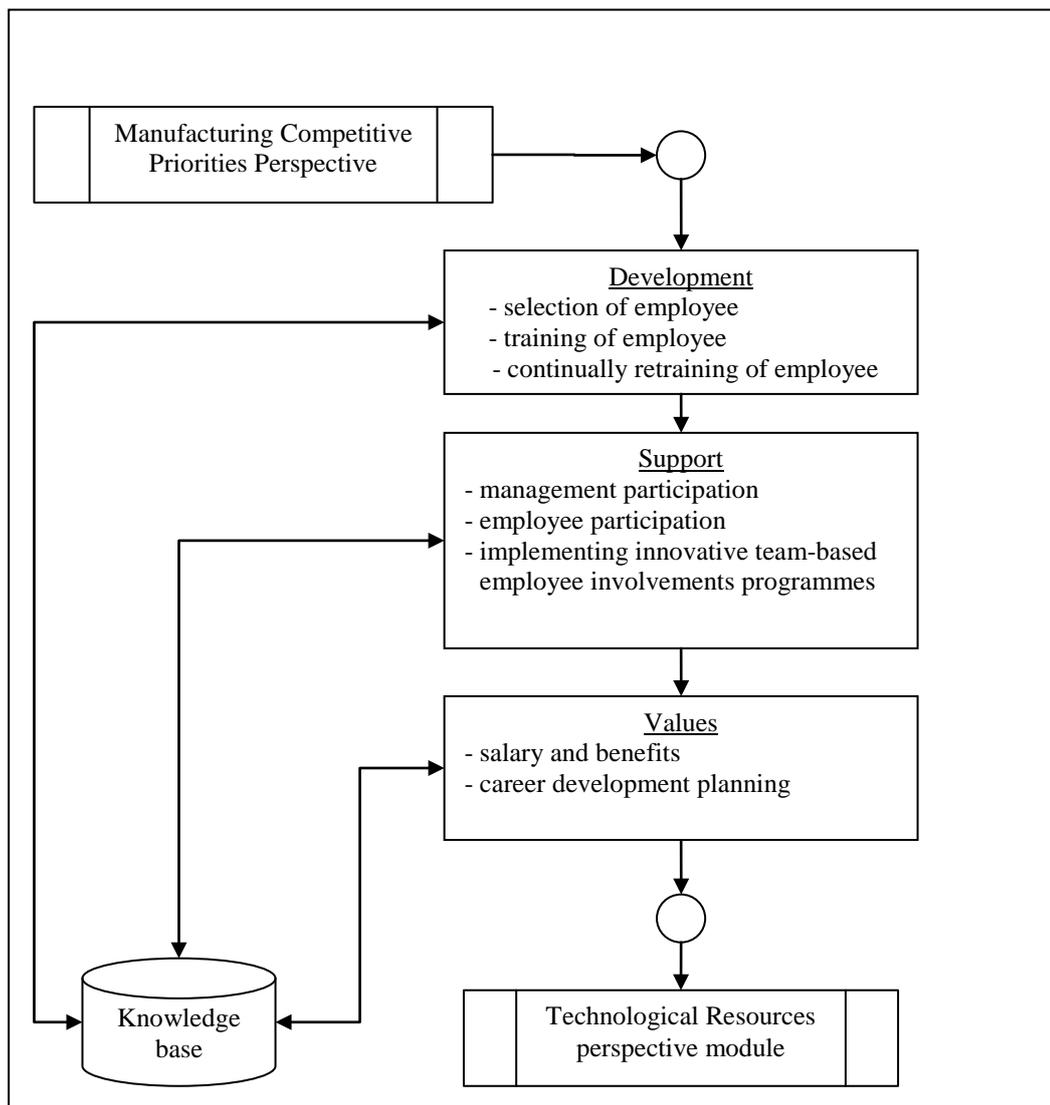


Figure 6.9: Flowchart of *Human Resource Perspective* Module

The example of rule–base implemented for *Development* in this module is briefly shown as follows.

IF *the organisation does have formal Human Resource Development (HRD) programme (Yes: GP; No: BP, PC1)*
AND *the organisation studies the need of the post before advertise the vacancy (Yes: GP; No: BP, PC1)*
AND *the organisation attempts to get the suitable employee internally prior to advertise the post to public (Yes: GP; No: BP, PC3)*
AND *HR department agrees with the respective department (the department which the new employee will be located) about the job scope (Yes: GP; No: BP, PC2)*
AND *the organisation mention about the requirement of lean manufacturing knowledge in the advertisement (Yes: GP; No: BP, PC3)*
AND *the organisation selects employee based on his/her experience in lean manufacturing environment (Yes: GP; No: BP, PC4)*
AND *the organisation hires employee without experience but with willingness to learn and involve in lean manufacturing environment (Yes: GP; No: BP, PC4)*
AND *the organisation hires fresh graduates (Yes: GP; No: BP, PC4)*
THEN *the organisation achievements in development programme is good and capable to improve human resources capability*
OR *the organisation needs to review its development programme to improve human resources capability*

From the above rules, the KBCLMM starts the asking the organisation whether it has a formal programme to develop human resources. The methods on how the organisation develops the resource are then evaluated. As an example, the organisation must study the needs for any job before advertising it. An absence of this will make the organisation recruits employee which may not contribute to the organisation. Hence, this is considered as a serious problem of PC1. The System also assesses if the management take into consideration certain aspects when hiring new staff. For example, an absence of hiring an employee with knowledge of lean manufacturing system is not considered as a serious problem, but if resolved it will give benefit to the organisation. Therefore, it is categorised as PC3.

6.2.2 Technology Resource Module

Technology Resource module is developed to assess the current status of organisation technology resources in CLMM. Mentzer *et. al.* (2000) found that

the technology resource is essential to the success of the lean chain collaboration, along with the potentiality of human resources capability. Therefore, in the *Technology Resources* module, the assessment of current technology resources implementation is done to identify the gap between the current situation and the desirable situation of the organisation. There are three factors to be evaluated, which are *Technology Management*, *Process Technology* and *Information Technology*. The process flow of *Organisation CLMM Capability – Technology Resource Perspective* module is shown in Figure 6.10.

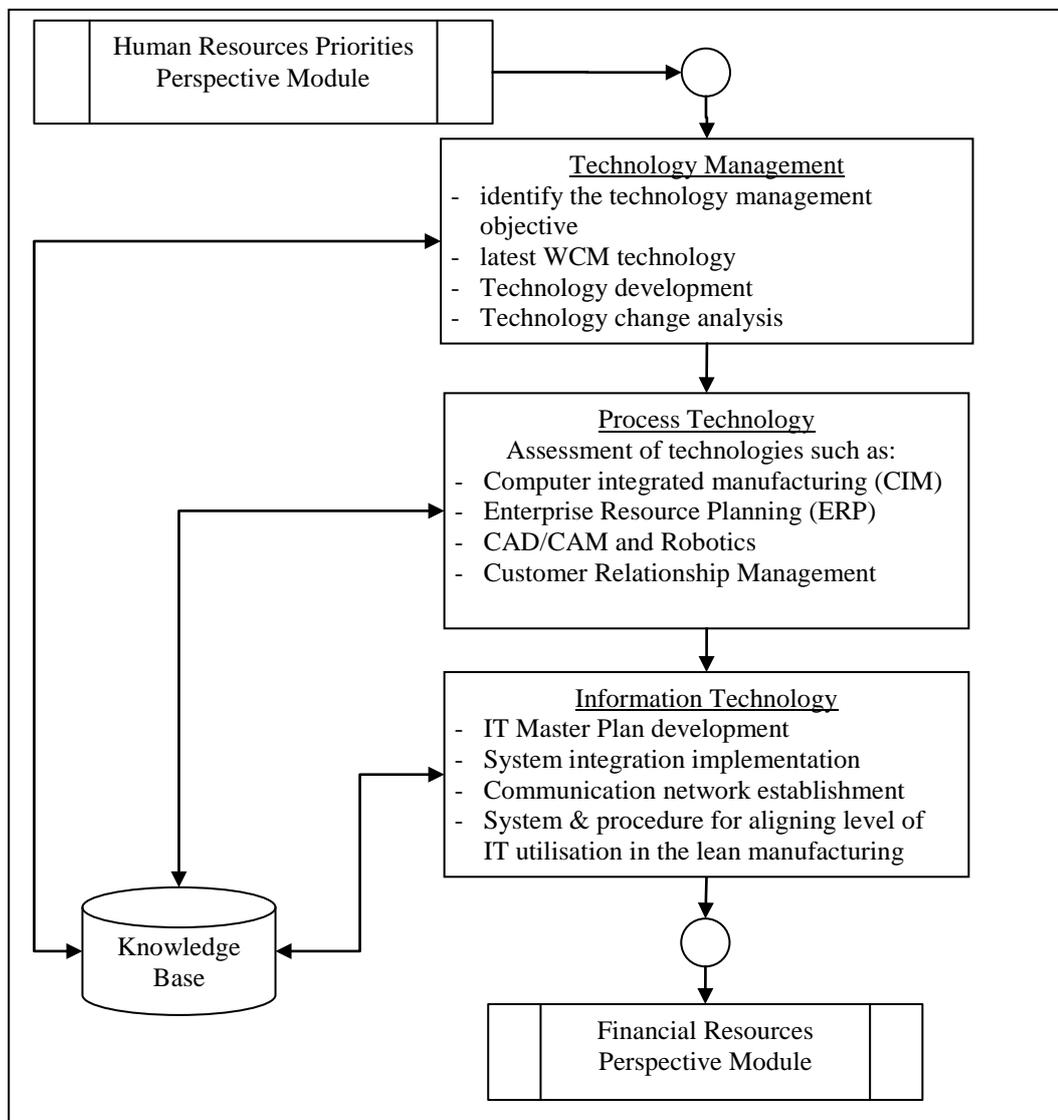


Figure 6.10: Flowchart of *Technology Resource Perspective* Module

The example of rule–base implemented for *Information Technology* procedure in this module is briefly shown as follows.

IF *the organisation implements standardisation of business process to improve information technology utilisation in lean manufacturing (Yes: GP; No: BP, PC1)*
AND *the organisation implements system integration to improve information technology utilisation in lean manufacturing (Yes: GP; No: BP, PC1)*
AND *the organisation establishes network communications to improve information technology utilisation in lean manufacturing (Yes: GP; No: BP, PC1)*
AND *information technology is used in parallel to lean manufacturing structure (Yes: GP; No: BP, PC2)*
AND *system and procedure for aligning the level of IT utilisation in lean manufacturing is established (Yes: GP; No: BP, PC1)*
AND *system & procedure for utilising IT in supporting lean manufacturing decision making process is established (Yes: GP; No: BP, PC1)*
AND *system & procedure for selecting IT systems that fulfil CLMM success factor is established (Yes: GP; No: BP, PC1)*
THEN *the organisation achievements in implementing information technology programme is good*
OR *the organisation needs further assessment on the implementation of information technology programme*

Since Information Technology (IT) is important in CLMM, it can be seen from the above rules that the KBCLMM categorises it as a serious problem of PC1 if the organisation does not implement standardisation of business process or system integration to improve information technology utilisation. Besides, the organisation must also establish network communication to improve the IT utilisation. The System also assess whether the organisation uses the IT in parallel to lean manufacturing structure. The absence of this shows that the IT is isolated to the CLMM implementation and considered as a serious problem of PC2.

6.2.3 Financial Resource Module

Financial Resource module is developed to assess the current status of organisation financial resources in the value chain. Achanga *et. al.* (2006) found that financial resource is essential to the success of the lean manufacturing implementation, along with technology and human resources capability. Many

companies, especially small and medium companies fear that the application of lean manufacturing, like any other productivity improvement initiative within any organisation, could require financial resources to hire consultants, training of people to utilise the techniques, as well as to aid the actual implementation [Achanga *et. al.* (2006)]. Production of firms may also be ceased temporarily in order for the workforce to embrace such knowledge; a fact that many view as an unnecessary loss of resources, especially if they do not anticipate immediate returns [Achanga *et. al.* (2006)].

The process flow of *Organisation CLMM Capability – Financial Resource Perspective* module is shown in Figure 6.11.

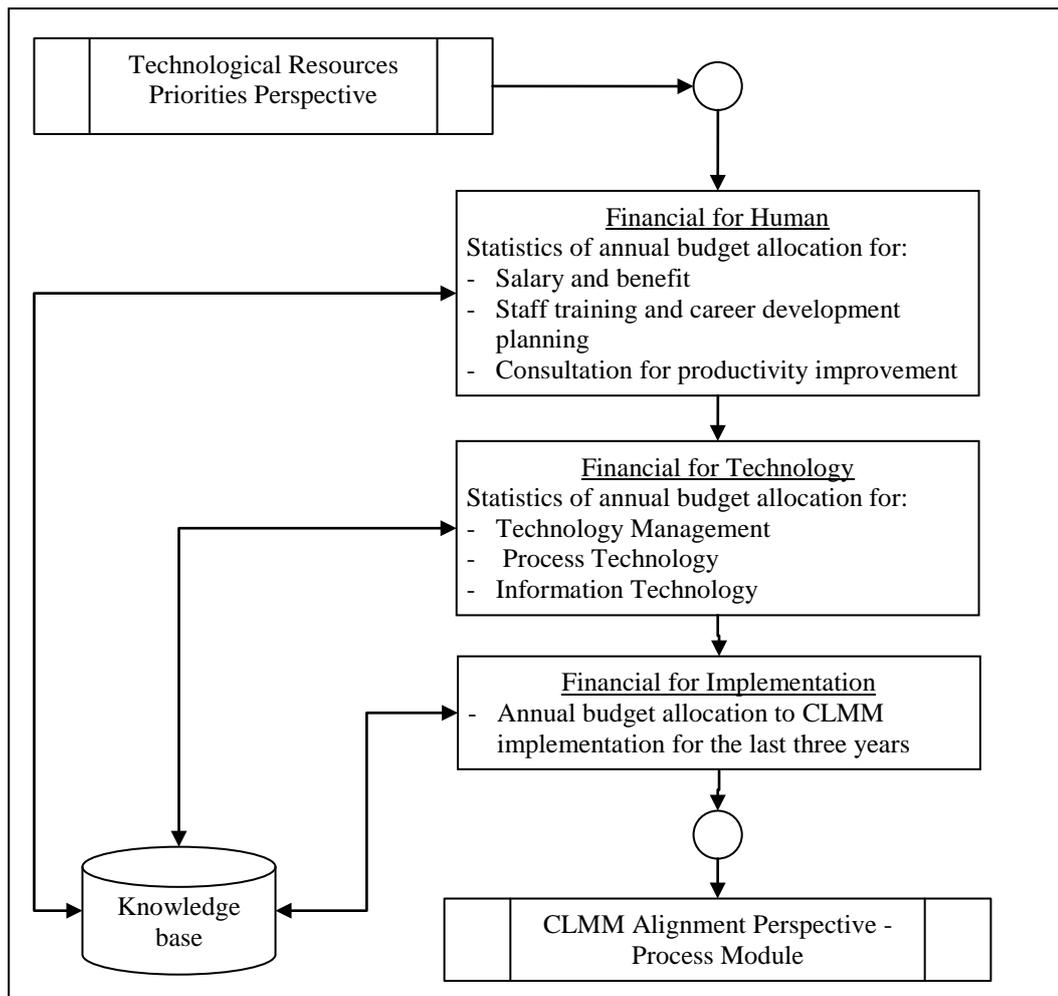


Figure 6.11: Flowchart of *Financial Resource Perspective* Module

The example of rule–base implemented for *Financial for Technology* in this module is briefly shown as follows.

IF *the budget for information technology is > 5% of total budget in 2007 (Yes: GP; No: BP, PC5)*
AND *the budget for information technology is between 2.5% and 5% of total budget in 2007 (Yes: BP, PC4)*
AND *the budget for information technology is between 1% and 2.5% of total budget in 2007 (Yes: BP, PC3)*
AND *the budget for information technology is between 0.5% and 1% of total budget in 2007 (Yes: BP, PC2; No: BP, PC1)*
AND *the budget for information technology is > 5% of total budget in 2006 (Yes: GP; No: BP, PC5)*
AND *the budget for information technology is between 2.5% and 5% of total budget in 2006 (Yes: BP, PC4)*
AND *the budget for information technology is between 1% and 2.5% of total budget in 2006 (Yes: BP, PC3)*
AND *the budget for information technology is between 0.5% and 1% of total budget in 2006 (Yes: BP, PC2; No: BP, PC1)*
AND *the budget for information technology is > 5% of total budget in 2005 (Yes: GP; No: BP, PC5)*
AND *the budget for information technology is between 2.5% and 5% of total budget in 2005 (Yes: BP, PC4)*
AND *the budget for information technology is between 1% and 2.5% of total budget in 2005 (Yes: BP, PC3)*
AND *the budget for information technology is between 0.5% and 1% of total budget in 2005 (Yes: BP, PC2; No: BP, PC1)*
THEN *the budget allocation for technology resource is good*
OR *the organisation needs to improve the budget allocation for technology resource*

Based on the user responses, the KBCLMM uses the above rules to measure the information technology investment in term of budget allocation. For example, if the budget for IT is more than 5% from total budget in 2007, the System categorises this as *Good Point*. Otherwise, the System categorises it as PC5. It should also be pointed out again that in the GAP Analysis, PC5 means it is not really a *Good* or *Bad Point*. The problem will only be discovered in the following questions. For example, if budget is less than 0.5%, then it is a serious problem of PC1. If more than 0.5% but less than 1%, the System still considers it as a serious problem, but with PC2. Based on the KBCLMM results, the organisation could take necessary actions to improve the budget allocation.

6.3 Level 5 - Organisation CLMM Alignment – Process Perspective

The *Organisation CLMM Alignment – Process Perspective* module in Level 5 of the KBCLMM System structure consists of three modules, which are *Employee Involvement*, *Waste Elimination* and *Continuous Improvement*. The objective of this level is to identify and evaluate the current organisation CLMM alignment, which is based on these three identified processes to achieve customer satisfaction. The detailed KB structure of this module is shown in Figure 6.12.

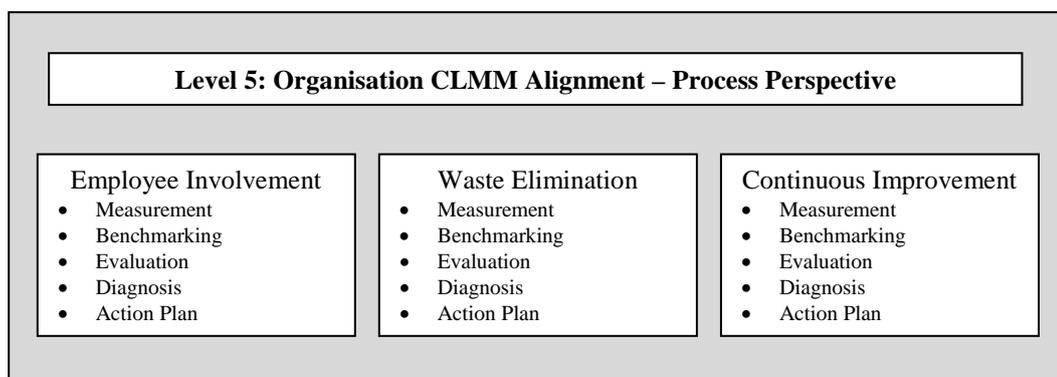


Figure 6.12 *Organisation CLMM Alignment - Process Perspective* Module

From Figure 6.12, the implementation levels of these processes are identified in the flow of how the organisation measure, benchmark, evaluate, diagnosis and plan the action to these three processes. The assessment includes the levels of team formation, training, goal setting, multi-functional team and area identification for waste elimination. Each of these three modules is described in the following sections.

6.3.1 Employee Involvement Module

Employee Involvement Process Perspective module is developed to assess the current status of organisation commitment to design and implement CLMM. As employee involvement element is recognised as essential in most manufacturing initiatives like CLMM, TQM and Six-Sigma, it is mandatory to

develop this module. The challenge of lean manufacturing management is to instil an awareness of the importance of participation in all employees and to motivate them to improve process and product quality. With CLMM, every employee is expected to have a high degree of personal responsibility and possession of the job. The process flow of *Organisation CLMM Alignment – Employee Involvement Process Perspective* module is shown in Figure 6.13.

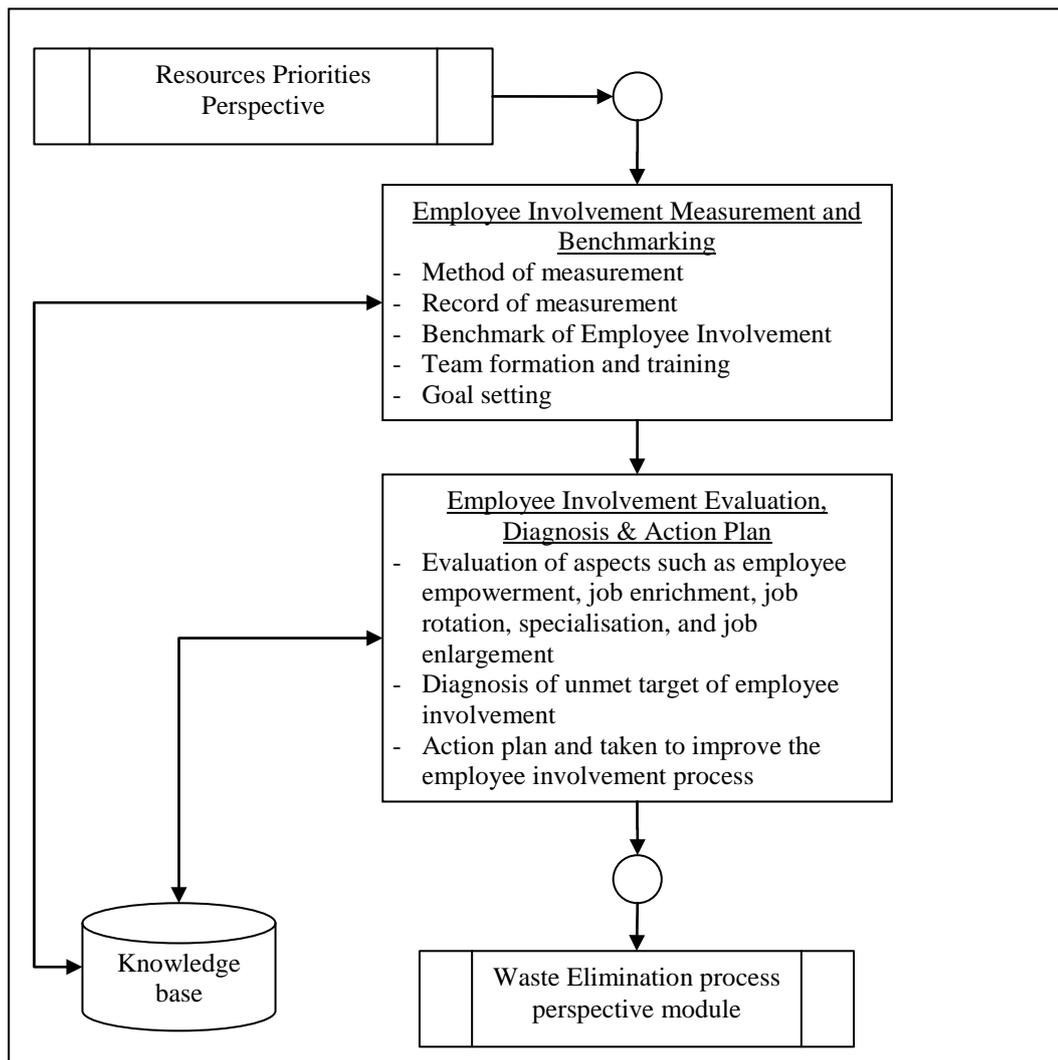


Figure 6.13: Flowchart of *Employee Involvement Perspective* Module

The example of rule–base implemented in this module is briefly shown as follows.

IF *the organisation has at least a method to measure the employee involvement (Yes: GP; No: BP, PC1)*
AND *the organisation has the record of employee involvement (Yes: GP; No: BP, PC1)*
AND *the organisation has identified the benchmark for the employee involvement (Yes: GP; No: BP, PC2)*
AND *the organisation implements job specialisation in the operations (Yes: GP; No: BP, PC4)*
AND *the organisation implements job enlargement in the operations (Yes: GP; No: BP, PC3)*
AND *the organisation implements job enrichment in the operations (Yes: GP; No: BP, PC2)*
AND *the organisation implements job rotation in the operations (Yes: GP; No: BP, PC1)*
AND *the organisation implements employee empowerment in the operations (Yes: GP; No: BP, PC1)*
AND *the organisation emphasises teamwork parallel to employee involvement (Yes: GP; No: BP, PC1)*
THEN *the organisation element of employee involvement is good and capable to achieve CLMM alignment*
OR *the organisation needs to review its employee involvement process to align the CLMM*

In this module, the questions in the KBCLMM begin with an assessment to identify the existence of employee involvement programmes in the organisation. This is done by questioning the measurement method and record for the process of employee involvement. The absence of measurement method and record shows that the organisation has no clear idea of how to align the employee involvement process that is used to support organisation in achieving CLMM. Hence, it is considered as a serious problem of PC1. The System then evaluates the implementation of employee involvement aspects such as job specialisation, job enlargement, job enrichment, job rotation, and employee empowerment. In this case, the absences of job specialisation and job enlargement are not serious problems, since in achieving CLMM, efforts should be put more on job rotation and employee empowerment [Slack *et. al.* (2007)].

6.3.2 Waste Elimination Module

Waste Elimination Process Perspective module is developed to assess the current status of organisation commitment to reduce and eliminate waste in achieving CLMM. As waste in lean manufacturing is defined as anything that is not required to add value to the part produced, identification, measurement,

evaluation, diagnosis and action plan are steps needed to ensure the management of the organisation is committed to this process. The process flow of *Organisation CLMM Alignment – Waste Elimination Process Perspective* module is shown in Figure 6.14.

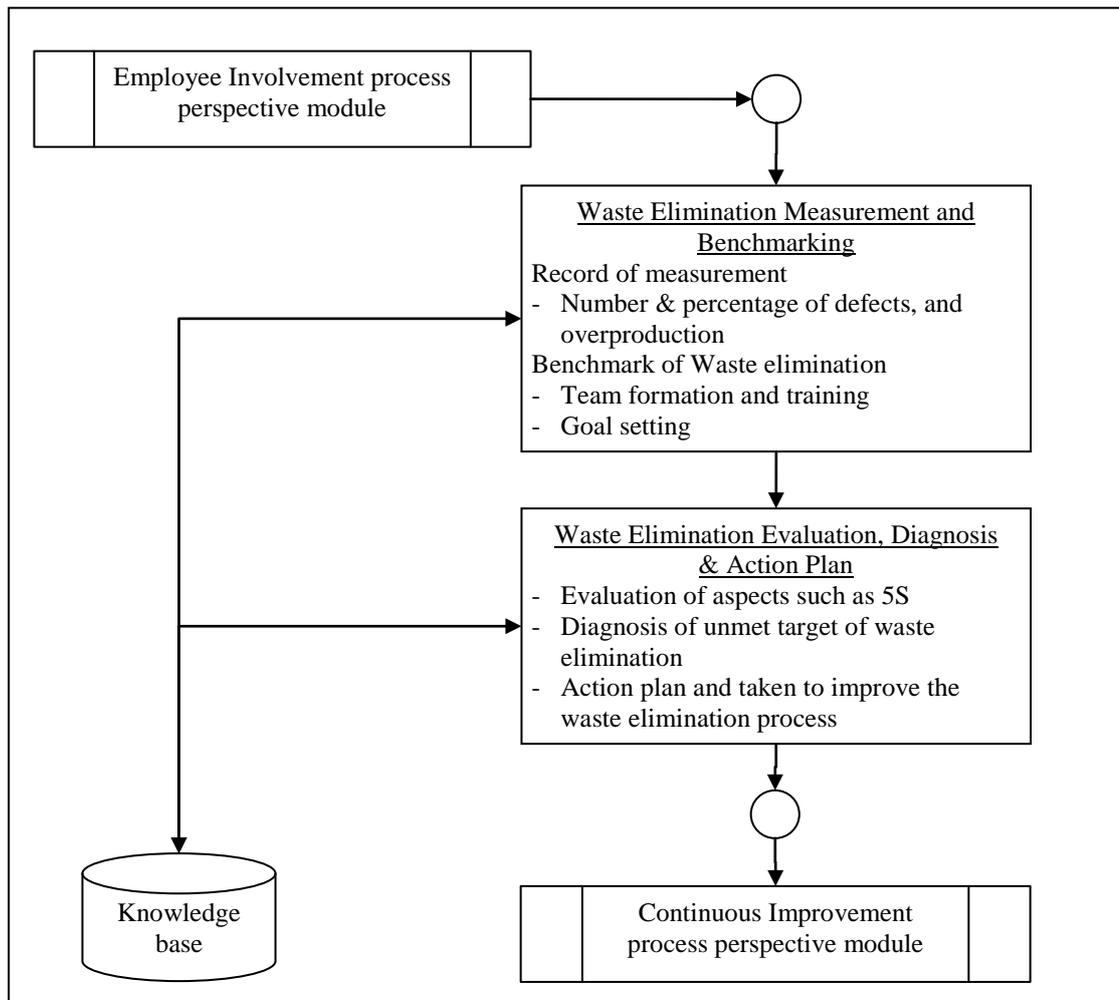


Figure 6.14: Flowchart of *Waste Elimination Perspective Module*

The example of rule–base implemented in this module is briefly shown as follows.

- IF** *the organisation has measurement records of waste elimination process (Yes: GP; No: BP, PC1)*
AND *the organisation has records of number and percentage of defects (Yes: GP; No: BP, PC1)*

AND *the organisation has records of number and percentage of overproduction (Yes: GP; No: BP, PC1)*
AND *the organisation has records of number and percentage of throughput time (Yes: GP; No: BP, PC3)*
AND *the organisation has records of average percentage of value-added time (Yes: GP; No: BP, PC2)*
AND *the organisation has identified the best practice of waste elimination (benchmark) (Yes: GP; No: BP, PC2)*
AND *the organisation regularly evaluates the waste elimination process (Yes: GP; No: BP, PC1)*
AND *the organisation regularly diagnosis the waste elimination process (Yes: GP; No: BP, PC2)*
AND *the organisation regularly takes action to improve the waste elimination process (Yes: GP; No: BP, PC1)*
THEN *the organisation element of waste elimination is good and capable to achieve CLMM alignment*
OR *the organisation needs to review its waste elimination process to align the CLMM*

From the above rules, it can be seen that the KBCLMM categorises it as a serious problem of PC1 if the organisation does not have record on the waste elimination process since waste elimination is an integral element of CLMM. The System also clarifies the measurement of metrics such as number of defects and overproduction, which need to be eliminated. Questions about the identification of best practice, evaluation, diagnosis, and action taken to improve the waste elimination process are then asked by the KBCLMM. For example, if there is no action taken to improve the waste elimination process, then the System concludes it as a serious problem of PC1.

6.3.3 Continuous Improvement Module

In order to achieve CLMM successfully, the organisation needs not only to have good employee involvement and waste elimination, but also excellent continuous improvement process. *Continuous Improvement Process Perspective* module is developed to assess the current status of organisation commitment to continuous improvement in achieving CLMM. The process flow of *Organisation CLMM Alignment – Continuous Improvement Process Perspective* module is shown in Figure 6.15.

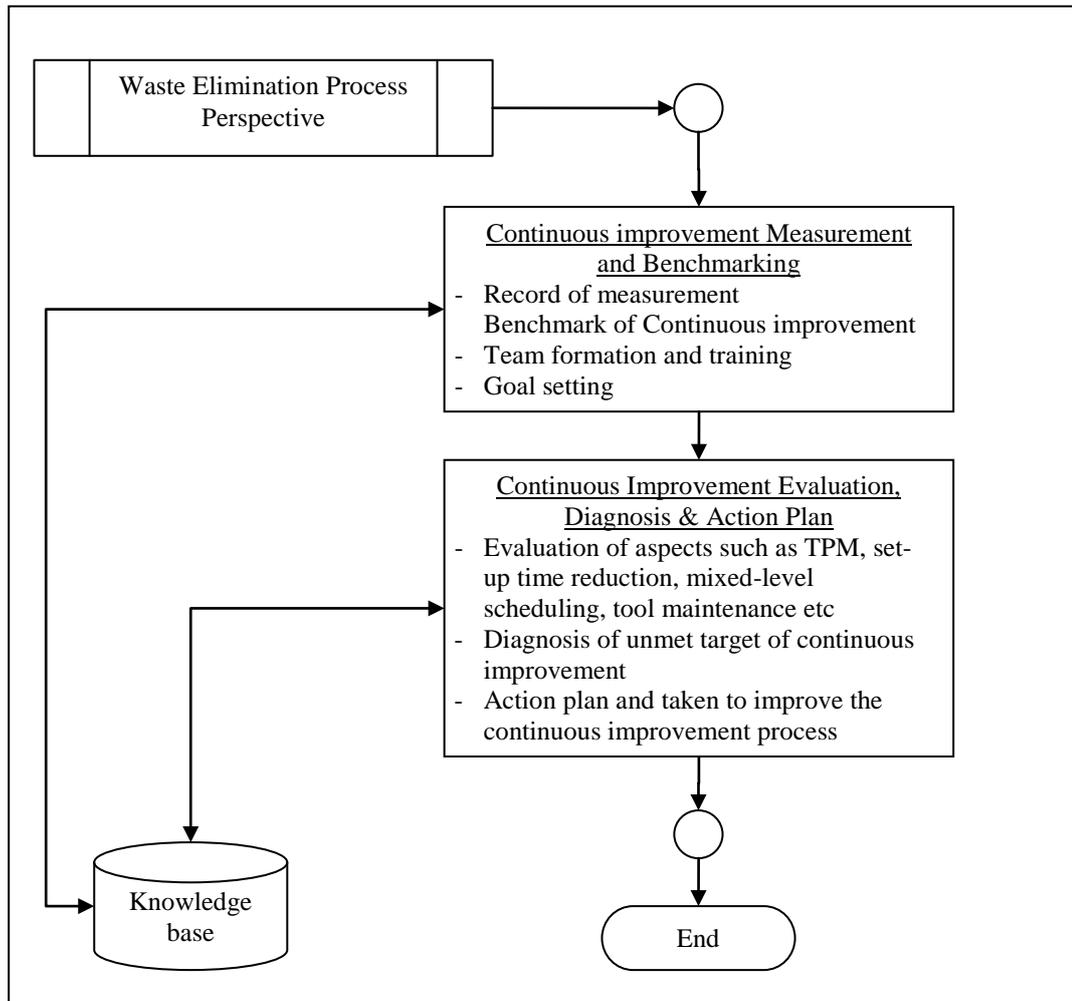


Figure 6.15: Flowchart of *Continuous Improvement Perspective Module*

A brief example of rule-base and questions are shown in the following rules.

- IF** *the organisation has measurement records of continuous improvement process (Yes: GP; No: BP, PC1)*
- AND** *the organisation has identified the best practice of continuous improvement (benchmark) (Yes: GP; No: BP, PC2)*
- AND** *the organisation regularly evaluates the mixed level scheduling as part of continuous improvement process (Yes: GP; No: BP, PC1)*
- AND** *the organisation regularly evaluates the total productive maintenance (TPM) as part of continuous improvement process (Yes: GP; No: BP, PC1)*
- AND** *the organisation regularly evaluates the visual factory as part of continuous improvement process (Yes: GP; No: BP, PC1)*
- AND** *the organisation regularly evaluates the mistake proofing technique as part of continuous improvement process (Yes: GP; No: BP, PC1)*
- AND** *the organisation regularly evaluates the work standardisation as part of continuous improvement process (Yes: GP; No: BP, PC1)*
- AND** *the organisation regularly evaluates the tool maintenance as part of continuous improvement process (Yes: GP; No: BP, PC1)*

- AND** *the organisation regularly diagnosis the continuous improvement process (Yes: GP; No: BP, PC2)*
- AND** *the organisation regularly takes action to continuously improve the operations (Yes: GP; No: BP, PC2)*
- THEN** *the organisation element of continuous improvement is good and capable to achieve CLMM alignment*
- OR** *the organisation needs to review its continuous improvement process to align the CLMM*

In this module, the questions in the KBCLMM begin with an assessment to identify the existence of measurement records for the continuous improvement process. The absence of measurement records shows that the organisation has no clear idea of how to align the continuous improvement process that is used as an integral part to achieve CLMM. Therefore, it is considered as a serious problem of PC1. The System then assesses the organisation evaluation of elements of continuous improvement such as total productive maintenance, visual factory, mistake proofing technique, set-up time reduction, and so on. In this case, an absence of any of these elements is a serious problem of PC1 because in achieving CLMM, efforts should be put all elements of continuous improvement. The KBCLMM also identifies the process of benchmarking, diagnosis, and action plan for the organisation achieve optimal continuous improvement as it is a mandatory for CLMM accomplishment.

6.4 Summary

This chapter has described in detail the development of Stage 2 in the Knowledge Based Collaborative Lean Manufacturing Management (KBCLMM) System. The development is based on the KBCLMM System structure as shown in Figure 6.1. There are three levels in the KBCLMM System structure, which begin with Level 3 – *Organisation CLMM Capability – Competitive Priorities Perspective*, Level 4 – *Organisation CLMM Capability – Resources Perspective*, and Level 5 - *Organisation CLMM Alignment – Process Perspective*. Each of

this perspective is summarised briefly in the following by referring each of components as module.

In Level 3, the *Organisation CLMM Capability – Competitive Priorities Perspective* module, which consists of five modules of strategic performance metric for CLMM, is described. These four modules are *Quality, Time, Flexibility, Value* and *Supply Chain Perspectives*. The assessment of these modules is based on several factors such as *Quality in Supply, Quality in Production and Quality in Delivery* for *Quality Perspective* module; *Time in Supply, Time in Production and Time in Delivery* for *Time Perspective* module.

Meanwhile, in the *Organisation CLMM Capability – Resources Perspective* module (Level 4), three modules are assessed, the *Human Resources, Technology Resources* and *Financial Resources* modules. There are three procedures in the *Human Resources* module, which are *Development, Support* and *Values*, while in the *Technological Resources* module there are *Technology Management, Process Technology* and *Information Technology* procedures. For the *Financial Resources* module, there are also procedures, i.e. *Financial Resource for Human, Financial Resource for Technology, and Financial for Implementation*.

Finally, in the *Organisation CLMM Alignment – Process Perspective* module, three categories of process is established which are *Employee Involvement, Waste Elimination* and *Continuous Improvement*.

In summary, Chapter 6 has presented the detailed development of the KBCSCM System in Stage 2, which consists of Levels 3, 4 and 5. The following

Chapter 7 will present the validation of the KBCLMM Model through the industrial and published case data.