CHAPTER 3

Research Methodology

3.1 Chapter Overview

In the previous chapter, the relevant literatures are reviewed. These include the conventional methods to manage IT assets within the organization. As mentioned in Chapter 2, these methods are typically based on the financial techniques which could lead to either over or under investments for the IT assets and infrastructure in the organization. Furthermore, the IT policy derived from these conventional methods present little relationship to the business objectives of the organization. The concept of asset management, especially the PAS 55, is also explored and could be utilized for the development of the IT management framework. However, there is distinction between IT assets and other assets where the IT assets are not directly linked to the organization’s revenues. Knowledge management and engineering is also reviewed which could assist in the decision model proposed in this thesis.

Hence, in this chapter, the development of an alternative IT asset management framework proposed in this thesis is provided and explained. This proposed framework comprises of the economic model which represents the learning curve of an organization in the management of the IT assets. Knowledge engineering methodology is applied for the development of this economic model. The next component of the proposed framework is the service performance model which utilizes the knowledge concepts contained in the economic model as the reasoning guidelines for the decision making activities. Finally, both economic and service performance model are developed and governed by the quality standard (ISO27000).

3.2 Proposed University IT Asset Management

Universally accepted method for the evaluation of the IT investment is not evident (McShea, 2009). Many conventional financial methods have been applied. Typically, these financial techniques are already used to evaluate the return from the assets invested. These include for examples, Return on Investment (ROI), Net Present Value (NPV), or Internal Rate of Return (IRR). Generally speaking, profit is of important to the company, and hence it is convenience to measure the investment from the accountability using the financial methods mentioned above. However with regards to the IT asset, there is no direct relation between IT investment and the company's revenue (Ferguson and Hadar, 2011). The above financial methods may lead to inappropriate or most of the time incorrect investment decision on the IT assets.

More common and basic method for the IT investment is Budget Costing. Typically, the budget costing for each financial year relies heavily on former year budget with no real consideration to the business condition and strategic management of the organization (Park et al., 2010). In another word, the IT investment budget is set as a percentage of the overall company budget relatively to previous year. Frequently, this could either result in over budgeting or insufficient budget to actually make serious IT infrastructure improvement. Moreover, since this method neglects the business condition, this tends to implicitly put focus more on the spending rather than vice versa. That is to determine the IT investment budget strategically from the business condition of the company. However, within this competitive context and limited resource scenario, budget constraint is unavoidable and could potentially effect the investment in the IT assets and infrastructure.

Although the above financial evaluations assist in the IT investment to a certain degree, they seem to disconnect from the business/organization context. The IT governance looks at the IT as one of the organization assets, and hence must also be managed and strategically aligned with the business context. In this research, the asset management framework is utilized and applied to develop the IT Asset Management framework. This framework focuses on improving the decision making on the IT related activities as well as justifying the business value from the IT investment.

Due to the characteristic nature of the IT asset mentioned earlier, more specifically with no direct relation to the company revenues, the IT asset management framework is developed and represents the governing framework for the economic and service performance models presented in this paper. This IT asset management proposes an alternative framework to assist company in the management of the IT asset. This framework facilitates most suitable decision making under pre-specific constraints by optimizing cost, performance and risk while satisfying stakeholders at the same time. Figure 3.1 shows the high level concept of the proposed IT asset management framework.

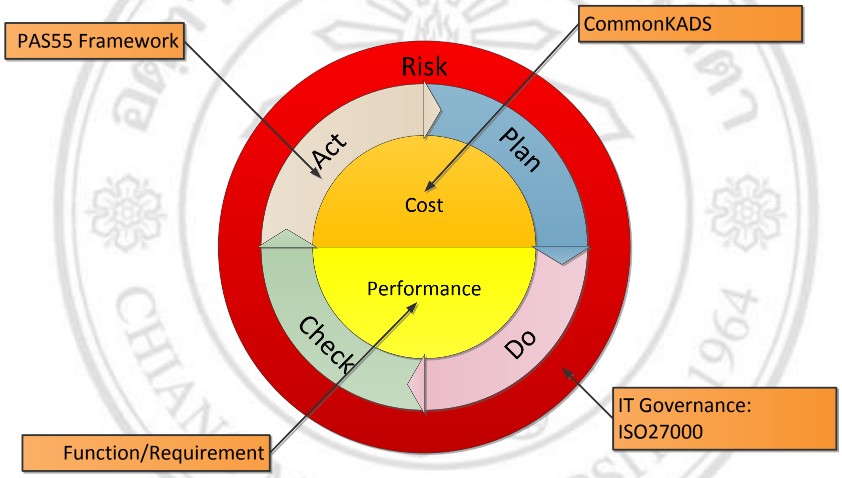


Figure 3.1 High Level concept of the Proposed IT Asset Management

Figure 3.1 shows the high level concept of the proposed IT asset management. This framework resolves IT related decisions by balancing between "economic performance" and "service performance". The economic performance represents investment and risks associated with an IT asset whereas the Service performance focuses mainly on fulfilling stakeholders' satisfactory. Since the IT equipment is accounted as an asset, not a cost center, it indicates the life cycle of itself. Hence, the economic performance is modelled through learning curve into different states across the life cycle of the IT asset. These are corrective maintenance, preventive maintenance, predictive maintenance, proactive maintenance and strategic maintenance. Experiences associated with each state mentioned previously are then translated into cost and risks utilizing the KE methodology (Schreiber et al., 1999).

Typically, service performance can be measured in many different ways (Franke, 2012). These are for example, usability, availability, reliability or security. This really depends on the focus of the evaluation. To overcome the problem of incomplete data/information required and to be compatible with the economic performance proposed in this framework, the service performance is modelled in terms of its quality focusing especially on the investment perspective. That is “functions divided by requirements”. Stakeholders can be categorized into “top executive”, “key users”, and “IT manager”. Ideally, if the functions equal requirements, it indicates that the IT investment is optimal and meets all the requirements. Practically however, this is not always the case. It is either functions are greater or lesser than requirements. Hence, to meet all the stakeholders’ expectations, experiences/knowledge from the economic performance must be utilized to adjust and optimize the solution within the feasible space.

This section explores conventional financial methods to evaluate the IT investment options which could lead to incorrect resource allocations when considering the characteristics of the IT asset. It then presents and explains the IT asset management framework proposed as an alternative IT management methodology. The next section then illustrates the modelling techniques used to develop the economic and service Performances of the IT asset. Note here that, these economic and service performances are modelled through the learning curve of experts which represents the organizational learning model of the university when managing the IT assets.

3.3 Economics Model of ITAM

3.3.1 Proposed Organizational Learning Model for University IT Asset Management

As mentioned previously, in this paper the IT equipment is regarded as an asset with its life cycle, rather than conventional view of a cost center. From the asset management’s perspective, the economic performance of the IT asset is modelled into costs and risks across its life cycle. This learning curve represents the proposed organizational learning model of the university IT asset management, and can be illustrated in Figure 3.2.

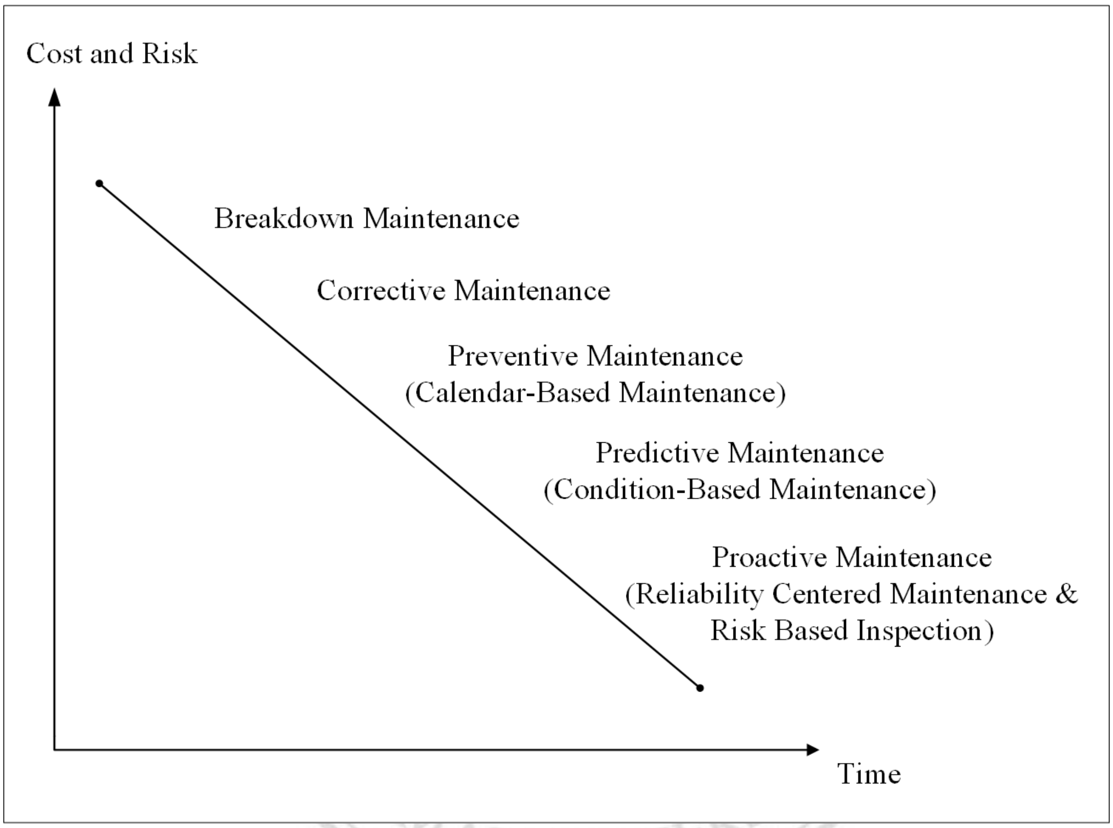


Figure 3.2 Proposed Organizational Learning Model for University IT Asset Management

Figure 3.2 shows the framework to model the economic performance with regard to operation and maintenance of an IT asset. This replicates and represents the learning model (learning curve) based on experience collectively gained over a period of time. It is a time consuming process with many parties involved to develop the common best practices. Hence, it requires a step-by-step development from breakdown to proactive maintenance. In the breakdown maintenance scheme, IT asset is de-assemble and assemble to get the basic knowledge. Corrective maintenance scheme represents knowledge on 'how-to' repair IT asset when failures occur. In preventive maintenance scheme, most activities involve resource scheduling to avoid unplanned outages. Predictive maintenance scheme indicates the abilities of the knowledge workers to foresee the future faults and events based on present condition of the IT asset. Finally, with more knowledge gained over an operating period, the proactive maintenance indicates abilities of the knowledge workers to assess the asset life time as well as its' parts which consequently assists the organization in the decision making on the replacement or the refurbishment.

CommonKADS, the Knowledge Engineering methodology, offers some useful inference templates to elicit and structure knowledge framework [11]. These include for example, templates for planning, diagnose, scheduling, monitoring and assessment. These templates provide useful guideline for interview, analyses, model and utilize knowledge relevant to the operation and maintenance of an IT asset from the experts. The appropriate template to capture the relevant knowledge (cost and risk) of an IT asset can be demonstrated as followed.

3.3.1.1 Breakdown Maintenance

In the beginning, the knowledge from manufacturers and instruction manual books are thoroughly studied. Then, new knowledge on 'how-to operate' and 'how-to maintain' assets in real workplace situation is developed with regard to cost and risk associated with it. In this step technical supervisors are always required on hand to assist in some critical tasks. The working procedures in operation and maintenance are explicitly developed for knowledge sharing and dissemination among knowledge workers. This can also be called 'routine planning knowledge, and hence, the "planning template" is utilized.

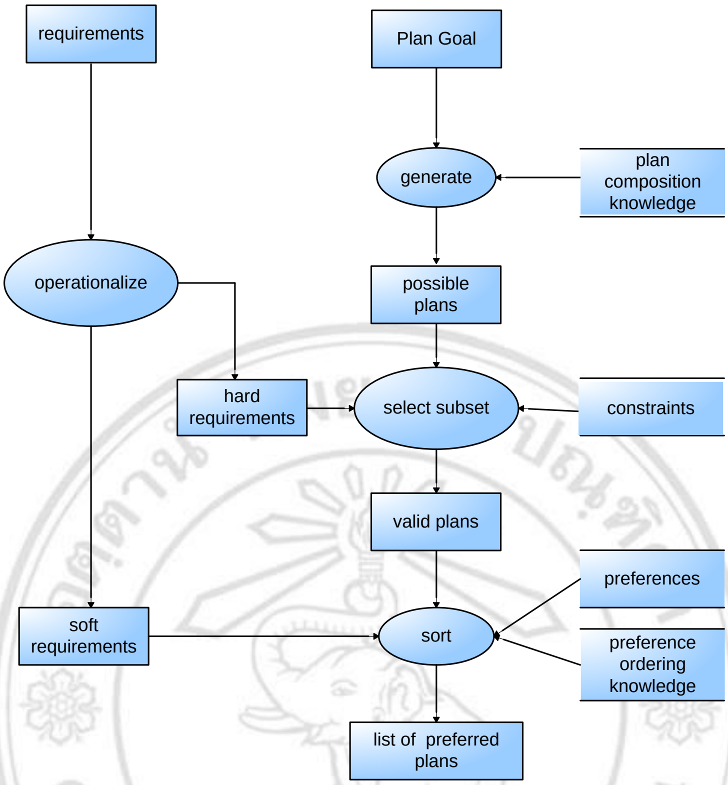


Figure 3.3 Planning Template

Figure 3.3 shows the planning inference template selected to capture the knowledge in the breakdown maintenance scheme. The planning template in Figure 3.3 shows that both hard and soft requirements from the IT operation and management's perspective should also be included in the knowledge elicitation. Moreover, working constraints and preference ordering of the knowledge workers from their real experience need to be taken into account. Then, the working instructions can be developed for knowledge sharing and dissemination.

3.3.1.2 Corrective Maintenance

In the early period of the operation, the operators and maintenance workers collaboratively learn to diagnose IT asset, processes and failures. Experience and knowledge in failures and events are collectively gained by the workers. This allows the workers to develop the knowledge on 'how-to identify' the faults in each particular failure and/or event as well as costs and risks associated with it. This can also be called 'diagnosis knowledge'. Note that this knowledge is extended and enhanced from the breakdown maintenance. Hence, to capture this 'how-to-repair' knowledge the diagnosis inference template is selected.

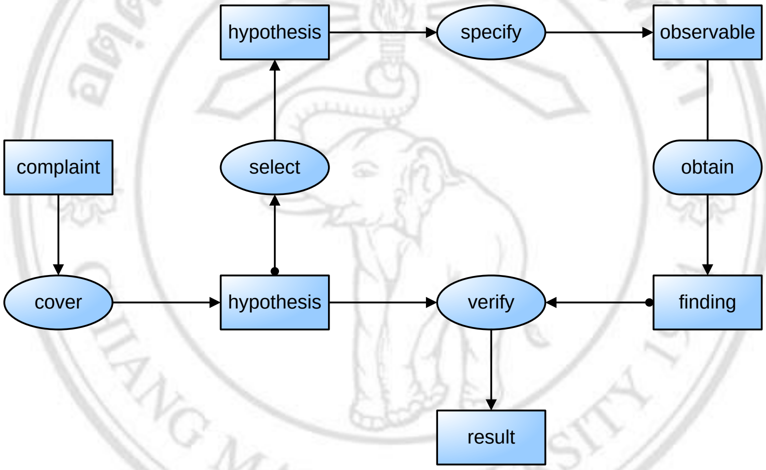


Figure 3.4 Diagnosis Template

Figure 3.4 shows the diagnosis inference template which is selected to capture the knowledge in the corrective maintenance. During the diagnosis, essential information is identified and extracted by the experts from the data acquisition system or reports of the problems encountered. Then, faults and events are analyzed using hypothesis and test methods. Note here that, the expert's hypothesis and verification rationale are the main knowledge and reasoning issues in this expert interview.

3.3.1.3 Preventive Maintenance

With the knowledge gained in the previous step, the operators and maintenance workers can then attempt to schedule the activities and their existing local resources. This is to minimize costs in order to prevent unplanned outage from faults and unpleasant events. This involves the development of their resource's scheduling and optimization techniques. This is also called 'Preventive Maintenance' or 'Calendar-Based Maintenance' scheme. Note that the opportunity costs and/or the availability are also taken into account in the scheduling. Heuristic-based techniques can be implemented to optimize the maintenance scheduling problems. Hence, the scheduling inference **template is selected to capture this type of knowledge.**

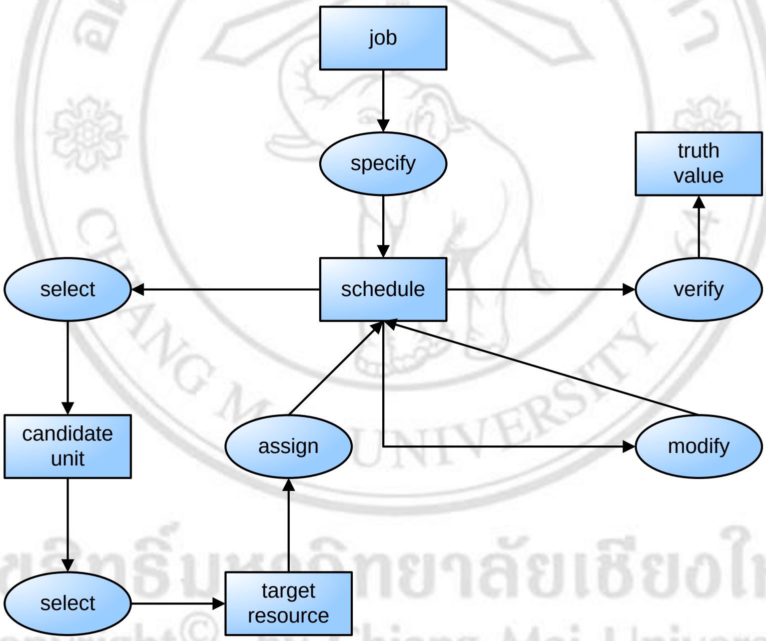


Figure 3.5 Scheduling Template

Figure 3.5 shows the scheduling inference template selected to capture the knowledge in the preventive maintenance scheme. As shown in Figure 3.5, it starts by identifying the preventive maintenance job. Then, the initial schedule is developed using the practical rules of the organization in the selection and assignment of its units and resources. The important issue in this scheme is that the knowledge acquisition should address on the organization experience/knowledge in modification and verification of the preventive maintenance. Moreover, it also covers some operational routines such as equipment test, exercise, visual inspection and adjustment.

3.3.1.4 Predictive Maintenance

With more knowledge gained over a period of time, this helps the workers to be able to detect some incidents or some conditions. In another word, this is ability to predict the likelihood of faults and events. With the ability to predict the potential future failure, this allows the appropriate operation and maintenance actions to be conducted immediately when a discrepancy conditions are found. This ability is called 'Predictive Maintenance' or 'Condition-Based Maintenance'. As a consequence, the monitoring inference template is selected.

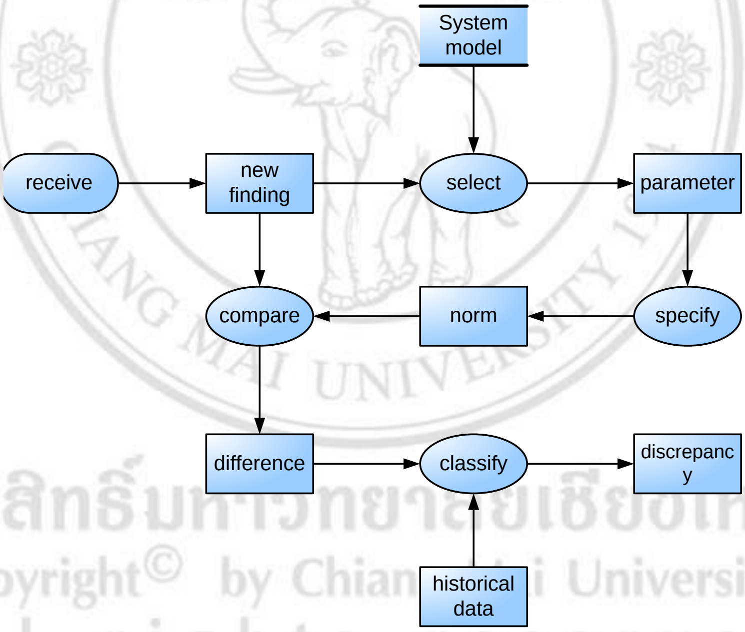


Figure 3.6 Monitoring Template

Figure 3.6 shows the monitoring inference template selected to capture the knowledge in the predictive maintenance scheme. With the ability to predict the potential future failure, this allows the appropriate operation and maintenance actions to be conducted immediately when a discrepancy conditions are found. As shown in Figure 3.6, field knowledge, especially new findings (information, parameters, process system models, normal condition of each parameter, comparison method between new findings and norm values, trends), must also be acquired. Note that the IT parameters monitored can be either operating or inspecting parameters from the information relating to the IT assets and/or infrastructure.

3.3.1.5 Proactive Maintenance

This maintenance scheme is based on historical records of equipment (IT asset) failures and its design information. This knowledge assists in the assessment of the equipment life time and its part's life-cycle, and also in the decision making process of the organization to refurbish or replace some equipment proactively before its expected life time. Risk factors are also abstracted by the experts for each asset category. To categories the types of the asset risks, knowledge on equipment design, failure history records, operation and maintenance practices, environment, disaster, health, and/or safety is necessary. This maintenance scheme is called 'Proactive Maintenance'. To reduce the risks by refurbishment and replacement, the methods such as 'Risk Based Inspection' and 'Reliability Centered Maintenance' can be utilized within this maintenance scheme. Hence, to capture this type of knowledge the assessment inference template is selected

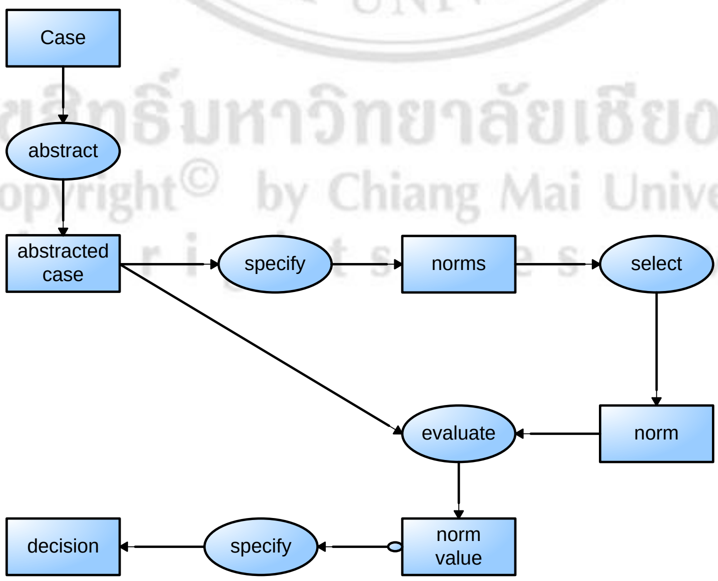


Figure 3.7 Assessment Template

Figure 3.7 shows the assessment inference template selected to capture the knowledge in the proactive maintenance scheme. Based on the guideline provided by the assessment template (Figure 3.7), the scope of the asset management or case inference role can be initially classified by operation and maintenance experience. Moreover, risk factors are also abstracted by the experts for each asset category. To categories the types of the asset risks, knowledge on equipment design, failure history records, operation and maintenance practices, environment, disaster, health, and/or safety is necessary (Beehler, 1997). All possible norms and other specific norms for each risk factor must be specified. It is important that the experts are elicited on their heuristic techniques or practical assessment methods to evaluate the asset risks, life-cycle and marginal costs.

According to the results of the asset evaluation, the asset management decisions could be to maintain or modify the current practices, refurbish or replace some equipment in order to minimize business risks or eventually develop asset management plan. Note here that it is more convenient to conduct the asset risk assessment and management activities during the turnaround period. If some risks are found but not urgent, the condition monitoring system should be implemented on the asset for the normal operation.

With the proposed modeling methodology explained above, the cost and risk (economic performance) of an IT asset can be modelled. Useful knowledge is translated into rationale for decision making activities regarding costs and risks. It can be seen from Figure 3.3 that the costs and risks of an IT asset reduce over time with regard to actions taken.

3.3.2 Development of the Economics Performance Model for ITAM

As mentioned previously, the CommonKADs knowledge engineering methodology is applied in this thesis to construct the knowledge model with regard to the decision making behavior of the experts regarding the economic performance of the IT asset. This section explains the application of the CommomKADS template to capture knowledge from experts who have appropriate experience and knowledge. This knowledge is then analyzed and modeled as knowledge maps and implemented as knowledge-based tools. A case study is also constructed as an example of a learning template or decision making template. A knowledge based system containing repository knowledge including documents and sources of information is also presented.

Knowledge capture to capture the knowledge of the operations was undertaken in the steps described below.

Step 1: Using CommonKADS in an interview (interview):
This will allow the general nature of the problem, to be assessed, according to CommonKADS (generalise).

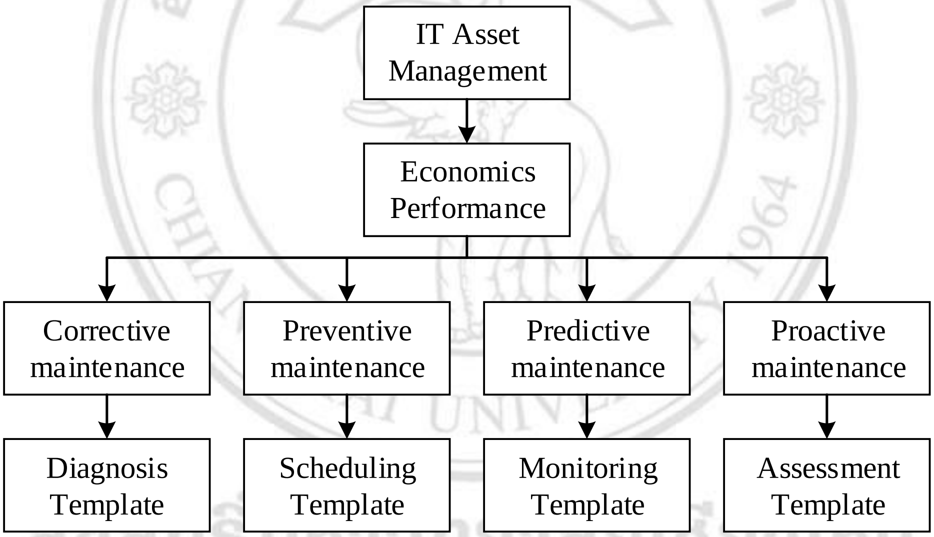


Figure 3.8 Categories of IT Asset Management Maintenance

2) Planning an interview (knowledge elicitation planning).
In an interview, knowledge of an expert or experts may have the following steps.

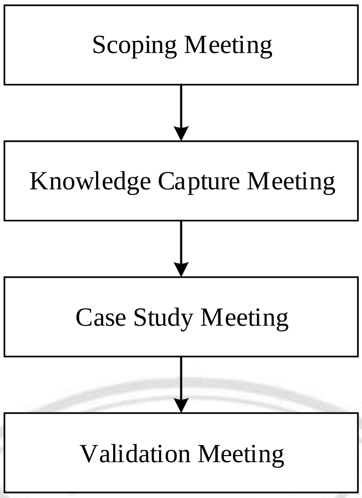


Figure 3.9 Steps of Planning an Interview

Step 2: Select the techniques and tools in an interview.

In this interview, selected knowledge templates were applied according to each specific problem, and a voice recorder was used as an interview tool.

Step 3: Create a meeting agenda in order to determine the scope of the interview.

The scope and agenda of the interview were scheduled in advance. Important issues in the scope and agenda of the meeting were as follows:

- The purpose and scope of the project to develop a knowledge strategy was determined
- The key elements of knowledge (tasks and subtasks).
- Establish an expert in the introduction.
- Plan and schedule (schedule).
- The case (scenario or case study).

Those attending the meeting. Responsible agency or professional experience in IT Management and Maintenance. The interview agenda for the scoping meeting is shown below.

Scoping Meeting in an Interview

Knowledge Maintenance

The first term of the notice.

- The purpose and origin.
- Knowledge of the topics: maintenance.
- Define the scope of the interview plan, knowledge, case studies and monitoring knowledge.

The second term of the mission-critical or critical (critical task knowledge).

Agenda Item 3 to the experts and practitioners (community of practice).

Agenda Item 4 plans to interview.

Agenda Item 5 a case study.

Agenda Item 6 other

- Experts involved. (telephone number, e-mail, organization).
- Recommend a book or document referred to in the Substation Maintenance (a URL).
- Business Information Systems (URL)

Step 4: interviews to capture the knowledge of how to Maintenance.

This step involves interviews to capture the structure of knowledge, apply a diagnosis template, scheduling template, monitoring template and assessment template for creating an agenda.

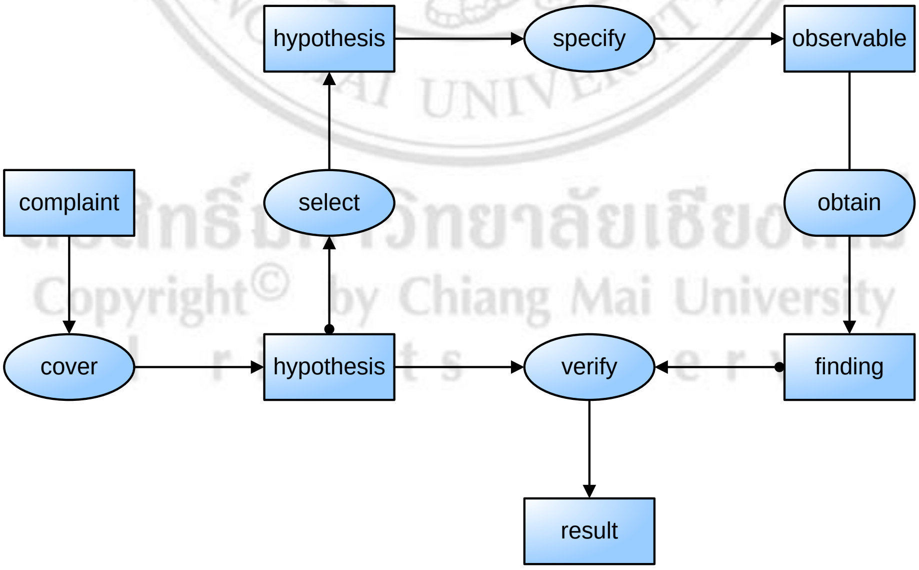


Figure 3.10 The diagram shows a common problem in diagnosis

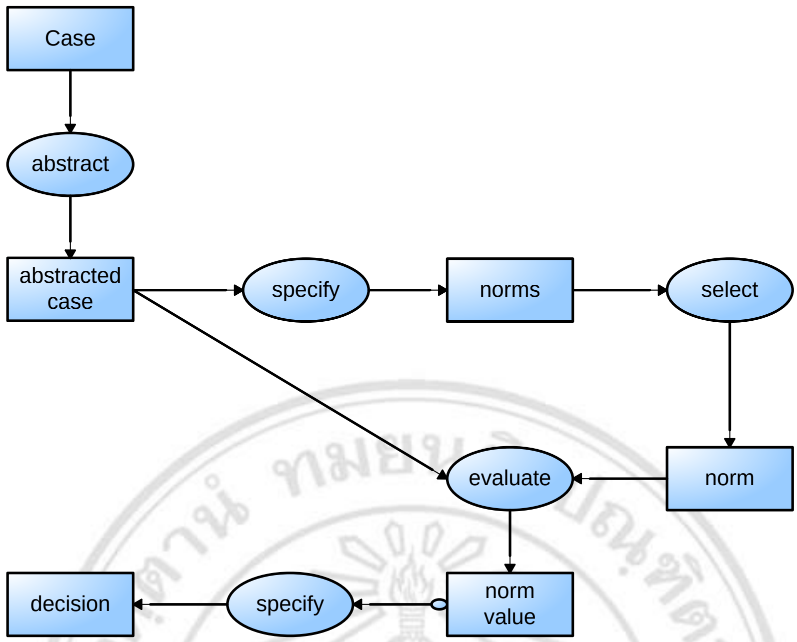


Figure 3.11 The diagram shows the problem of the assessment

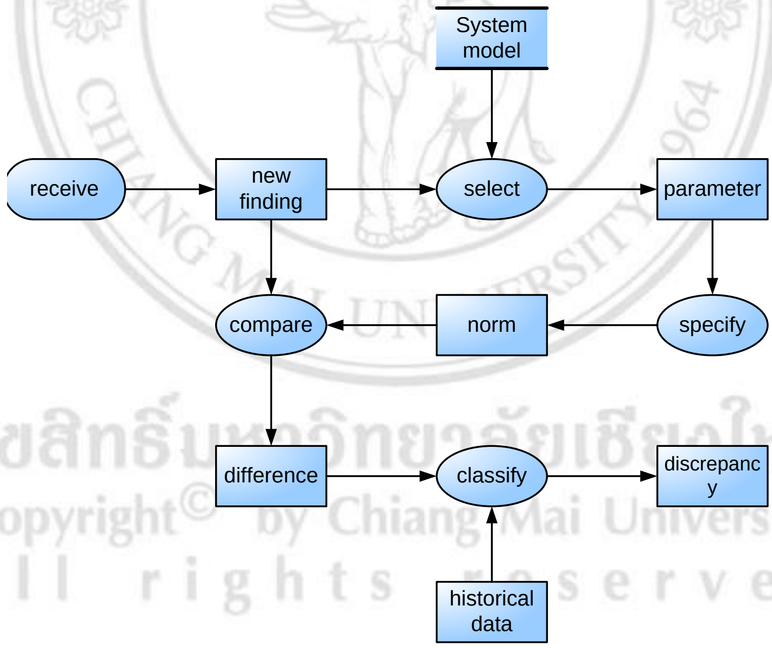


Figure 3.12 The diagram shows the surveillance/monitor.

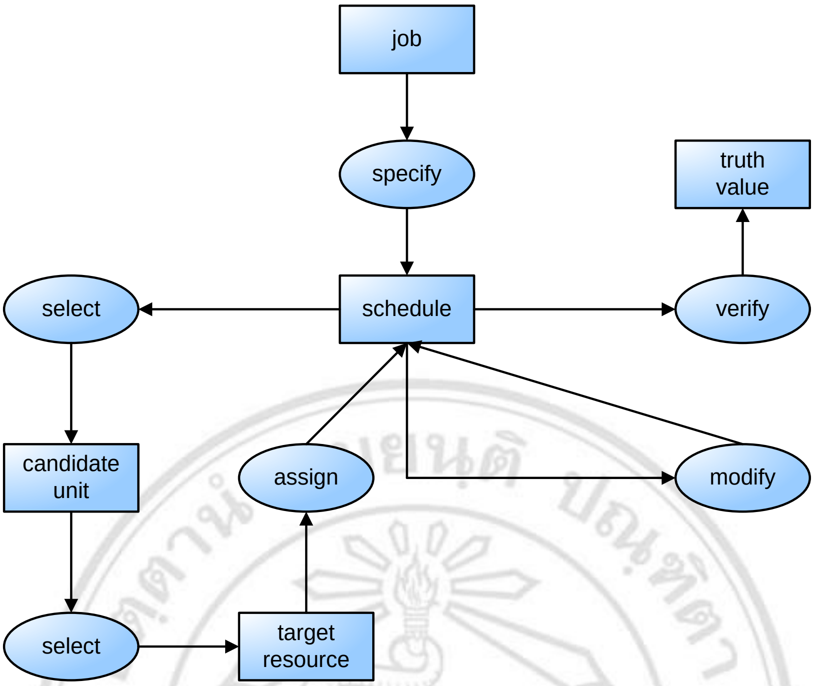


Figure 3.13 The diagram shows the problem of scheduling.

The interview agenda for the knowledge capture meeting was as follows:

- Describe the purpose and procedures of the expert.
- Describe the purpose of the meeting.
- Provide an opportunity for experts to explain the terms of IT management in general, and for the knowledge engineer to understand the principles and basic knowledge necessary to define terms used in the interview. This step is to define the elements, taxonomy and ontology tree or issue the experts think and conceptualization to solve the problem.

Knowledge capture meeting via attending the meeting. Professionals who are responsible and have experience of maintenance. The interview agenda for the knowledge capture meeting is shown below.

Knowledge Capture Meeting

Knowledge Maintenance

The first term of the notice.

- Purpose.

- Knowledge of the topics - maintenance.

Agenda 2: The purpose of the interview, the knowledge of maintenance.

Agenda Item 3 experts explain maintenance for approximately 15 minutes.

Agenda Item 4 Input / Process / Output of the Maintenance.

- Before the release of maintenance or the need to consider what resources it provides.

- Maintenance of the methods and procedures related to the technique in action.

- Results after maintenance.

Agenda Item 5 special techniques to evaluate proposals for licensing. The major risks or issues that require attention in the maintenance.

Agenda Item 6, the completeness of the document. Data and information.

Agenda Item 7: The other techniques. Derived from experience. Making a decision.

Agenda Item 8 other

- Experts involved.

- A reference book or document to do so. Licensing

- Business Information Systems.

Step 5: This step involved case study interviews. Structured interviews, case studies and a related agenda.

Agenda for the case study interviews:

- Explain the purpose and procedures of the expert.
- Describe the purpose of the meeting.
- Knowledge engineer to review the knowledge gained from past meetings.
- An opportunity for experts to study the problem of the crisis in general.
- Questions regarding the maintenance.
- Discussion of other items.
- For reference, a search for experts and information and data used.

Agenda for the case study meeting:

Case Study Meeting **Maintenance** Those attending the meeting. Professionals who are responsible and have a real experience. **The first term** of the notice. - The purpose of the project. - Knowledge of the topics maintenance. **Agenda 2:** The purpose of the interviews, case studies. **Agenda Item 3** are described in the maintenance of approximately 15 minutes. **Item 4** of the questions in maintenance. **Agenda Item 5** other - Experts involved. - A reference book or document to do so. Licensing - Business Information Systems.

Step 6: Verify adequacy and accuracy of the captured knowledge

Agenda for the validation meeting.

- Explain the purpose and procedures of the expert.
- Describe the purpose of the meeting.
- Engineering knowledge - offer in-depth knowledge of technical maintenance.
- Discussion of other agenda items.
- The reviewing engineer, a professional referee and more. Information and data used to complete independently.

Agenda for the Validation Meeting:

Validation Meeting

Knowledge Maintenance

Those attending the meeting.

Professionals who are responsible and have experience to do the maintenance.

The first term of the notice.

- The purpose of the project.

- Knowledge of the topics maintenance.

Agenda 2: The purpose of the interview. Validates the knowledge.

Agenda Item 3 engineering knowledge to teach knowledge of maintenance.

Agenda Item 4 others.

- Experts involved.

- A reference book or document to do so. Licensing

- Business Information Systems.

3.4 Knowledge Analysis

Analysis of knowledge (knowledge analysis) is a step in knowledge engineering to analyze the knowledge provided by experts from the recording sessions. This separates the issues of knowledge into different levels as follows:

- Task is a task that is important in the capture of knowledge
- Inference is thought to be the primary consideration in their work.
- Domain concept represents the issues within inference.

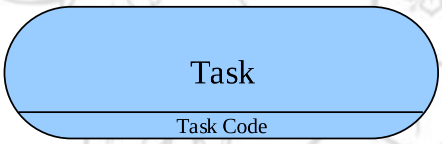
Analysis also helps to create a task and inference with knowledge being detected and corrected later and to identify the source of knowledge.

- The expression of knowledge (T/I/O)-AAA.
- Where T refers to the knowledge of the task.
- I means the level of knowledge of inference.
- O refers to the knowledge of the ontology.
- AAA shows the order of knowledge, according to the nature of knowledge.

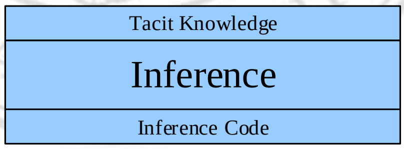
The results of the transcript analysis can be characterized as knowledge that is organized into categories.

- Task: principles in naming. The letter 'T' shows the knowledge of task and then the numbers show the knowledge, for example, T0, T1, T2, ..., TN
- Sub Task: principles in naming. Task level, but will have two numbers. The one most relevant to the Task ID. And the second number indicates the number of sub task, for example, T11, T12, T13, ..., T1N
- Inference: Principles for naming. The letter 'I' indicates the knowledge of inference, followed by a number of task or sub task, which is then followed by a number of inference, for example, I111, I112, I113, ..., I11N.
- Domain: Show domain specific information.
- Knowledge Base: The name to fill in a 'KB' as the name.

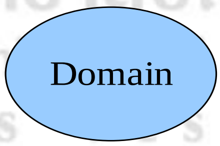
- Task



- Inference



- Domain



The purpose of the interview was to capture experience on the maintenance and investment of the IT resources within CAMT. Meeting schedules to interview experts according to the interview planning given above can be summarised as follows:

- The management or supervisory IT maintenance and network management System, CMU. IT on November 16, 2009 (2552)

- Scoping Meeting – interviews with administrators or supervisors, IT professionals and network administrators, information systems, CMU. IT on January 10, 2010 (2553).
- Knowledge capture meeting with head of IT and network management or executive information systems, CMU. IT on January 21, 2010 (2553).
- Interviews, case studies case study meeting with head of IT and network management or management information systems, CMU. IT on February 10, 2010 (2553).
- Interviews, case studies case study meeting with head of IT and network management or management information systems, CMU. IT on March 30, 2010 (2553).

The transcript from the counsellor has led to modeling knowledge and creating knowledge maps. Both at the mission (task) thinking (inference), and what a (domain) levels. Furthermore, the knowledge of the 'maintenance' is shown in the knowledge mapping/model. Experience during the course of the study is used as a comparison to the based-case. The study was designed to synthesize the knowledge of a second model to be appropriate and beneficial to the work as follows:

- The economic performance model of the ITAM consists of a series of different subtasks. The taxonomy shown in the knowledge map is corrective maintenance preventive maintenance, predictive maintenance, and proactive maintenance, which are a source of ideas, knowledge and experience of the maintenance workers at the various cases. This makes it possible to experience a variety of case studies through the layers of knowledge.
- A series of maintenance case studies (case templates) of the study were designed to support both the original study, and the ongoing case maintenance. The operator can put the principles and reasons in this case, and the maintenance staff can use this to chat and exchange with other practitioners who work together on the same maintenance.

3.5 Knowledge Maps

Task-Subtask

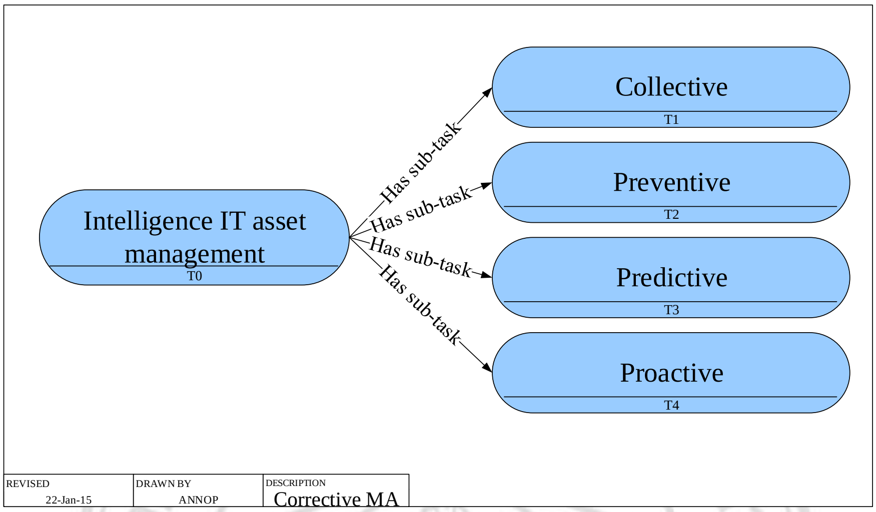


Figure 3.14 Diagram Present Task-Subtask

Task-Inference: T1 Corrective Maintenance

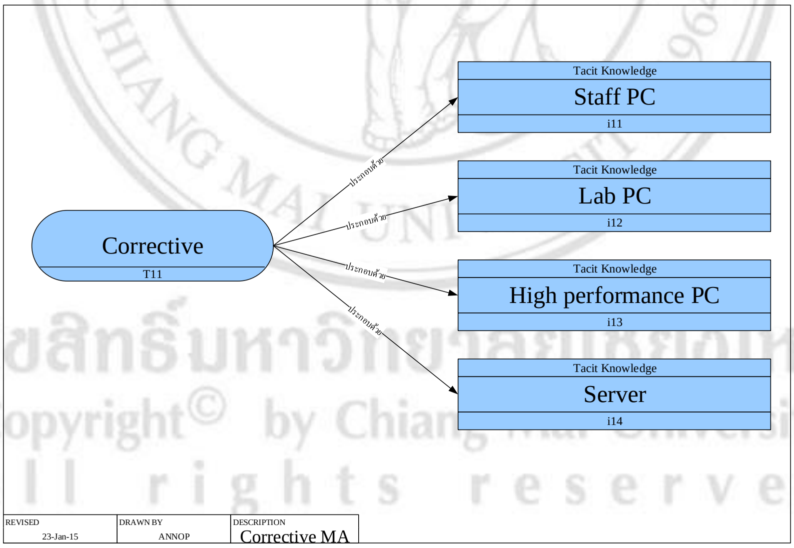


Figure 3.15 Diagram present details T1 Corrective Maintenance

Inference-Domain: T1i11 Corrective Maintenance

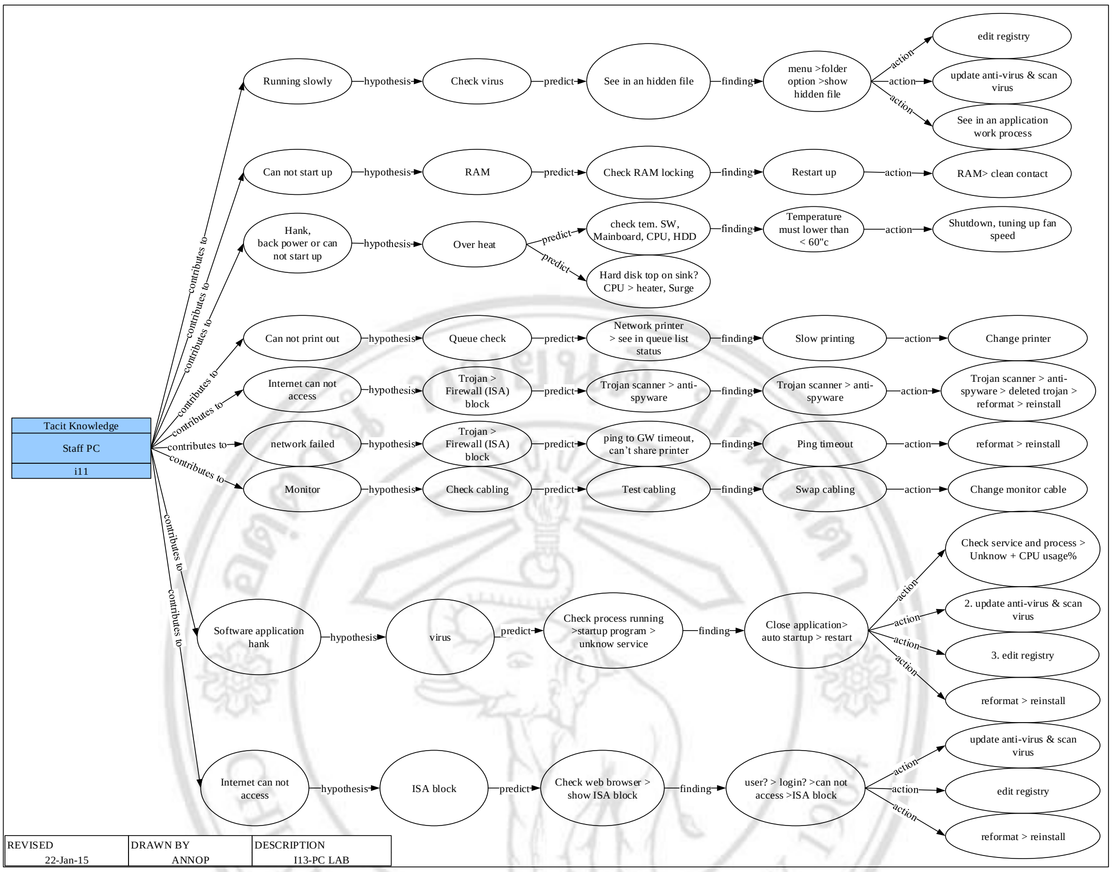


Figure 3.16 Diagram present Inference-Domain of Staff PC

Inference-Domain: T1i12 Corrective Maintenance

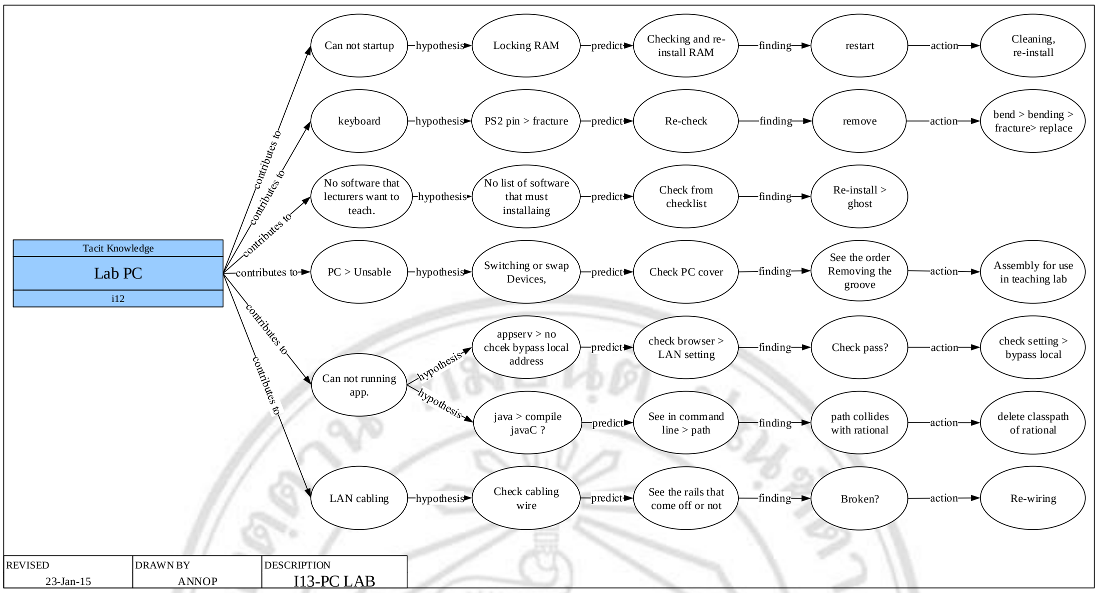


Figure 3.17 Diagram present Inference-Domain of Lab PC

Inference-Domain: T1i14 Corrective Maintenance

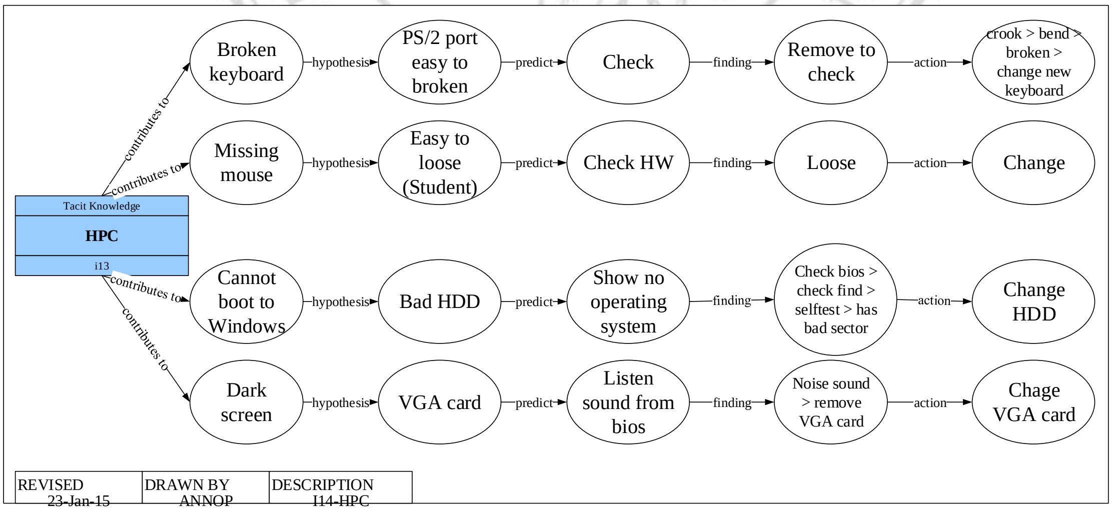


Figure 3.18 Diagram present Inference-Domain of HPC

Inference-Domain: T1i17 Corrective Maintenance

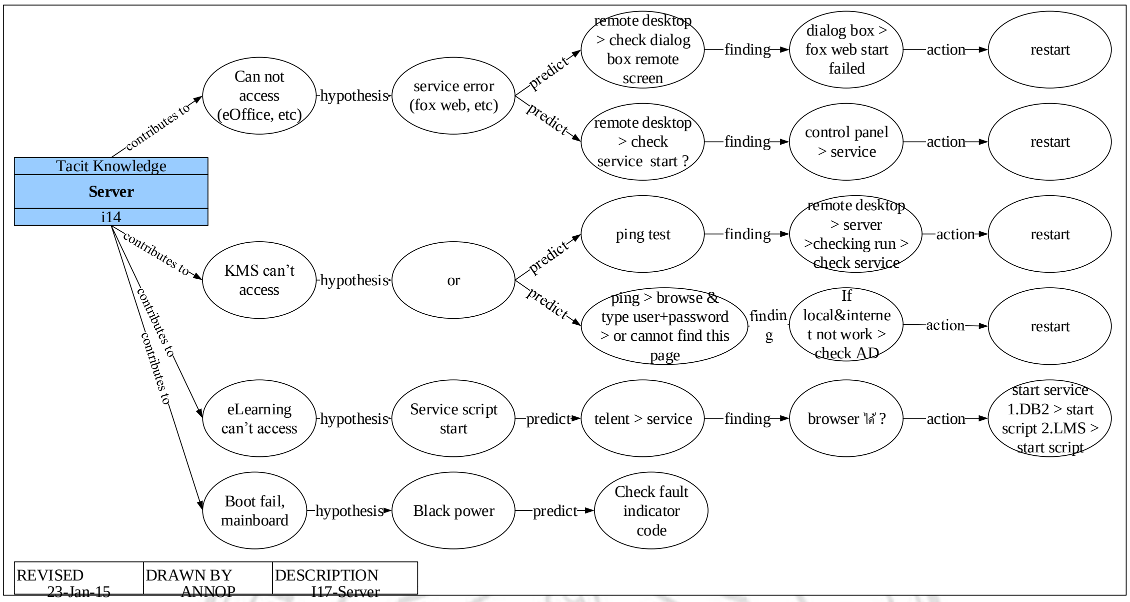


Figure 3.19 Diagram present Inference-Domain of Server

Task-Inference: T2 Preventive Maintenance

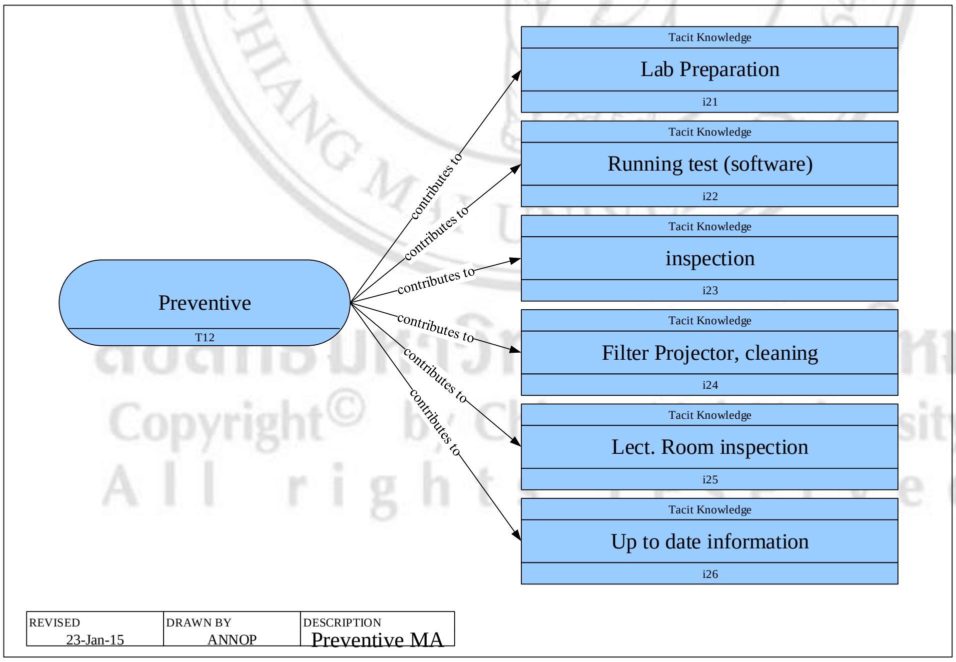


Figure 3.20 Diagram Present Task-Inference of Preventive Maintenance

Inference-Domain: T2i21 Preventive Maintenance

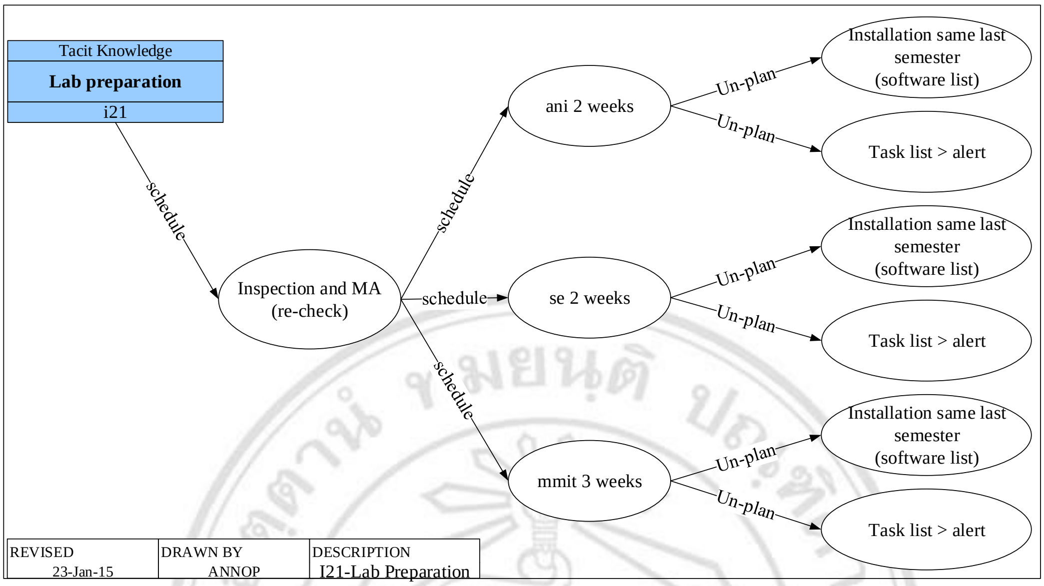


Figure 3.21 Diagram present Inference-Domain of Lab Preparation

Inference-Domain: T2i22 Preventive Maintenance

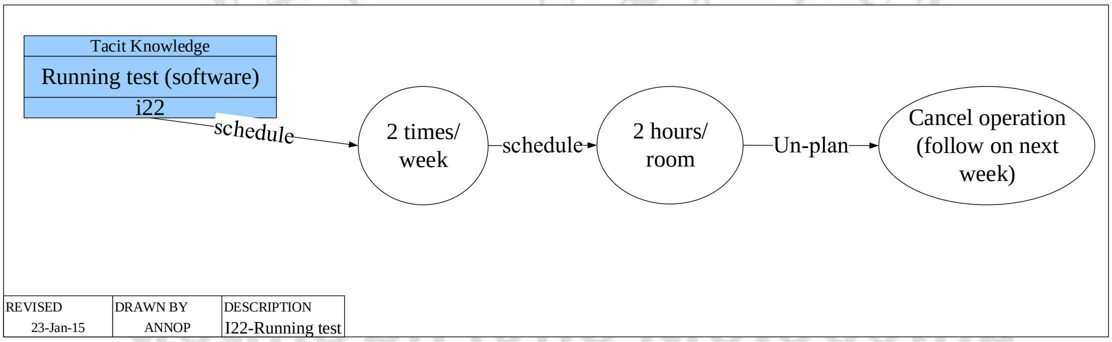


Figure 3.22 Diagram present Inference-Domain of Running Test (Software)

Inference-Domain: T2i23 Preventive Maintenance

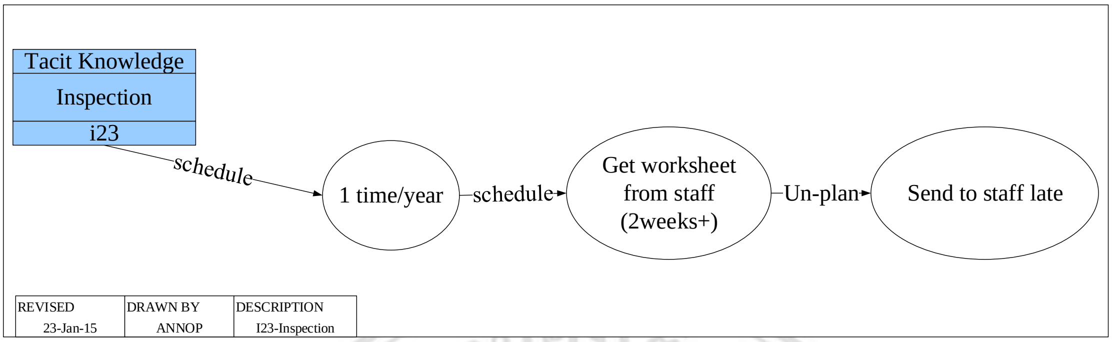


Figure 3.23 Diagram Present Inference-Domain of Inspection

Inference-Domain: T2i24 Preventive Maintenance

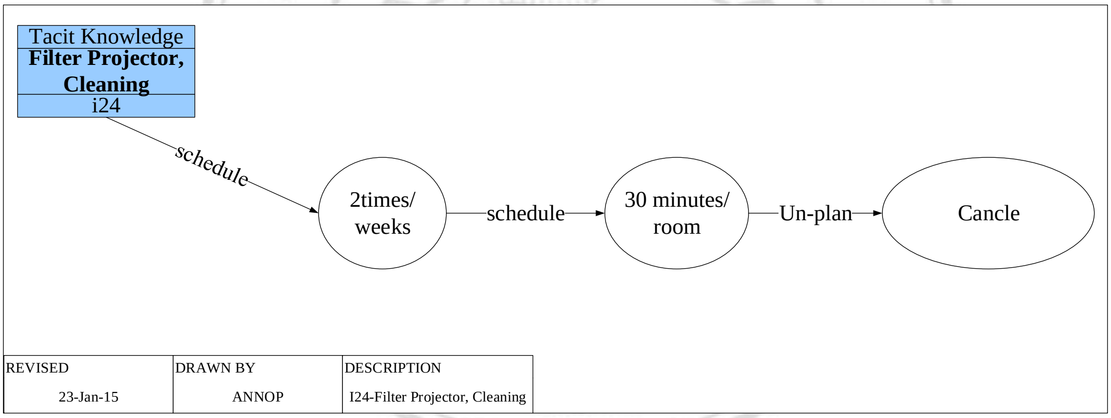


Figure 3.24 Diagram Present Inference-Domain of Filter Projector, Cleaning

Inference-Domain: T2i25 Corrective Maintenance

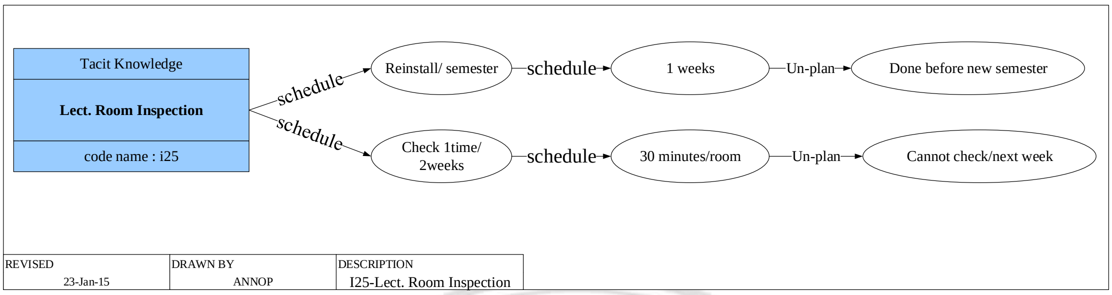


Figure 3.25 Diagram present Inference-Domain of Lect. Room Inspection

Inference-Domain: T2i26 Preventive Maintenance

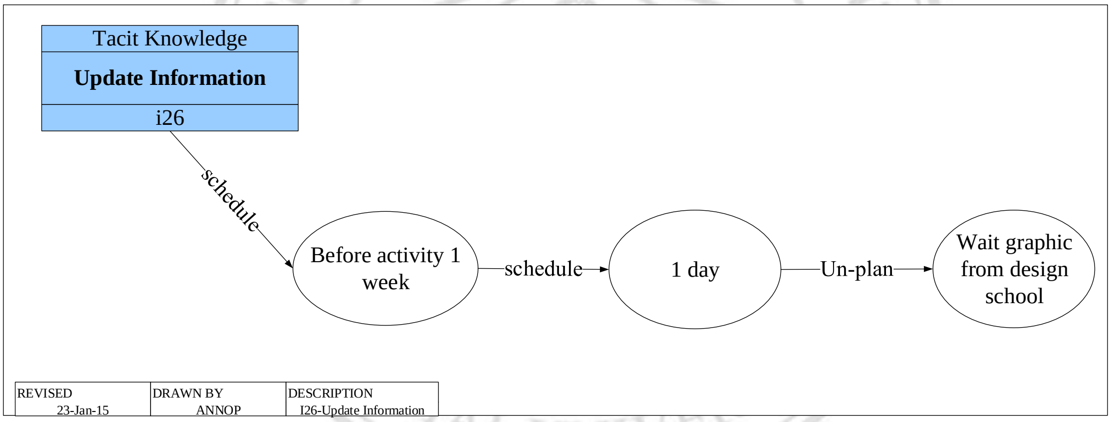


Figure 3.26 Diagram Present Inference-Domain of Update Information

Task-Inference: T3 Predictive Maintenance

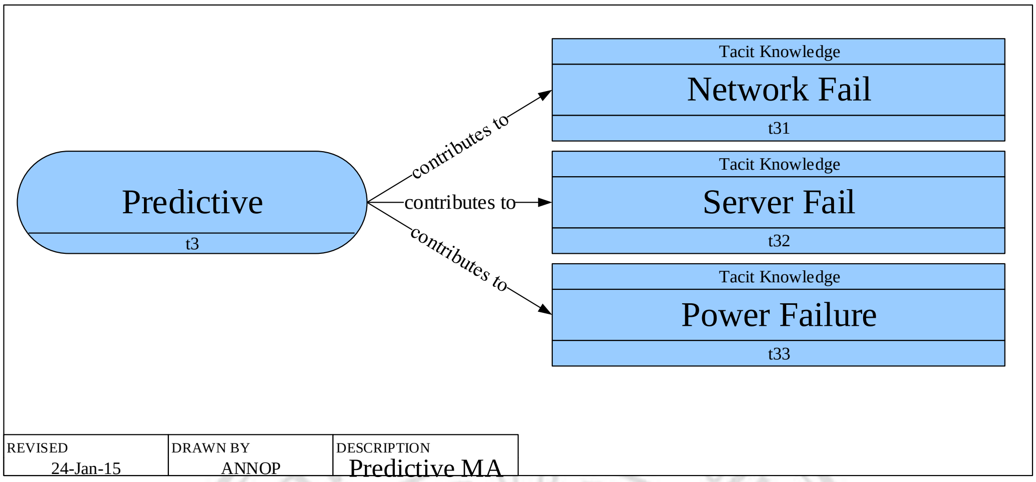


Figure 3.27 Diagram Present Task-Inference of Predictive Maintenance

Inference-Domain: T3i31 Predictive Maintenance

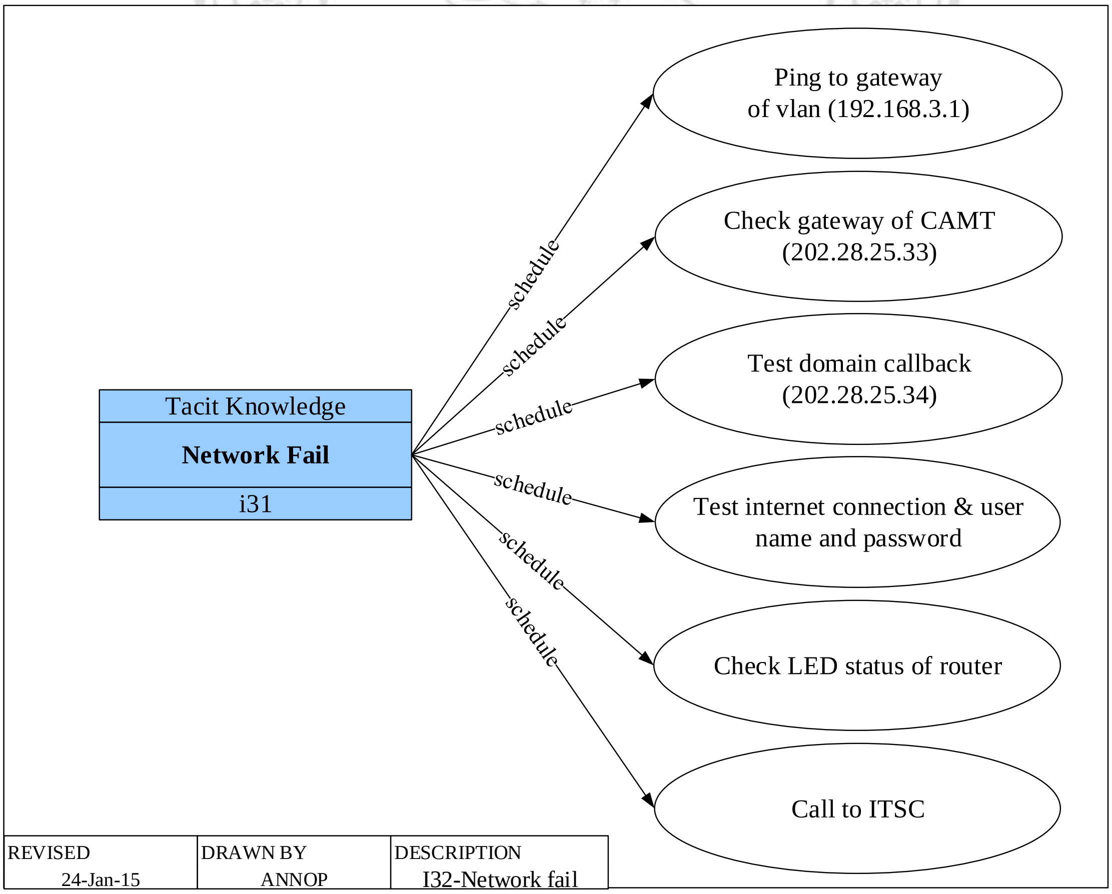


Figure 3.28 Diagram Present Inference-Domain of Network Fail

Inference-Domain: T3i32 Predictive Maintenance

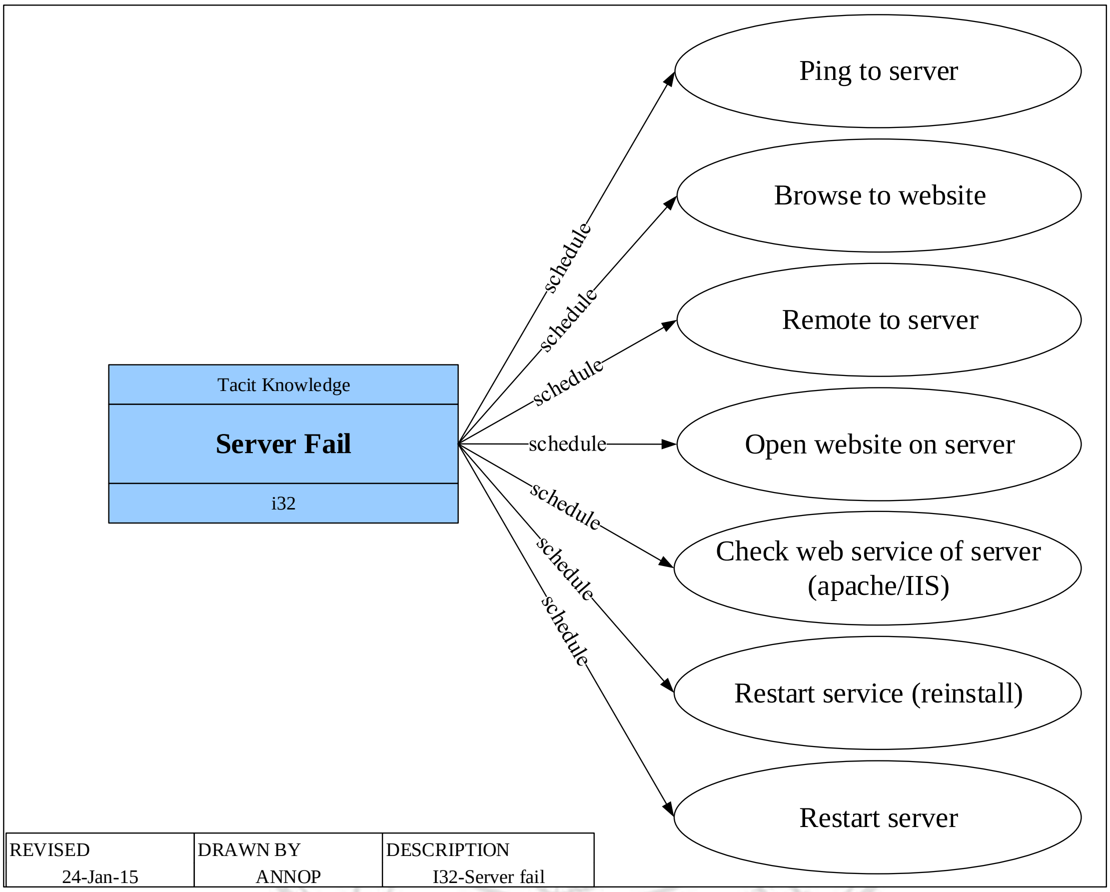


Figure 3.29 Diagram Present Inference-Domain of Server's Problem

Inference-Domain: T3i33 Predictive Maintenance

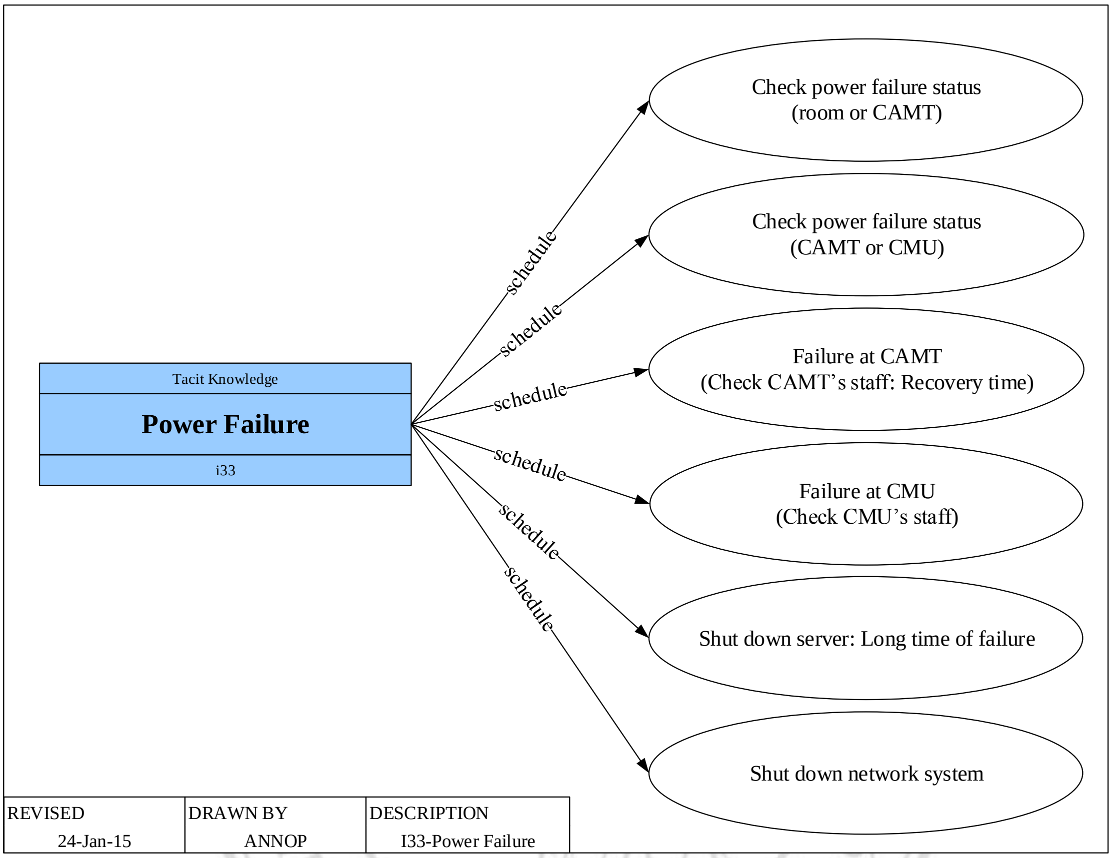


Figure 3.30 Diagram Present Inference-Domain of Power Failure

Task-Inference: T4 Proactive Maintenance

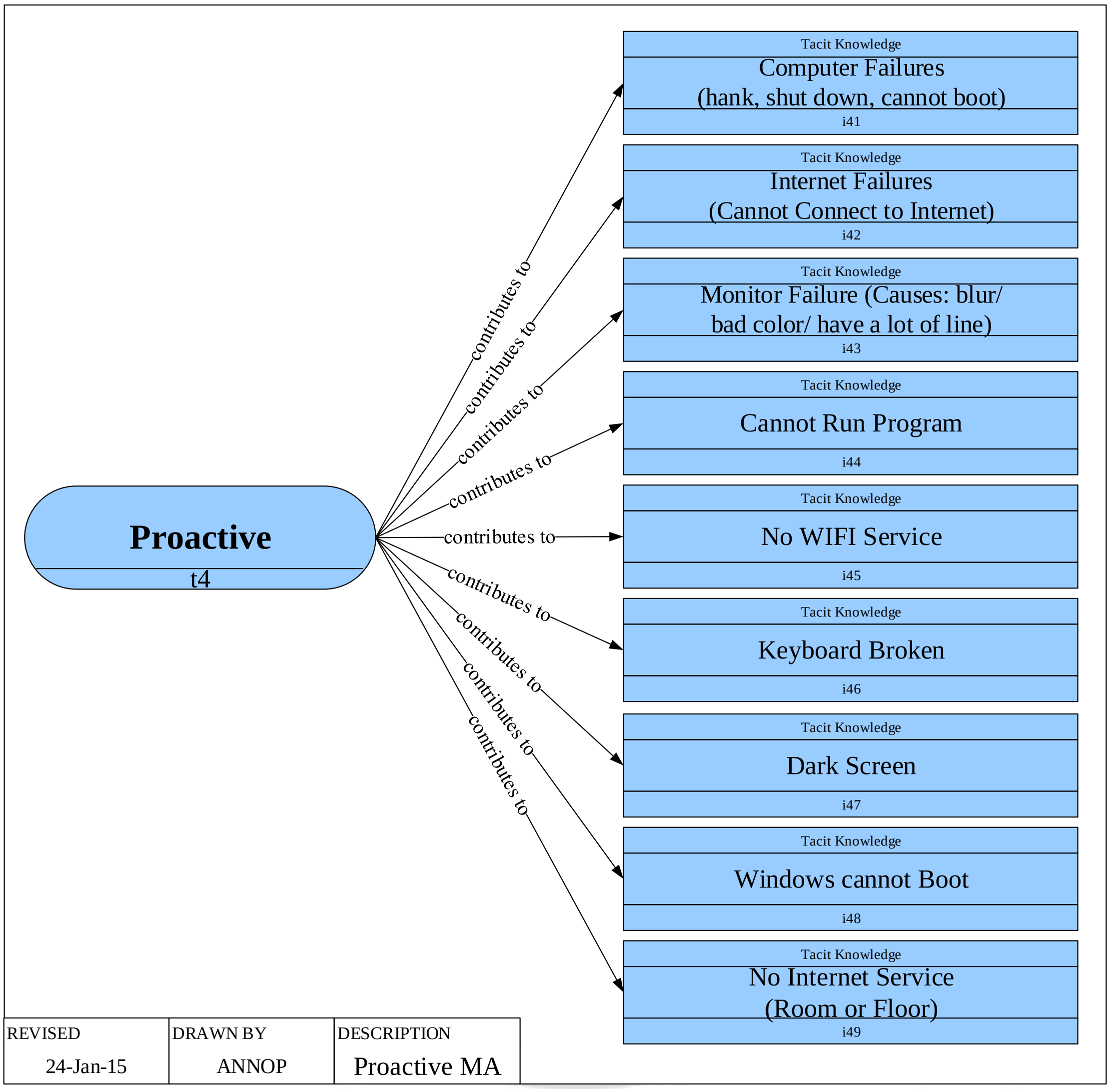


Figure 3.31 Diagram Present Task-Inference of Proactive Maintenance

Inference-Domain: T4i41 Proactive Maintenance

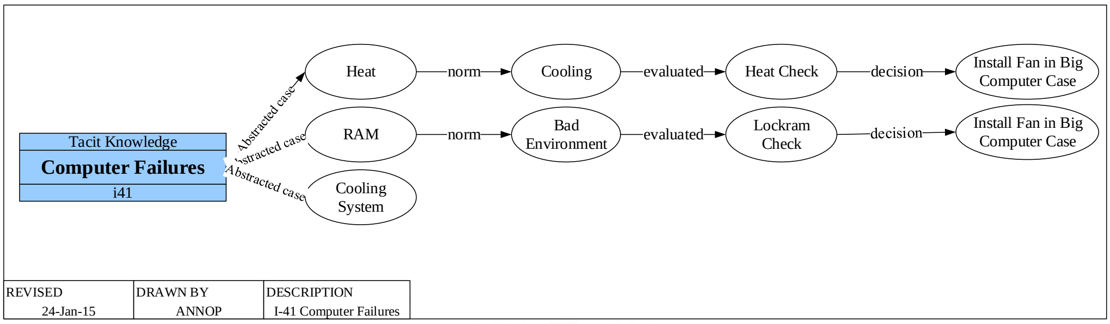


Figure 3.32 Diagram Present Inference-Domain of Computer Failures

Inference-Domain: T4i42 Proactive Maintenance

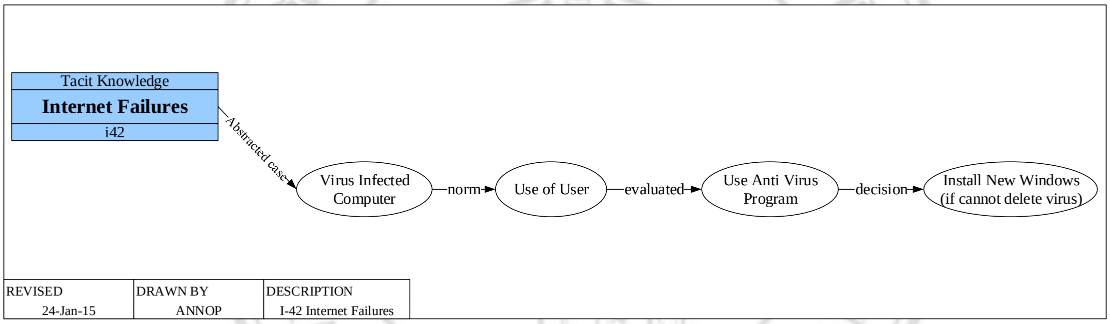


Figure 3.33 Diagram Present Inference-Domain of Internet Failures

Inference-Domain: T4i43 Proactive Maintenance

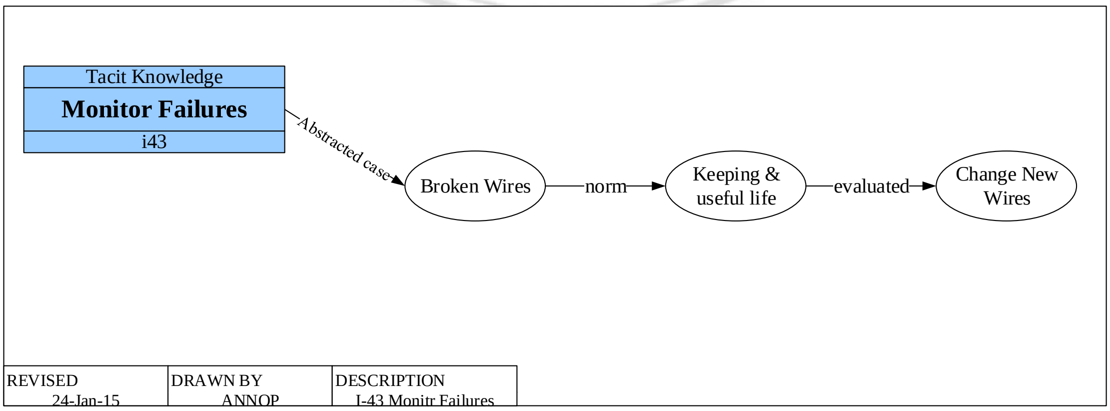


Figure 3.34 Diagram Present Inference-Domain of Monitor Failures

Inference-Domain: T4i44 Proactive Maintenance

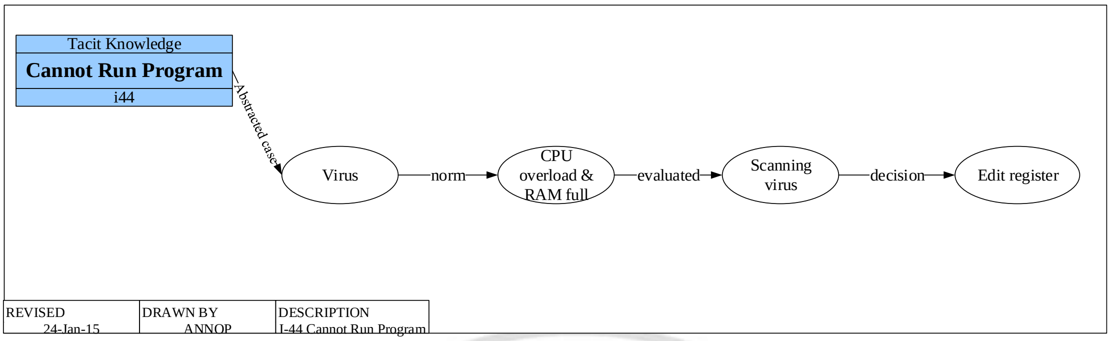


Figure 3.35 Diagram Present Inference-Domain of Cannot Run Program

Inference-Domain: T4i45 Proactive Maintenance

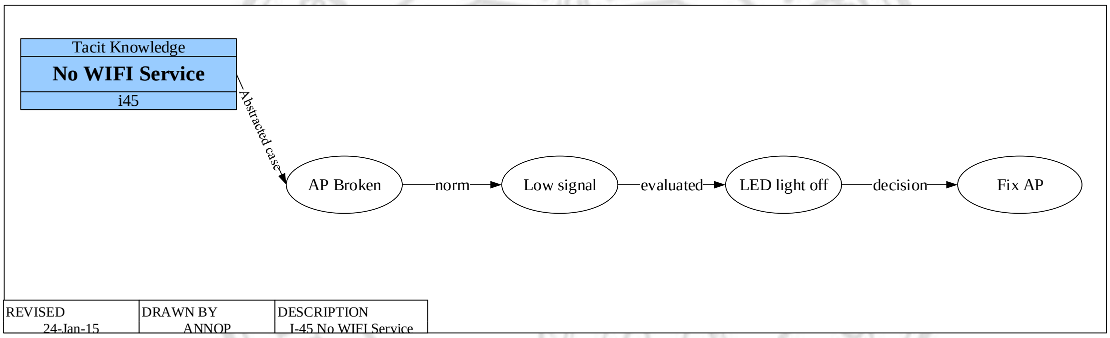


Figure 3.36 Diagram Present Inference-Domain of No WIFI Service

Inference-Domain: T4i46 Proactive Maintenance

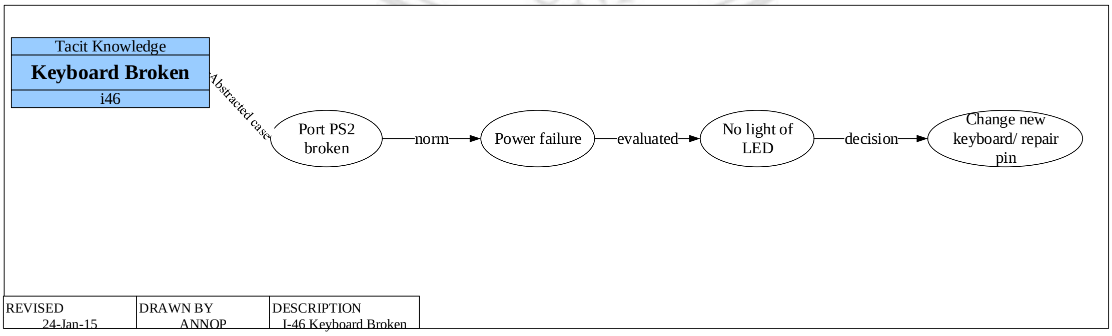


Figure 3.37 Diagram Present Inference-Domain of Keyboard Broken

Inference-Domain: T4i47 Proactive Maintenance

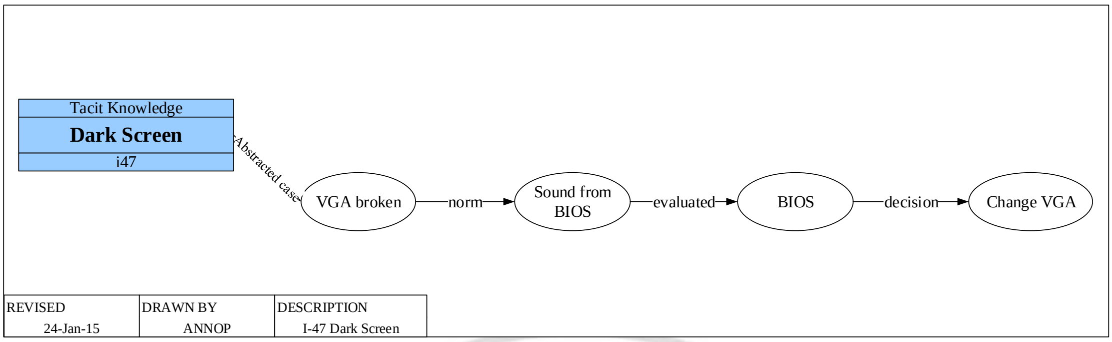


Figure 3.38 Diagram Present Inference-Domain of Dark Screen

Inference-Domain: T4i48 Proactive Maintenance

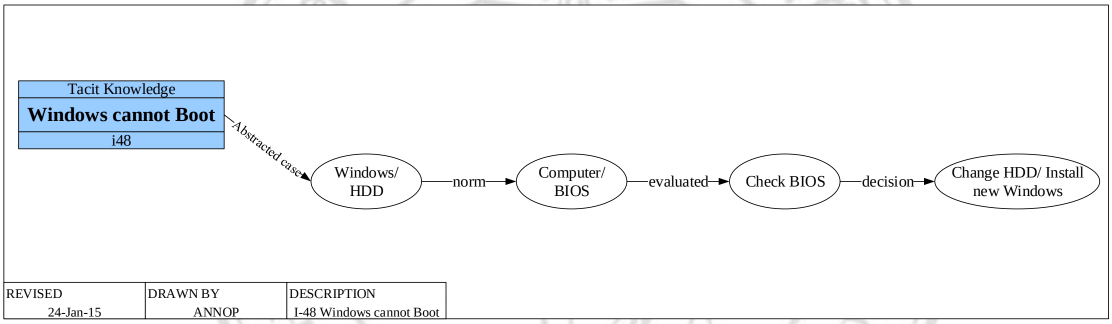


Figure 3.39 Diagram Present Inference-Domain of Windows cannot Boot

Inference-Domain: T4i49 Proactive Maintenance

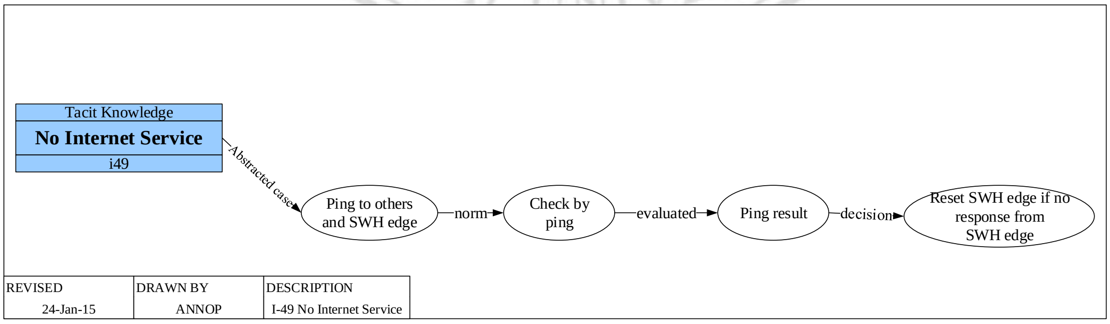


Figure 3.40 Diagram Present Inference-Domain of No Internet Service

3.6 Service Model of ITAM

In the previous subsection, the proposed method to construct the organisational learning model of the university IT asset management is explained. This model represents the learning curve of the experts and organisation when dealing with the IT assets. The rule based and reasoning guideline contained in the learning model can then be used to balance and optimise the requirements from all stakeholders involves. Hence, this sub section provides and explains the modelling method used in this paper to construct the "Service Performance" model of the proposed IT asset management.

As mentioned previously, the Service Performance can be measured in many different ways. This includes for example, usability, availability, reliability or security, and the selection really depends on the focus of the evaluation. However, these measurement indexes rely mainly on the historical data to perform statistical analysis, and most of the time incomplete. Hence, to overcome the problem of incomplete and be compatible with the rule based of the Economic Performance in this framework, the Service Performance is modelled in terms of its quality focusing especially on the investment perspective. That is the Service Performance is equal to functions divided by requirements, where functions mean services the IT assets can performed and the requirements mean the services the stakeholders wish. This can be illustrated in

$$\text{Service Performance} = \frac{\text{Functions}}{\text{Requirements}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

equation (1).

In this paper, the stakeholders can be divided into 3 entities with different objectives. Firstly, on one end is the top executive who makes the investment decision and allocate the financial budget for the IT investment. The main objective of the top executive would be to allocate the financial budget effectively, and get the most out of every investment. In other words, the top executive would not overpay to get more functions than required, or at most allow functions to meet all the requirements. On the other end is the IT manager whose main objective is to be allocated with as much budget as possible for the IT investment. As a result, functions are usually greater than realistically required to perform services. This second entity of the IT manager can also be thought of as the representation of the users within the organisation. The last entity is the key user or the key expert who most of the time acts in the middle to balance between the top executive (economically preferred) and the IT manager (serviceability preferred). The key user or expert does this balancing by utilising the knowledge constructed in the form of the organisational learning model (Section 3.2).

3.7 Balancing Mechanism of the Proposed IT Investment Framework

According to equation (1), since this research categorizes the stakeholders involved in the IT investment decision into 3 parties, there are 3 service performance functions for the consideration. Conventionally, the investment decision can be based on the objective of 1 stakeholder. This could either be the top executive or the IT manager. This is simple, but to reach the IT investment decision this way would surely neglect other stakeholders' satisfactory. Another way is to optimize the 3 service performance functions to find the IT investment option which meets the objectives of all the stakeholders involved. Unlike other evaluation methods, the service performance model in this paper utilizes reasoning concepts/rule based concepts which contains knowledge on costs, risks and performances of the IT asset. Furthermore, this proposed evaluation method provides greater flexibility to reach the IT investment decision.

In order to formulate the balancing mechanism or the decision making model of the proposed IT investment framework, the implication of the service performance proposed in equation (1) is analyses and given in Table 3.1.

Table 3.1. Implication of the Service Performance Model

Perspective	**Stakeholders**	**Objectives**	**Actions**	**Results of equation (1)**
Business	Top executive	Baseline	Focusing solely on economic performance	Usually less than 1 (or <1)
System	Key expert	Usage and Convenient	Balanced	Equal to 1 (or =1), but hardly possible
Informatics	IT Manager	Current technology	Focusing solely on service performance	Usually greater than 1 (or >1)

According to the equation (1) and the implication given in Table 3.1, it can be seen that the most satisfactory scenario is when the IT investment results in the balanced situation (functions exactly equals the requirements of all the stakeholders) which is hardly possible practically. Over and under investment indicates "opportunity costs" and "not enough functions" situations respectively. As a consequence, these over and under investments could lead to lesser satisfactory of each stakeholder from the balanced situation (highest point).

Hence, in simplest form, the behaviors of these 3 stakeholders can be represented by the parabolic equation as given in the equation (2).

$$\textit{Stakeholder behavior (Value or Quality)} = -(x-a)^2+b \qquad (2)$$

Where, a = 0.5 for the top executive (based on the implication given in Table 3.1)

a = 1 for the key expert (based on the implication given in Table 3.1)

a = 1.5 for the IT manager (based on the implication given in Table 3.1)

b = 1 for the most satisfaction

Furthermore, based on the equation (2), the behaviour of each stakeholder and the balancing mechanism can then be simulated and illustrated in Figure 3.41.

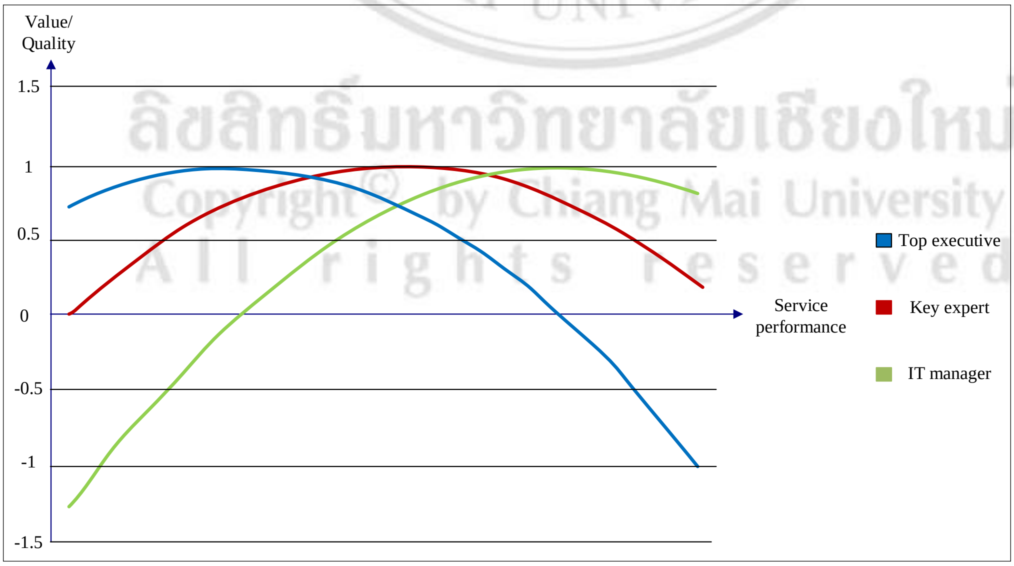


Figure 3.41. Simulated Behaviours of Stakeholders in the Service Performance Model

Figure 3.41 shows the simulated behaviors of all the stakeholders (top executive, IT manager, and key user/expert) and the possible balancing activities. It can be seen that each entity feels most satisfied when the objective is met. This is represented by the value equal to one at the top of the relevant graph in Figure 3.41. Any other numbers on the same graph would then represent the dissatisfactory of that entity arisen from particular reasons. With the simulated scenario shown in Figure 3.41, service performance being equal to 0.5 (or functions is lesser than requirements) is when the top executive is most satisfied. On the other hand, when the IT manager is most satisfied is when he/she can get more functions than required (or service performance being equal to 1.5 in Figure 3.41). To consolidate the opposite objectives of the top executive and the IT manager, the key user/expert needs to balance the satisfactory of the service performances of these 2 entities. This balancing activities can be illustrated as the graph in the middle of Figure 3.41. When considering the satisfactory of all the stakeholders involved, this creates the so called feasible space where the key user or the key expert needs to utilize the knowledge (rules or reasoning) of the organizational learning model in IT asset management (economic performance model) proposed in the previous section. These could include, for example, refurbishing some existing IT assets together with the new investments to lessen the budgets or relocate the existing IT assets to perform similar tasks with lower service quality required. All this is to optimize and find the most suitable solution which is accepted by all stakeholders. Furthermore, the utilization of the knowledge model on IT asset management could alter the shape of the graphs shown in Figure 3.41 to provide greater flexibility to reach the IT investment decision while taking into account constraints presented. Note here that, the shape of the graph shown in Figure 3.41 could be different if the accepted level of each stakeholder differs from the simulated scenario. As a consequence, the so called feasible space would look different, and the key user or key expert would need to utilize more or less knowledge to balance the service performance of all parties.

In this subsection, the service performance model of the proposed IT investment framework based on the university learning model on asset management is explained. It can be seen that the proposed service performance model focuses on evaluating the quality of the IT investments shown in equation (1). To make most suitable decision on the IT investment, the organizational learning model which represents the strategy in problem solving and contains the constructed knowledge (costs, risks, and performances) throughout the life cycle in the form of learning curve is of important. Together, the organizational learning model (economic performance) and the investment quality (service performance) represents the alternative IT investment framework based on the university learning model on asset management in this paper. The next section then provides the case study and results when applying this framework with the College of Arts, Media and Technology (CAMT) within the Chiang Mai University.