

Development of Competency Standards Model for the Auto Mechanics Department in Vocational High Schools

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Abstract — This research aimed at exploring how to establish an appropriate competency standard model for the department of auto mechanics in the vocational high schools. Such a model can help the auto mechanics departments in the vocational and technical education system to train students that meet the quantity and quality demands of auto industry for manpower. The research goals were 1) to discuss the importance of competency standards, 2) to probe into the feasibility of functional analysis and 3) to develop a functional map for the trade of auto mechanics. This research analyzed the professional competency standards for the trade of auto mechanics through functional analyses. It collected literatures relating to the knowledge and skills needed in the profession, held expert interviews, and conducted functional analyses. Then it proposed feasible schemes for vocational schools to develop curricula that can help supply talents that auto industry needs. Literature analysis and functional analysis are two major methods, among others, used in this research.

Index Terms — senior vocational high school, department of auto mechanics, competency standards, senior vocational high school, department of auto mechanics, functional analysis

RESEARCH BACKGROUND AND MOTIVE

What competency of future auto-related professions students should acquire to satisfy the needs of the increasingly advanced high-tech auto industry, the auto technology, and the social environment, and to accord with the talent standards in the auto profession market has so far become an important subject about the development of the auto industry. At present, in order to meet the needs of new high-tech auto transportation of the 21st century, it is really necessary to establish the professional competency standard for the automobile industry. Supportive factors are as follows:

● Transition in auto mechanics industry

With the development of new science and technology of the auto, the vocational high school must shift the learning goal for students from the traditional technical education to the technical service education. The new learning goal is to turn out professional talents with the specialized competency and the viewpoint on the value of modern civilization. Besides the required professional mechanics, the students should also dabble in other auto-related management fields. The new goal should go forward to technical service education to develop the traditional auto repair industry. Apparently, it is urgent to probe into the auto mechanists' competency in different angles.

● Improving education quality on auto mechanists

Based on the development of the auto mechanics industry and the demands for industry changes, the key competency and the professional competency of the auto-related departments necessarily need to be reevaluated to ensure the practicability of the dynamic-mechanics curricula of the vocational system, and the standard curricula of the school. What's more, the education quality of the auto mechanists must be guaranteed.

● Meeting the need for human resources of the auto repair industry

The professional competency standard of auto mechanists is the interface between the auto repair industry and the professional training. In another word, in order to turn out talents qualified for the needs of the industry, the vocational high school should provide appropriate curricula and realize the link between practice and learning. That is to say, the professional curricula should positively respond to the market demand for the talents' competency so as to cut down the contradiction between the professional curricula and the demand of the auto industry. It is the best way to develop the auto mechanists' competency based on the opinion that the market demand of the industry should be competency-oriented.

● Refining the auto mechanist licensing system

At present, the auto repair workers or the auto repair technicians in Taiwan only engage in the common fields of auto mechanics. The objects of their examination and repair include gasoline engine, diesel oil engine, the auto underpan, the electric system of the auto, etc. Presently, the fields of auto examination and repair do not agree with the classification of the auto repair mechanics required by the auto repair manager. So it is really necessary to readjust the examination licensing for future auto repair occupation to establish the technical competency licensing system for the auto repair occupation which conforms to the market mechanism. The development of the auto mechanics' competency can provide the competency standard to improve the auto mechanic licensing system.

Herein, the probe into the competency, which the auto mechanics should acquire, attaches great importance to establishing the concrete competency framework for the talent cultivation and their practice that keeps pace with the high-tech information age.

RESEARCH PURPOSES

Because of the above mentioned factors and motives of the research, based on the experience of analysing the professional competency carried out by the developed countries as well as on the requirements for the professional competency of the auto mechanics made by the auto repair industry at home, the functional analysis is applied to the analysis on the auto mechanics' competency to further develop the competency functional map for auto mechanics. The goals of this research are as follows:

- Probe into the importance of the competency standard.
- Probe into the feasibility of the competency model.
- Establish the competency functional map for auto mechanics.

RESEARCH METHOD AND PROCEDURES

The literature exploration is carried out based on the theory of the functional analysis and the current situation of the auto repair industry. The functional map should be developed referring itself to the Functional Analysis Manual on Competency Analysis written by Professor Cheng-rong Tian, and further to the method and steps of functional analysis. In addition, in the process of developing the functional map, the competency model and the in-situ demand for the professional competency of the auto mechanics are also explored.

In terms of the design and implement mode of this research, the concerned materials are collected first and then the literature analysis is carried out to illustrate the research background and its motive, analyze the current situation about the professional competency standard of the auto professions, and then select experts to attend the functional analysis meeting to draw the competency functional map for auto mechanics. The concrete research steps are as follows:

- Literature review

The theories and literatures concerning the analyses on the competency, the professional competency, and the auto mechanics' competency both at home and abroad were collected. In addition, based on the concept of competency orientation, the manpower demand of the social environment, and the changes of industrial structures, the demand for auto mechanics' competency was further analyzed and discussed. At the same time, the concerned information was not only packed up as the reference data for the functional analysts to carry out the functional analysis, but also compiled as the focus group meeting manual.

- Select experts to attend the functional analysis meeting.

The expert participants in the functional analysis meeting: the scholars in the auto field, the practical operators in the field, the educators in the departments concerning the automobile.

- Hold the functional analysis meeting for the first time

The functional analyst made the introductory remarks, introduced participants and their learning experiences, and briefly introduced the general idea about the functional analysis. It was the functional analyst's task to explain the significance of the key goals and their analysis method. After the participants put forward the key goals, the functional analyst presided over the meeting to discuss the goals and form a common understanding. Afterwards the functional analyst briefly introduced the significance of the main functions and their analysis method. The participants brought forward the main functions and then the functional analyst presided over the meeting to discuss these functions and form a common understanding.

- Finish the main functions of auto mechanics' competency

The conclusion of the first functional analysis meeting was packed up into a functional map for the second meeting to follow.

- Hold the functional analysis meeting for the second time

The functional analyst first explained the conclusion made in the first meeting and affirmed that there was no missing. Afterwards, he briefly introduced the significance of the minor functions and their analysis method. It was the participants' task to put forward the minor functions and the functional analyst presided over the meeting to discuss the minor functions and form a common understanding.

- Finish the minor functions of auto mechanists' competency

The conclusion of the second functional analysis meeting was packed up into the functional map for the third meeting to follow.

- Hold the third functional analysis meeting

The functional analyst first explained the conclusion made in the second meeting and affirmed there is no missing. Afterwards he briefly introduced the significance of the function units and their analysis method. The participants then brought forward the function units and then the functional analyst presided over the meeting to discuss the function units and form a common understanding.

- Finish the function units of auto mechanists' competency

The conclusion of the meeting was packed up into the functional map for the fourth meeting to confirm.

- Hold the fourth functional analysis meeting.

The functional analyst first explained the first draft of the functional map and then asked the participants to examine and confirm the competency functional map for auto mechanists. In the end, the functional analyst made a meeting conclusion and extended thanks to the participants.

- Finish the competency functional map for auto mechanists

All the information of four meetings was packed up together and the final revision and makeup of the functional map were carried out.

- Compose the research report.

RESEARCH PROCESS AND EXECUTION

This research aimed at developing standards for auto mechanists' competency. Based on Functional Analysis Manual on Competency Analysis developed by Professor Cheng-rong Tian, it carried out the competency analysis in the method of the functional analysis. Moreover, the functional analysis meetings were held in the manner of the focus group interview. In the concept of the competency model, the experts and scholars in the auto field developed the functional map for the professional competency. The functional map was not only the final fruit of this research but also the final fruit of the functional analysis meetings. So the development of the functional map was closely connected with the participants in the functional analysis meetings. The following is the description of reliability and effectiveness of the functional analysis meeting participants and that of the functional map.

- Functional analysis meeting participants

As the literatures concerning the functional analysis show, the functional analysis is an analysis method of focus group interview. The learning experiences of the participants attach great importance to the results of the analysis. So the functional analyst must cautiously select participants.

According to the selection principle for the functional analysis, the participants in the functional analysis meetings are chosen out as the following principle.

- Auto repair workers, the supervisors of this field, the representatives of the official training agencies of this field, the representatives of the educational departments of this field, the concerned researchers of this field, and the human rights group representatives, etc.
- Participants have at least three years of working experience in the field of auto repair.
- Participants are mainly from the northern area, the central area, and the southern area.
- Participants may all participate in the whole process of the functional analysis.

In conclusion, the information about the functional analysis meeting participants is as the following table 1 shows.

Classification	The number of representatives	The title of the technical post	The area
Scholars in the auto field	01	Professor	Northern Taiwan
	02	Associate Professor	Northern Taiwan
	03	Associate Professor	Northern Taiwan
	04	Professor	Central Taiwan

Representatives of the auto industry	05	Manager (grand master)	Northern Taiwan
	06	Engineer	Northern Taiwan
	07	Manager (grand master)	Central Taiwan
Educators in the auto field	08	Chair, Department of Auto Mechanics	Northern Taiwan
	09	Chair, Department of Auto Mechanics	Northern Taiwan
	10	Lecturer, Department of Auto Mechanics (grand master)	Central Taiwan
	11	Lecturer, Department of Auto Mechanics (grand master)	Southern Taiwan

TABLE 1
BACKGROUND INFORMATION ABOUT AUTO MECHANISTS FUNCTIONAL ANALYSIS MEETING PARTICIPANTS

- Preparation for the functional analysis meeting
 - Collect domestic competency researches concerning auto mechanists and the classification standards of the trades and professions, which can act as the reference information for current situation of auto mechanists.
 - The functional analysis is framed on the analysis and the discussion from experts. So, the selection of experts is really an important task. The task of this stage is mainly to single out the most representative experts to attend the functional analysis meeting.
 - After the confirmation of the list of the expert participants, the researcher provides some basic principles, such as the preliminary functional map, the handbook of the functional analysis, etc. Moreover, the researcher should not ask the experts to think about these principles or to try to fill in the functional map beforehand. Doing so is to check whether the preparations for the subject beforehand have an impact on the process of the functional analysis meeting.
 - Dispatch the written notice to the meeting participants.

- Functional analysis meeting

In the manner of focus group interview, the functional analysis meeting was held for three times. Each time it lasts three hours. In the first hour, the functional analyst made introductory remarks and briefly introduced the participants, their learning experiences, and explained the functional analysis. In the rest time, the functional analyst led the participants to discuss key professional goals, the main functions, and function modules (including the minor functions and the functional units).

The main task of the last functional analysis meeting was that the participants confirmed the competency functional map for auto mechanists.

- After the functional analysis meeting

After the meeting, the functional analyst reviewed the functional analysis and filled in the functional analysis form acting as the ground for next improvement and for the quality control.

DATA ANALYSIS

- Comply with the description mode of Verb+ Object + Condition

The functional analysis described every functional unit that the individual could accomplish. The analysis on every stage conformed to the functional analysis regulations, and followed the description mode of Verb+ Object + Condition.

- After the functional analysis meeting, a functional map for the professional competency was developed.

In the process of the analysis, the functional analyst presided over the functional analysis meeting and conducted the focus group interview. The recorder jotted down the advice put forward by participants, with which the functional analyst further conducted the discussion to make an agreement.

After the functional analysis meeting, the competency functional map for auto mechanists was developed. Consequently, the experts checked and confirmed the functional map. The concrete advice brought forward by the experts was packed up acting as the ground for the further revision or explanation. So far, the standards for auto mechanists' competency had been drawn out.

- The functional analysis was carried out in the manner of focus group interview.

In the manner of focus group interview, six to twelve participants made free and interactive discussions around the topic: auto's dedication to the humankind, the country, and the society. The result of the functional analysis was a functional map. The analysis process was composed of four stages, that is, the analysis of the key goal, the main functional analysis, the minor functional analysis, and the functional unit analysis.

- Accomplish the competency functional map for auto mechanists

According to the composition regulations of the functional map, the meeting data were packed up. The final proofreading and makeup perfected the functional map.

RESULTS

● The key goal

The functional analyst pointed out that the subject of the discussion focused on the profession: auto mechanists. The experts were conducted to discuss auto mechanists' dedication to the country, the humankind, and the society. After the experts' discussion in terms of the dedication of the auto, the auto service plant, the professional service personnel, and the auto owner to the family, the society, and the country, the experts made the final conclusion that the key goal of auto mechanists profession was to provide various satisfactory services so that the auto can safely and normally drive, which accords with the environment protection rules. The discussion about the key goal mainly focused on its category. Especially at the beginning, it was inclined to extend its category excessively. Therefore, the functional analyst must cautiously remind the participants of it.

● The main functions

The discussion of the main functions goes according to the basic principle that the key goal is divided into the main functions according to the regulation of classification. The key goal and the main functions have the two-way relation. That is to say, the realization of the key goal means that of the main functions and the realization of the main functions also means that of the key goal. Therefore, the analysis on the main functions was the most important stage of the functional analysis. On this stage, the functional analyst asked the experts to divide the key goal into the main functions and think over what should be done to reach the key goal of providing various satisfactory services so that the auto can safely and normally drive, which accords with the environment protection rules or think over what functions should be accomplished to reach the key goal. After the experts conceived of the relations between the auto and the auto owner, between the auto and the professional service personnel, between the auto owner and the professional service personnel, between the professional service personnel and the factory, and between the factory and the environment, the above ten main functions were summarized into following three items:

- Maintain, examine, and repair the auto.
- Maintain the working environment and quality of the plant district.
- Improve the service quality to satisfy the owner's expectation.

● The minor functions

After the analysis on the main functions, the analysis on the minor functions proceeds, which was also called the analysis on the key role. On this stage, the functional analyst once again asked the experts what should be done to reach the main functions or what functions should be accomplished to reach the main functions. The minor functions were actually the tasks, which must be accomplished to reach the main functions. The following Chart One is the functional map showing the minor functions.

● The functional units

After the analysis on the minor functions, the examination followed whether these functions could be accomplished by the individual. When it was certified that the minor function could be further divided into the functional units, the functional analyst once again asked the experts what should be done to reach the minor functions or what functions should be accomplished to reach the minor functions. The following Chart One is the functional map showing the functional units developed from the minor functions.

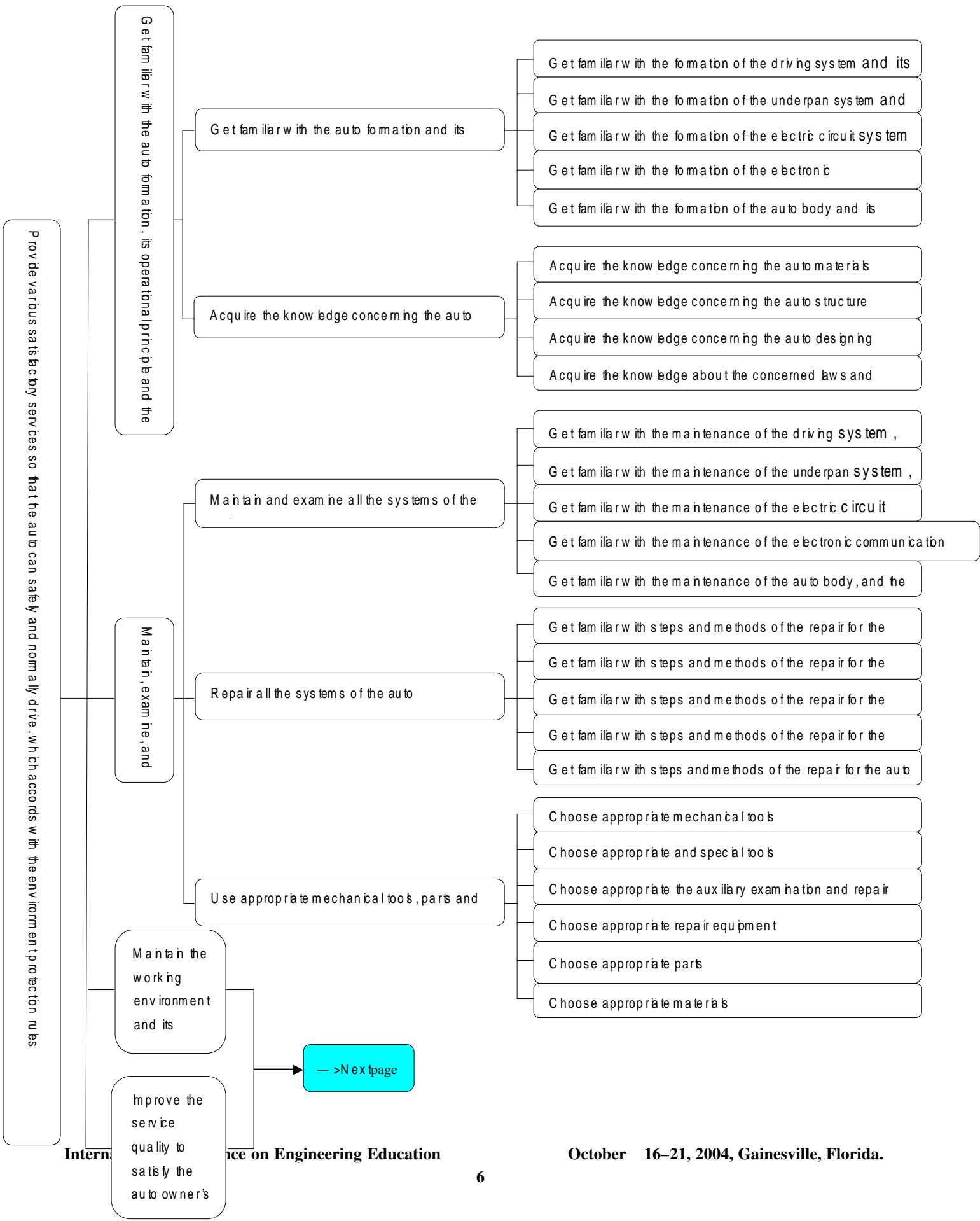
Through three times of the functional analysis meeting, the initial functional map was accomplished. In the fourth functional analysis meeting, the final confirmation and examination were made for the functional map. The participants in this meeting all agreed on this functional map. So far, this functional analysis was finished. The functional map developed in this research is as Chart One shows:

Key goal

Main functions

Minor functions

Functional units



—>Next page

Key goal

Main functions

Minor functions

Functional units

Provide various satisfactory services so that the auto can safely and normally drive, which accords with the environment protection rules

Get familiar with the auto formation, its operational principle

Maintain, examine, and

Maintain the working environment and its quality of the

Improve the service quality to satisfy the auto owner's

< -- Last

Maintain the working environment of the

Maintain secure working environment

Maintain the equipment of the factory

Keep excellent interactive working

Improve the service quality of repair

Improve the service quality after the repair

Improve the specialty quality

- Keep the working environment of the factory clean
- Support the environment protection work, such as the
- Support guarding against the air pollution of the factory
- Support guarding against the noise pollution of the
- Stay harmonious with the neighbours of the factory

- Hold the knowledge about the industrial security
- Hold the knowledge about dealing with accidents

- Keep the liquidity of the service
- Appropriately use parts and materials
- Maintain the equipment and the establishments of
- Estimate the correct time to discard the equipment and

- Make the planning of the career
- Smoothly communicate with others
- Get familiar with the characteristics of the auto

- Provide the consultation chance for the auto owner
- Keep the auto for repair clean and original
- Smoothly communicate with the auto owner

- Care about driving status of the owner
- Guide the owner to lay emphasis on the auto
- Guide the owner to get familiar with the driving
- Guide the owner to acquire the knowledge about

- Form the habit of actively acquiring new
- Form the habit of consulting the maintenance handbook and
- Actively participate in the education and studying activities
- Actively obtain the specialized licences concerning the

FIGURE 1
COMPETENCY FUNCTIONAL MAP FOR AUTO MECHANISTS

CONCLUSION AND SUGGESTION

In the manner of focus group interview, the functional analysis is applied in this research to develop the competency functional map for auto mechanists. It is found that there are great differences between this functional map and the previous auto mechanists' competency index. The main cause is that the auto industry market has greatly changed. The functions of auto mechanists have also changed from the previous production, manufacturing, and repair to the current repair, distribution, management, and service. It is certified by this research that the needs for the professional competency in the auto industry have changed and as a result, the functions of auto mechanists have transformed from the technical trade into the technical service trade. So the participants all hold the idea that it is necessary to develop the framework for the professional competency standard of auto mechanists and all agree to develop the competency standards according with the real occupational market in the method of the functional analysis and the competency model.

It is found by this research that the key goal of auto mechanists at present and in future is to provide various satisfactory services so that the auto can safely and normally drive, which accords with the environment protection rules. It is also found this goal involves the interactive relations between the individual and the auto, between the auto and science, between science and the environment, and between the science and the individual, which conforms to the category of the technical service.

It is initially found from the conclusion of this research that the competency, which auto mechanists should hold, is greatly different from the previously required competency. The following is the suggestions in terms of the technical and vocational education, the professional training, the professional licensing, and the auto mechanists.

● Technical and vocational education

It is confirmed by this research that the education for auto mechanists has transformed from the technical education to the technical service education. As a result, the correspondent readjustment to this transformation must be made in respects of the curricula planning and the teachers' source and further studying to meet the needs of the industrial market.

Consulting the competency standards and the features of its peripheral industry, the school can further formulate its competency training directions and form its own training characteristics to compile its own standard curricula.

In respects of the teachers' source and further studying, the teachers in the department of auto mechanics should be given more chances to understand the auto mechanists as well as the requirements and transformation of the occupational market. For this, the school can consult the conclusion made in this research, which can also act as the professional competency reference for the school to recruit new teachers and as the reference for the on-duty teachers to enrich in their own professional competency.

● Professional training

The professional train must comply with the need of the industry. The results of this research can provide more specific training goals for the professional training concerning auto mechanists. According to the professional competency standards of auto mechanists shown in the functional map drawn by this research, the curricula and the teaching materials for the professional training can be planned to bring the professional training into full play.

● Professional licensing

According to the professional competency standards of auto mechanists shown in the functional map drawn by this research, the concerned auto professional licensing departments can specifically lay out the classification of domestic professional licensing and examine the concerned measurement and mechanism. They can further establish closer relationship with the professional education department, the professional training department, and the concerned industries so as to improve the public reliability and the substantial functions of the concerned licensing.

● In terms of auto mechanists

Since the functions of auto mechanists have transformed from the previous technical trade into the technical service trade, the concerned operators in the auto field should also make the correspondent readjustment in order to face the market competition and satisfy the market needs. In conclusion, the results of this research can act as the reference for the concern operators in the auto field to plan their companies' perspectives and improve their professional competency so as to reach the goal of everlasting management.

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