CHAPTER 5 DISCUSSION AND CONCLUSION

5.1 Discussions

The KBESCFD is an innovation in which one is given a set of symptoms or manifestations observed from a diagnosed system and is required to find a parsimonious set of disorders in a given layer of the system. These disorders may produce (or explain) directly or indirectly (e.g., through disorder propagation) those symptoms by using human expert reasoning knowledge about the domain. The diagnostic problem solving for a complex system is proved to be particularly difficult because of the lack of efficient techniques on knowledge organization and knowledge integration at present for the problem.

In this study researchers address issues of expertise models and present a novel strategy for integrating multiple knowledge sources in the diagnostic problem solving of complex systems. More importantly, a knowledge-based expert system for car faulty diagnosis (KBESCFD) is produced in this article. The KBESFD is a knowledge-based information-processing system, integrating fault diagnosis, state detection, and reasoning, with repair consultation for car without whole-block disassembly. An implementation architecture for this system is described, including hierarchical diagnosis, knowledge acquisition, knowledge representation, and concept mapping techniques related to the diagnosis.

KBESCFD is a car faulty diagnosis system where a number of symptoms are listed and rules of generating for possible causes are outlined. The user interface of the system is equipped with a formal representation software IHMC Cmaps Tools version 4.18. The finding suggested that:

5.1.1 Adaptations of knowledge inventory

Knowledge inventory (KI) described above are stored in the database for subsequent diagnosis use. KI is seen as a dynamic base that is generated and used by both monitoring and diagnosis. Besides results, KI also explains other two kinds of fault data in KBESCFD categories: prior knowledge from the fault symptoms diagnosis and the data-acquisition module (Angeli & Chatzinikolaouas, 2001; Frank, Ding, & Marcu, 2000)) shown in Figure 5.1.

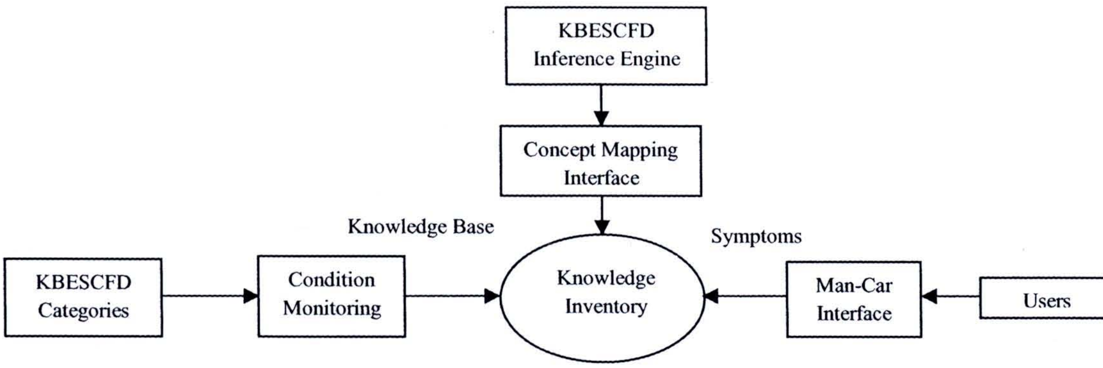

Figure 5.1 Data acquisition of KBESCFD model

5.1.2 Adaptations of KBESCFD

In the KBESCFD, the diagnostic knowledge acquisition includes based on generate the concept mapping in each maps is the most critical fault, even if it is unlikely to occur in practice. The concept maps are drafted and saved into the respective knowledge bases. This kind of knowledge is acquired from the prior knowledge and previous experienced. They are the description of the logical relationship and representation of knowledge. The data is obtained from the knowledge inventory and the domain experts, or summarized from long-term practical experience (Fisher, Gleitman & Gleitman, 1991; Isermann, 2005; Nyberg & Krysander, 2003). This is used to find possible faults or location of a fault.

Hence, experience knowledge is mainly about the diagnostic behavior of knowledge engineers or domain experts. This may also be obtained from the diagnostic or repair records of maintenance personal at the workplace. In the design of the knowledge-based expert system, one of the key important is knowledge representation. The concept mapping is employ to establish the hierarchical diagnostic of knowledge with experience knowledge, as well as the causal between the symptoms and the faults, are represented as independent facts or rules. This forms the hierarchy of diagnostic knowledge representation.

5.1.3 Reasoning engine

According to O'Donnell, Dansereau, & Hall (2003) suggested that concept maps could be transformed the reasoning engine is the kernel of the integrated diagnosis expert system. A diagnosis process is also the combination of fault data and diagnostic knowledge. In the KBESCFD model is the reasoning engine that performs the function of the combination. This model is divided into three composes from the reasoning point of view. They are functional knowledge (functional decomposition), principle knowledge (decomposition according to the frequency problem occurs) and experience knowledge (human expert reasoning or knowledgeable engineers' experience).

All of the knowledge bases are in the form of concept mapping, during the diagnosis of a fault, a human expert reasoning firstly locates the faulty functional modules using functional fault concept maps (Novak, (1995, 1998). Therefore, users can be related to the faulty to find the rough fault causes, and lastly localizes the fault causes with the help of corresponding rule maps. The diagnostic reasoning process in the KBESCFD model is carried out as shown in Figure 5.3.

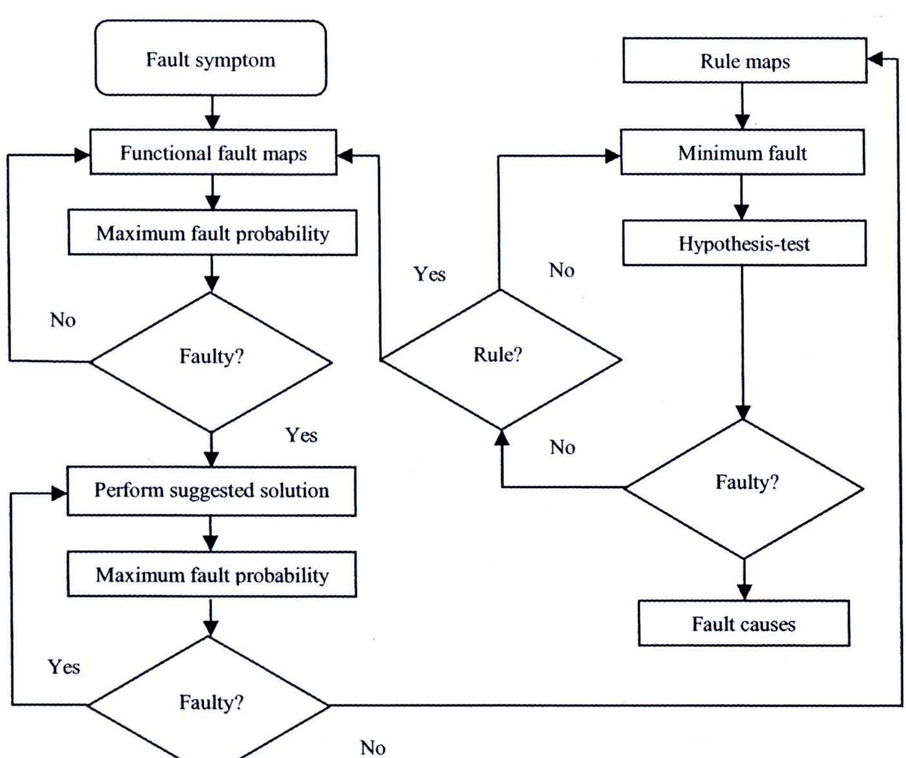

Figure 5.2 The diagnostic reasoning process of KBESCFD model

In Figure 5.3, the diagnostic reasoning based on the functional fault maps and principle fault map is performed using the strategy of knowledge representation combined the failure probability of each concept in the fault maps. Whether a link is faulty or not is determined by various directions in action and the logic map is more complicated. For rules associated in process condition, reasoning is performed as a sequential hypothesis-test cycle (Gelgele & Wang, 1998). It may be difficult to demonstrate all possible diagnostic results in this study. Analyzing all the symptoms, all the rules and all the tests, this can create a compulsory search inference engine.

5.2 Research finding

The results of the study showed that there are no statistically significant differences in training achievemnt in term of knowledge acquisition. The study indicated that there was a great significant difference between the pre-map and post-map scores in steering system faulty diagnosis and manual transmission faulty diagnosis of the CA-CM group Even though, the multi-point injection engine faulty diagnosis was fail. In addition, learning satisfaction was high level. Why must be two mappers? Why must the mechanical system? Because of automotive electrical and electronic did difficult to solve, the rationale in metacognitive is generated for premising and conclusions. This is a significantly question and new finding on automotive problem-solving skills for Thai technicians.

By reviewing the literature, Jonassen (1997, 2000, 2004) argued that the accomplishment of problem solving, as an activity, is more complex than the sum of its component parts. Without question, problem solving necessarily engages a variety of cognitive components, such as propositional information, concepts, rules, and principles *(domain knowledge).* However, it also involves *structural knowledge* (information networking, semantic mapping/ *applicative skills* (constructing/applying arguments, analogizing, and inferencing), and *metacognitive skills* (goal setting, allocating cognitive resources, assessing prior knowledge, assessing progress/error checking) in the learner.

What are the issues that artificial skills between mechanical and electronic knowledge domain? Automotive problem solving also engages *motivation/attitudinal components* (exerting effort, persisting on task, engaging intentionally) and certainly requires *knowledge about self* (articulating prior knowledge, articulating sociocultural knowledge, articulating personal strategies, and articulating cognitive prejudices/ weaknesses) (Butler, 2005; Foran, 2005; Jonassen & Tessmer, 1996; Jones, 2002; Mills, 2005; Peatman, 1988). Gagne, Briggs, and Wager (1992) acknowledge that problem-solving learning is difficult and suggest only a brief template for applying the *events of instruction* in the same way they treat concept learning and rule learning outcomes. Smith and Ragan (1993) also suggest the events of instruction model, although they acknowledge differences in the nature of the steps.

The KBESCFD model depends upon the problem solver's understanding and representation of the type problem, including an understanding of the problem state and goal state. These, along with a set of operators for moving from the initial state to the goal state, are known as the problem *space* or problem *schema* (Wood, 1983). The problem space is

"the fundamental organizational unit of all human goal-oriented activity" (Newell, 1980, p. 696). With practice over time, problem solvers construct richer problem representations or schemas which they can apply in a more proceduralized or automatized manner. Therefore, experts differ from novices because their problem schemas better enable them to recognize a problem situation as belonging to a certain class of problem.

Thus, KBESCFD is applied in this study. However, because technicians are situated in everyday practice, they are much more interesting and meaningful to learners, who are required to define the problem and determine what information and skills are needed to help solve it. In designing instruction that engages learners in ill-structured problem solving, the designer must work with subject matter experts and experienced practitioners to accomplish the following tasks. A sample ill-structured instructional design problem is described in the Appendix. It is a generic description of an ill-structured problem. Space constraints preclude presentation of all of the case material. In this performance-technology problem, there are multiple solutions. However, the more appropriate ones rely on discovering what kind of problem it is.

5.3 Conclusions

Given the human expert reasoning have large data enjoyed the advantages of both automobiles and computers, it may be correctly and festinated on artificial intelligence diagnosis. In fact, car manufacturers have employed indications of computer-based systems namely "scan tools", but not provided and insignificant coverage is given in the study. They may be good reasons for this: chances the reluctance of car manufactures to commercialize; the relatively recent application base on human expert reasoning, application of intelligent systems is difficulty for training the technicians within the dynamic of automotive environment.

As illustrated, this new innovative can assist car faulty diagnosticians and broader uses in following a systematic training diagnostic strategy using the symptoms referred. Able to provide experts reasoning in fix and repair malfunctions needed to employ in the context of Thai technicians. It is expected to change the traditional techniques of car diagnosis and maintenance to increase both systematic and intelligent. They play from keeping and delivering as a knowledge management. A consistent diagnosis expertise of experienced technicians, the innovation is also believed to contribute to safe operation and economy in maintenance work.

5.4 Implications

Although the KBESCFD prototype completely in the human expert reasoning of car faulty diagnosis, it is a little quite a complete and reliable model. Adaptation of innovation is unlikely to cope with by adding them to the database. Computer programming is effectively in the future cope and development involves adding more rich experience and maintenance knowledge from KBESCFD. But the model represents a breakthrough in car faulty diagnosis by providing concept mapping as an inference engine and assisting both novice and expert diagnosticians in solving car problems.