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# The Development of a Competency Based Course of Study to Meet Thailand's Mould and Die Industry Needs

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**Abstract:** The research objective was to analyse whether or not Thailand's current training programs for mould technicians meet the mould and die industry's standard competencies and then create a course of study that allows this training to be completed more successfully and efficiently. The analysis looked at the situation, problems, obstacles and needs of the labour force during their training. The research tools used to collect the data were questionnaires and focus groups. The sampling group was chosen by purposive random sampling which included experts related to the development of personnel in the moulding industry. Results revealed that most of the companies in the moulding industry, who responded to this study felt that Thailand's mould and die personal lacked the knowledge, skills and attitude required for competency standards. Standard competencies in the mould and die industry need to be divided into three levels of personnel: operators, experts and management. The reason for this is that the course competencies are defined by the enterprises themselves. The item objective congruence can be used to define standard vocational competency course for the mould and die industry by the following steps: defining key purpose, defining key role, defining key function, defining unit of competence and defining element of competence. An analysis of competency courses by Delphi technique found that experts, educational institute representatives, related mould personnel development institute representatives and enterprise representatives agreed both times. The difference was that it was higher for the 2nd time although, most medians were at agree-the-most level. Organisations and employers can use standard vocational competency courses as a guide to developing knowledge and job skills of workers and then add to them in such a way as to greatly improve training standards so that personnel meet the professional needs of the industry.

**Key words:** Moulding competency, mould occupation standard, mould and die, mould, industry, Thailand

## INTRODUCTION

**Background and motive of the problem:** The mould and die industry is an interesting industry and it plays an important role in developing other industries as success in various industries, the automobile industry, mechanical industry, electronics industry, electrical appliance industry, plastic industry, product and general wares industry all depends on the quality of the moulding industry.

Therefore, it could be said that the moulding industry lies behind the success of all industries. At present, the mould industry is in the process of developing and progressing however, it still depends on the importation of moulds from foreign countries, especially moulds for the electrical, electronic and vehicle industries. The cost to Thai businesses is 26,000 million baht every year. Yet Thailand's could exports was limited to 4,000 million baht year$^{-1}$, six times lower than the cost of imports. The expected trend for the industry is that there will be a growth in demand for mould importation of 10% each year according to the current growth of the electrical, electronics and vehicle industries (Amrine *et al*., 1997) (Thong-U-thai and Kaewkuekool, 2007). It is therefore, imperative that Thailand's own moulding industry grows to meet this demand and overturn the current import/export imbalance.

The government is aware if this and realises the importance of building, a local mould industry that will reduce reliance on importations whilst simultaneously increasing future mould exportation. In order to do this, a number of proposed projects have been developed to

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solve the major problems presently found in Thailand's mould and die industry. The 1st such project commenced with the approval of cabinet on the 10th of August 2004, under the supervision the Thai-German institute who, it was hoped would ensure that the project operated with optimal effectiveness (Moulding Industry Development Project, 2003; Sukhotanang, 2006). The main problem currently affecting the development of the mould industry in Thailand is the lack of human resource in the mould industries who have knowledge, skill and positive attitude that is needed to run the machinery (including CNC, measuring instruments, basic mechanical tools, moulding, drawing and design by computer, mould maintenance, materials, safety and pollution control) and including a poor understanding of Mathematics, Sciences and English language (Thong-U-thai and Kaewkuekool, 2007).

According to the survey of both short and long training courses in the mould industry, there is no currently available course that develops mould technicians to the levels required by the industry. This is a significant oversight and highlights, the urgent need for researchers/trainers to change current courses of study so that they actually train current or potential personnel to the standard competency expected and needed by the industry. In order to do this, organisations and employers can use standard vocational competency courses as a guide to developing the knowledge and skills of workers but the poor quality of current training outcomes suggest that it is also essential to add to these standard actions if training standards are to be improved.

Superior training courses and higher standards when then combined with good management practices will enhance productivity and competitiveness by improving the quality of products and services. This enhancement will stem from a better trained workforce who can operate more efficiently and effectively to the level expected by standard vocational competencies and international guidelines. Well trained personnel will also have the confidence to seek more knowledge will appreciate their work and will have a higher degree of job satisfaction as they ascertain a higher compensation for their improved development. The benefits of a well trained workforce are also culminative and generational as personnel will help transfer their knowledge and life experience to future mould technicians via the educational system that provides the industry with its professional qualifications.

## MATERIALS AND METHODS

**Objectives:** To study the situations, problems, obstacles and needs of the labour force's competencies for the moulding industry. To compare the situations, problems, obstacles and needs of employers in the moulding industry. To study the relationship between courses, competencies and the standards of mould technicians. To define a course of study that will train mould technicians to the standard competency levels needed by the industry.

**Limitations:** The part of the study, looking at the situations, problems, obstacles and needs of the labour force's competencies for the moulding industry focused on the middle management level of the industry . Also, the sampling was classified by specific type and included 128 enterprises. The part of the research looking at developing and defining a course of study that will train mould technicians to the standard competency levels, needed by the industry focused on experts related to the development of personnel in the moulding industry (they belonged to enterprises in the moulding industry, the Thai-German Institute (TGI), the institute for labour skill development, the Thai association of the moulding industry and technical colleges which provide majors focusing on the moulding industry).

**Tools use to collect data:** A questionnaire about the situations, problems, obstacles and needs of employers in the moulding industry. A survey with Item Objective Congruence (IOC) which complies with the experts in terms of the suitability of each element in the course. A questionnaire about the opinions of mould experts and representatives from enterprises who have examined the structure of current competency courses and standards for mould technicians. A focus group was organised and a public hearing was held about competency courses and standards for mould technicians.

**Procedure:** To collect the data, the researchers used the questionnaire and the focus group of experts from the mould and die industries as well as representatives from enterprises. Conducted a study of needs/population, analysis about the situations, problems, obstacles and needs of the labour force's competencies for the moulding industry by questionnaire.

Designed/created/analysed a table job. A focus group was organised and a survey with IOC was developed to summarise the vocational standards of mould and die technicians as required by the enterprises (Boontam, 1998) at the moulding operator level, moulding expert operator level and moulding management level. Also, a meeting was held to define criteria for vocational standards for mould and die technicians. The subcommittee consisted of representatives from

vocational education institutes, representatives from the thai mould and die industries, representatives from the Thai-German institute, representatives from the Skilled labour development institute and representatives from mould and die enterprises in BSID. They helped define standard competencies for mould and die technicians (Natalia and Tom, 2005; Norton, 1985) which focused on defining the key purpose, role and function of competency as well as defining units and elements of competence.

Development of functional mapping by enterprises who gathered to define the drafted structure of standard competency courses for mould and die technicians according to the table of standard vocational competencies as required by enterprises (Unterbrunner, 1982; Masters and McCurry, 1990) (meetings to examine structure at the 1st-3rd time). Also, the questionnaires about the opinions of experts and representatives (by Delphi technique) at the 1st and 2nd times were analysed to summarise the viewpoints, consider the median of the course as follows (Jensen, 1996) and define the co-relations between each item.

Testing among course competency focus group was organised and the public hearing was held. There were 58 representatives from vocational education institutes, representatives from the Thai mould and die industries, the Thai-German institute, the Skilled labour development institute and the mould and die enterprises.

## RESULTS AND DISCUSSION

**Problem and obstacle specification in the labour force of the mould and die industry:** A summary of Table 1 shows that the 1st problem in professional knowledge is moulding design (mean = 3.82) whilst the 2nd and 3rd problems are in moulding technology (mean = 3.78) and the moulding manufacturing process (mean = 3.73), respectively.

A summary of Table 2 shows that the 1st problem in professional skill is in creating mould and die (mean = 3.75) whilst the 2nd and 3rd problems are in back up data by computer (mean = 3.73) and measurement and test mould (mean = 3.72), respectively. A summary of Table 3 shows that the 1st problem in professional attitudes is the intention of running (mean = 3.88) whilst the 2nd and 3rd problems are a head's success is important work (mean = 3.83) and operational duties in good faith (mean = 3.81), respectively.

**Comparing need specification by establishment size in the labour force of the mould and die industry:** Table 4 shows the results, compare the need specifications of professional knowledge and show that significant 0.01 are safety in industry, management industry control machine with computer (CAM) and significant 0.05 are Math in industry, science and applications, strength of material, moulding design, moulding design, design drawing by computer (CAD), quality control and metal welding.

Table 1: Problems in the professional knowledge of the labour force

| Problems in professional knowledge | Mean±SE |
|---|---|
| Moulding design | 3.82±0.85 |
| Moulding technology | 3.78±0.86 |
| Moulding manufacturing process | 3.73±0.89 |
| Automatic control system (NC, CNC) | 3.71±0.90 |
| Quality control | 3.70±0.78 |
| Production of moulding industry | 3.70±0.86 |
| Mechanical strength and various calculation | 3.67±0.77 |
| Control machine with computer (CAM) | 3.66±0.79 |
| Measurement | 3.60±0.77 |
| Management industry | 3.60±0.84 |

Table 2: Problems in the professional skills of the labour force

| Problems in professional skills | Mean± SE |
|---|---|
| Create mould and die | 3.75±0.94 |
| Back up data by computer | 3.73±0.91 |
| Measurement and test mould | 3.72±0.94 |
| Reading and drawing | 3.66±0.82 |
| Technology CNC | 3.64±0.90 |
| Create cutting tool | 3.59±0.89 |
| Maintenance mould and die | 3.58±0.81 |
| Testing material | 3.57±0.96 |
| Project in industry | 3.57±0.86 |

Table 3: Problems in the professional attitudes of the labour force

| Problems in professional attitude | Mean±SE |
|---|---|
| Intention of running | 3.88±0.88 |
| Head's success is important work | 3.83±0.85 |
| Operational duties in good faith | 3.81±0.93 |
| Expressed the desire to find more knowledge from different sources | 3.81±0.93 |
| The effort trying to solve real problem | 3.71±0.77 |
| To work regularly | 3.61±0.83 |
| Accept opinions of colleagues rationally | 3.64±0.95 |
| Advice suggestion to colleagues | 3.60±0.89 |
| A time to meet | 3.60±0.91 |
| Devoted their time to work and function | 3.58±0.94 |

Table 5 shows the results for comparing need specification of professional skills showing significant 0.01 are design and drawing by computer, using CNC and significant 0.05 is metal welding.

Table 6 shows the results for comparing the need specifications of professional attitudes significant 0.01 has integrity. Operational duties in good faith and significant 0.05 are intention of running, head's success is important work.

**Comparing comments about need specification in the labour force of the mould and die industry:** Figure 1 shows the demand for knowledge, skills and

Table 4: Comparing need specification of professional knowledge of the labour force

| | Mean | | | | |
|---|---|---|---|---|---|
| Professional knowledge | Small | Medium | Large | F-test | Sig. |
| Using English language on the data and information | 3.00 | 3.90 | 3.70 | 2.67 | 0.073 |
| Using English language | 3.00 | 3.62 | 3.82 | 2.71 | 0.070 |
| Safety in industry | 3.33 | 3.97 | 4.21 | 4.86 | ** |
| Math in industry | 3.00 | 3.82 | 3.97 | 3.49 | * |
| Science and applications | 3.00 | 3.80 | 3.64 | 3.89 | * |
| Part of mechanical works | 4.00 | 3.90 | 4.18 | 3.04 | 0.051 |
| Mechanical strength and various calculation | 3.33 | 3.59 | 3.76 | 0.99 | 0.374 |
| Strength of material | 3.33 | 3.91 | 4.18 | 3.67 | * |
| Design of mechanical parts | 3.67 | 4.03 | 4.24 | 2.08 | 0.129 |
| Metallurgy | 3.67 | 3.84 | 4.09 | 2.25 | 0.109 |
| Management industry | 3.00 | 4.01 | 3.85 | 5.39 | ** |
| Moulding manufacturing process | 4.33 | 4.22 | 4.21 | 0.06 | 0.935 |
| Moulding technology | 4.00 | 4.17 | 4.15 | 0.15 | 0.861 |
| Moulding design | 4.00 | 4.18 | 4.45 | 4.07 | * |
| Production of moulding industry | 4.00 | 4.09 | 4.03 | 0.14 | 0.866 |
| The estimated price | 3.33 | 3.96 | 3.85 | 2.51 | 0.085 |
| Automatic control system (CNC) | 3.67 | 4.13 | 4.09 | 1.00 | 0.369 |
| Design drawing by computer (CAD) | 3.33 | 4.02 | 4.27 | 3.90 | * |
| Control machine with computer (CAM) | 3.33 | 4.01 | 4.27 | 4.88 | ** |
| Quality control | 3.00 | 4.04 | 4.18 | 4.13 | * |
| Metal welding | 3.33 | 3.82 | 3.52 | 3.15 | * |
| Material technical | 3.33 | 3.93 | 3.79 | 2.40 | 0.095 |
| Measurement | 4.00 | 4.05 | 4.18 | 0.73 | 0.483 |

*Significant 0.05; **significant 0.01

Table 5: Comparing need specification of professional skills in the labour force

| | Mean | | | | |
|---|---|---|---|---|---|
| Professional skills | Small | Medium | Large | F test | Sig. |
| Reading and drawing | 3.67 | 4.40 | 4.39 | 2.68 | 0.072 |
| Back up data by computer | 3.33 | 3.73 | 3.97 | 2.35 | 0.099 |
| Testing material | 3.33 | 3.86 | 3.73 | 0.94 | 0.391 |
| Technology CNC | 3.67 | 4.21 | 4.21 | 1.09 | 0.339 |
| Creat cutting tool | 3.67 | 4.01 | 3.82 | 1.37 | 0.257 |
| Creat jig ang fixture | 3.33 | 3.96 | 3.79 | 2.90 | 0.059 |
| Project in industry | 3.00 | 3.72 | 3.73 | 1.45 | 0.237 |
| Machine control | 3.67 | 3.98 | 4.12 | 1.10 | 0.333 |
| Creat mould and die | 4.00 | 4.37 | 4.21 | 1.22 | 0.298 |
| Maintenance mould and die | 3.67 | 4.29 | 4.15 | 1.96 | 0.145 |
| Measurement and test mould | 3.67 | 4.23 | 3.97 | 2.52 | 0.084 |
| Foundry operation | 3.33 | 3.62 | 3.52 | 0.32 | 0.723 |
| Math in industry | 3.33 | 3.75 | 3.75 | 0.74 | 0.475 |
| Science and applications | 3.33 | 3.53 | 3.64 | 0.57 | 0.567 |
| Mechanical strength and various calculation | 3.33 | 3.79 | 3.76 | 0.61 | 0.543 |
| Design and drawing by computer | 3.00 | 4.08 | 4.30 | 11.4 | ** |
| English | 2.67 | 3.51 | 3.36 | 2.84 | 0.062 |
| Basic bench work | 4.00 | 4.04 | 4.30 | 2.14 | 0.122 |
| Basic mechanical works | 3.67 | 3.67 | 4.18 | 1.01 | 0.367 |
| Safty and pollution control | 4.00 | 3.89 | 3.79 | 0.36 | 0.698 |
| Material technician | 3.67 | 3.97 | 4.09 | 0.80 | 0.451 |
| Metal welding | 3.67 | 3.86 | 3.42 | 4.64 | * |
| Froming for part of mould and die | 3.67 | 4.15 | 4.18 | 1.22 | 0.297 |
| Using CNC | 3.67 | 4.22 | 4.52 | 4.86 | ** |
| Mainenace mould and die | 3.67 | 4.11 | 4.09 | 0.73 | 0.482 |

*Significant 0.05; **significant 0.01

attitudes of establishments with higher mould technician knowledge, skills and attitudes that are present.

Table 6: Comparing need specification of profession attitude in the labour force

| | Mean | | | | |
|---|---|---|---|---|---|
| Professional attitude | Small | Medium | Large | F-test | Sig. |
| Intention of running | 4.33 | 4.41 | 4.73 | 4.35 | * |
| Head's success is important work | 4.33 | 4.29 | 4.58 | 3.20 | * |
| Expressed the desire to find more knowledge from different sources | 4.00 | 4.34 | 4.18 | 1.48 | 0.231 |
| The effort trying to solve real problem | 4.00 | 4.14 | 4.33 | 1.62 | 0.200 |
| Maintain mechanical equipment | .577 | .557 | .683 | 1.33 | 0.266 |
| Cleaning machine | 4.33 | 4.24 | 4.15 | 0.32 | 0.723 |
| To work regularly | 4.33 | 4.25 | 4.24 | 0.03 | 0.963 |
| A time to meet | 4.00 | 4.30 | 4.52 | 2.55 | 0.082 |
| Has integrity | 4.00 | 4.30 | 4.61 | 4.95 | ** |
| Operational duties in good faith | | | | | |
| Devoted their time to work and function | 4.00 | 4.28 | 4.36 | 0.60 | 0.547 |
| Show reaction to the ethics and practices of supervisor or foreman | 3.67 | 4.22 | 4.36 | 2.18 | 0.117 |
| Show reactions and demeanor to a colleague or underling | 3.67 | 4.25 | 4.24 | 1.93 | 0.148 |
| Working with other creative people | 4.00 | 4.30 | 4.42 | 1.19 | 0.306 |
| Advice suggestion to colleagues | 3.67 | 4.34 | 4.42 | 2.67 | 0.073 |
| Accept opinions of colleagues rationally | 3.67 | 4.33 | 4.42 | 2.88 | 0.060 |
| Follow the instructions willingly | 4.00 | 4.29 | 4.36 | 0.72 | 0.485 |
| Help help colleagues sometimes | 3.67 | 4.15 | 4.27 | 1.65 | 0.196 |
| Maintain unity in the organization | 4.00 | 4.30 | 4.39 | 0.81 | 0.447 |
| To assist organization or communities | 3.67 | 4.05 | 3.97 | 0.62 | 0.536 |

*Significant 0.05; **significant 0.01

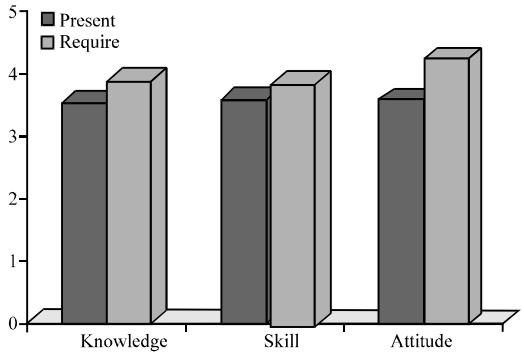


Fig. 1: Comparing comments about need specification in the labour force of the mould and die industry

**Structure of a standard vocational competency course for mould and die technicians according to level:** Table 7 shows on the structure of a standard vocational competency course for mould and die technicians showing that the: operation level consists of skill design and drawing moulds and dies, mechanical works, measurement, metal forming, improvement material, English in industry, Maths in industry and safety in industry. The expert operation level consists of skill design and drawing mould and die, mechanical works,measurement, metal forming, improvement material,

Table 7: Structure of a standard vocational competency course for mould and die technicians

| Operation levels | Expert operation levels | Management levels |
|---|---|---|
| Design and drawing mould and die | Design and drawing mould and die | Design and drawing mould and die |
| Mechanical works | Mechanical works | Higher mechanical works |
| Measurement | Measurement | Higher measurement |
| Metal forming | Metal forming | Higher metal forming |
| Improvement material | Improvement material | Material engineering |
| English in industry | English in industry | Assembly mould and die |
| Math in industry | Assembly mould and die | CNC (CAD/CAM/CAE) |
| Safety in industry | CNC mechanical works | Theory on higher mould and die |
| | Theory on higher mould and die | Higher mould and die works |
| | Higher mould and die works | Maintenance mould and die |
| | Maintenance mould and die | Planning process |
| | Planning process | Management on mould and die |

Table 8: The elements of competency found in a standard vocational competency course for mould and die technicians, as identified by experts related to the development of the personnel in moulding industry

| | | Mean±SE | | | |
|---|---|---|---|---|---|
| Competency | Elements of competency | (1st) | (2nd) | t-test | Sig. |
| Drawing mould and die | Writing numbers, letters, symbols and lines in 1st and 3rd angle projection | 4.53±0.51 | 4.60±0.50 | 35.13 | ** |
| | Using drawing tools and devices | 4.80±0.41 | 4.80±0.41 | 44.90 | ** |
| | Reading and drawing projection | 4.73±0.45 | 4.73±0.45 | 40.04 | ** |
| | Reading and drawing geometric forms | 4.80±0.41 | 4.80±0.41 | 44.90 | ** |
| | Analysis principles and practice in drawing projection | 4.86±0.35 | 4.86±0.35 | 53.56 | ** |
| | Specifying size | 4.86±0.25 | 4.93±0.35 | 53.56 | ** |
| | Reading and drawing projection from isometric | 4.80±0.41 | 4.86±0.35 | 53.56 | ** |
| | Analysis principles in drawing cross section | 4.86±0.35 | 4.86±0.51 | 36.50 | ** |
| | Texture symbols and design process | 4.86±0.51 | 4.93±0.25 | 74.00 | ** |
| | Specifying various tolerances | 4.86±0.35 | 4.86±0.35 | 53.56 | ** |
| | Specifying fits | 4.80±0.41 | 4.80±0.41 | 44.90 | ** |
| | Knowing materials table for the works | 4.73±0.59 | 4.73±0.59 | 30.88 | ** |
| | Drawing easy illustrations | 4.66±0.48 | 4.73±0.45 | 40.04 | ** |
| | Drawing part pieces from the works | 4.66±0.41 | 4.80±0.61 | 29.28 | ** |
| | Basic GD and T specification | 4.60±0.63 | 4.86±0.51 | 33.50 | ** |
| Drawing by Auto CAD | Reading and drawing projection by computer | 4.73±0.45 | 4.86±0.51 | 53.56 | ** |
| | Reading and drawing basic mould and die by computer (CAD) | 4.73±0.45 | 4.80±0.41 | 74.00 | ** |
| Basic mechanical | Drafting | 4.80±0.41 | 4.93±0.25 | 74.00 | ** |
| works | Measuring and testing | 4.73±0.51 | 4.86±0.45 | 74.00 | ** |
| | Cutting | 4.80±0.41 | 4.86±0.41 | 44.90 | ** |
| Adjusting | Adjust part of mould by filing (file) | 4.73±0.35 | 4.86±0.41 | 44.90 | ** |
| Assembling | Tolerance/assembling mould part | 4.73±0.59 | 4.73±0.45 | 53.56 | ** |
| | Fitting by spatial tool | 4.73±0.41 | 4.80±0.45 | 53.56 | ** |
| Measurement | Measuring part by venire calliper | 4.80±0.41 | 4.93±0.25 | 37.04 | ** |
| | Measuring part by micrometer | 4.80±0.41 | 4.93±0.25 | 40.04 | ** |
| | Measuring part by angular plate | 4.73±0.45 | 4.80±0.41 | 44.90 | ** |
| | Measuring part by dial indicator | 4.66±0.35 | 4.86±0.61 | 53.56 | ** |
| | Maintenance measuring tools | 4.73±0.25 | 4.86±0.61 | 74.00 | ** |
| Basic mechanical | Analysis theory on mechanical tools | 4.80±0.41 | 4.93±0.45 | 44.90 | ** |
| works | Basic usage of mechanical tools and mechanical equipment | 4.73±0.25 | 4.86±0.35 | 53.56 | ** |
| | Analysis principle and explain procedure mould process | 4.73±0.25 | 4.86±0.35 | 74.00 | ** |
| | Measuring and testing part of mould | 4.73±0.45 | 4.86±0.35 | 53.56 | ** |
| Lathe | Operation on lathe with tolerance of 0.01 mm | 4.80±0.41 | 4.66±0.48 | 37.04 | ** |
| Milling | Operation on milling with tolerance of 0.01 mm | 4.73±0.45 | 4.80±0.41 | 35.13 | ** |
| Drilling works | Operation on drilling with tolerance of 0.1 mm | 4.60±0.50 | 4.66±0.48 | 35.13 | ** |
| Grindings works | Operation on cutting works with tolerance of 0.01 mm | 4.60±0.50 | 4.60±0.50 | 44.90 | ** |
| Screwing works | Screwing works with mechanical tools | 4.66±0.48 | 4.86±0.50 | 29.28 | ** |
| | Screwing works with mechanical equipment | 4.66±0.48 | 4.66±0.48 | 44.90 | ** |
| | Screwing inside and outside | 4.60±0.72 | 4.73±0.45 | 40.04 | ** |
| Cutting tool | Cutting tool of another tool | 4.60±0.63 | 4.80±0.41 | 44.90 | ** |
| Theory on | Cutting tool for various mechanical work | 4.80±0.41 | 4.86±0.35 | 74.00 | ** |
| metal forming | Type and property of cutting tool | 4.66±0.41 | 4.73±0.45 | 53.56 | ** |
| Improvement material | Annealing process | 4.80±0.41 | 4.80±0.41 | 53.56 | ** |
| from heat treatment | Hardening process | 4.80±0.41 | 4.80±0.41 | 74.00 | ** |
| | Tempering process | 4.66±0.35 | 4.80±0.41 | 74.00 | ** |
| | Lubricant and cooled material | 4.73±0.45 | 4.73±0.45 | 33.16 | ** |
| Testing property | Testing hardness by rockwell method | 4.80±0.41 | 4.86±0.35 | 40.04 | ** |
| of part | Testing hardness by brinell method | 4.80±0.41 | 4.93±0.25 | 40.04 | ** |
| | Testing hardness by vicker method | 4.86±0.35 | 4.86±0.35 | 37.04 | ** |

Table 8: Continued

| Competency | Elements of competency | Mean±SE (1st) | Mean±SE (2nd) | t-test | Sig. |
|---|---|---|---|---|---|
| | Testing hardness by tensile | 4.73±0.45 | 4.93±0.25 | 40.04 | ** |
| Basic Math | Basic equation | 4.66±0.35 | 4.80±0.41 | 74.00 | ** |
| Calculation speed | Calculating cycle speed | 4.93±0.25 | 4.93±0.25 | 74.00 | ** |
| | Calculating cutting speed | 4.73±0.25 | 4.93±0.25 | 74.00 | ** |
| | Calculating feeding rate | 4.73±0.25 | 4.86±0.35 | 74.00 | ** |
| Applied Math | Pythagoras | 4.66±0.35 | 4.86±0.35 | 53.56 | ** |
| | Trigonometry | 4.86±0.35 | 4.93±0.25 | 53.56 | ** |
| | Ratio and axle ratio | 4.73±0.25 | 4.93±0.25 | 74.00 | ** |
| | Taper rate | 4.73±0.25 | 4.80±0.56 | 74.00 | ** |
| | System of gear belt and screw | 4.66±0.35 | 4.80±0.41 | 33.16 | ** |
| Basic English | Being able to identify basic tools | 4.53±0.45 | 4.73±0.45 | 40.04 | ** |
| | Being able to identify workpieces, tools and production process | 4.73±0.45 | 4.86±0.45 | 40.04 | ** |
| | Being able to read English manual for maintenance | 4.53±0.45 | 4.66±0.48 | 37.04 | ** |
| | Reading data from name plate of equipment | 4.73±0.45 | 4.73±0.45 | 40.04 | ** |
| Using English vocabulary | Technical terms for maintenance | 4.60±0.50 | 4.73±0.45 | 40.04 | ** |
| | Technical terms for machine | 4.60±0.50 | 4.73±0.45 | 40.04 | ** |
| Safety in factory | Using tools in working for comfort and safety | 4.73±0.45 | 4.86±0.35 | 53.56 | ** |
| | Choosing tools for individual safety in cutting tool | 4.86±0.35 | 4.86±0.35 | 53.56 | ** |
| Safety rules | Safety rules in factory | 4.73±0.25 | 4.93±0.25 | 74.00 | ** |
| | Regulations and law for labour | 4.93±0.25 | 4.93±0.25 | 74.00 | ** |

Table 9: A standard vocational competency course for mould and die technicians as identified by experts and enterprise representatives in a focus group

| Key purpose | Key role | Key function | Unit of competence | Element of competence |
|---|---|---|---|---|
| Standard vocational competency course for mould and die | Drawing mechanical works | Drawing mould and die | Drawing mould and die | Writing numbers, letters, symbols and lines in 1st and 3rd angle projection |
| | | | | Using drawing tools and devices |
| | | | | Reading and drawing projection |
| | | | | Reading and drawing geometric forms |
| | | | | Analysis principles and practice in drawing projection |
| | | | | Specifying size |
| | | | | Reading and drawing projection from isometric |
| | | | | Analysis principles in drawing cross section |
| | | | | Texture symbols and design process |
| | | | | Specifying various tolerances |
| | | | | Specifying fits |
| | | | | Knowing materials table for the works |
| | | | | Drawing easy illustrations |
| | | | | Drawing part pieces from the works |
| | | | | Basic GD and T specification |
| | | | Drawing by auto CAD | Reading and drawing projection by computer |
| | | | | Reading and drawing basic mould and die by computer (CAD) |
| | Mechanical works | Basic bench mark | Basic mechanical works | Drafting |
| | | | | Measuring and testing |
| | | | | Cutting |
| | | Fine measurement | Adjusting | Adjust part of mould by filing (file) |
| | | | Assembling | Tolerance/ assembling mould part |
| | | | | Fitting by spacial tool |
| | | Measurement | Measurement | Measuring part by vernire caliper |
| | | | | Measuring part by micrometer |
| | | | | Measuring part by angular plate |
| | | | | Measuring part by dial indicator |
| | | | | Maintenance measuring tools |
| | | Mechanical | Basic mechanical works | Analysis theory on mechanical tools |
| | | | | Basic usage of mechanical tools and mechanical equipment |
| | | | | Analysis principle and explain procedure mould process |
| | | | | Measuring and testing part of mould |
| | | | Lathe | Operation on lathe with tolerance of 0.01 mm |
| | | | Milling | Operation on milling with tolerance of 0.01 mm |

Table 9: Continued

| Key purpose | Key role | Key function | Unit of competence | Element of competence |
|---|---|---|---|---|
| | | | Drilling works | Operation on drilling with tolerance of 0.1 mm |
| | | | Grindings works | Operation on cutting works with tolerance of 0.01 mm |
| | | | Screwing works | Screwing works with mechanical tools |
| | | | | Screwing works with mechanical equipment |
| | | | | Screwing inside and outside |
| | Material | Tool | Cutting tool | Cutting tool of another tool |
| | | Metal forming | Theory on metal forming | Cutting tool for various mechanical work |
| | | | | Type and property of cutting tool |
| | | Heat treatment | Improvement material from heat treatment | Annealing process |
| | | | | Hardening process |
| | | | | Tempering process |
| | | | | Lubricant and cooled material |
| | | Material testing | Testing property of part | Testing hardness by Rockwell method |
| | | | | Testing hardness by Brinell method |
| | | | | Testing hardness by Vicker method |
| | | | | Testing hardness by tensile |
| | Math Basic Math | Basic Math | | Basic equation |
| | Mechanical Math | Calculation speed | | Calculating cycle speed |
| | | | | Calculating cutting speed |
| | | | | Calculating feeding rate |
| | | | Applied Math | Pythagoras |
| | | | | Trigonometry |
| | | | | Ratio and axle ratio |
| | | | | Taper rate |
| | | | | System of gear belt and screw |
| | English | General English | Basic English | Being able to call basic tools |
| | | | | Being able to call workpiece, tools and production process |
| | | | | Being able to read English manual for maintenance |
| | | | | Reading data from name plate of equipment |
| | | | Using English vocabulary | Technical terms for maintenance |
| | | | | Technical terms for machine |
| | Safety | General safety | Safety in factory | Using tools in working for comfort and safety |
| | | | | Choosing tools for individual safety in cutting tool |
| | | | Safety rules | Safety rules in factory |
| | | | | Regulations and law for labour |

English in industry, assembly of mould and die, CNC mechanical works, theory on higher mould and die, higher mould and die works, maintenance mould and die and planning process.

The management level consists of skill design and drawing mould and die, higher mechanical works, higher measurement, higher metal forming, material engineering, assembly mould and die, CNC (CAD/CAM/CAE), higher mould and die works, maintenance mould and management on mould and die.

**Elements of competence in a standard vocational competency course for mould and die technicians:** Table 8 compare standard vocational competency course for mould and die technicians from experts related to the development of the personnel in moulding industry 1st and 2nd time. Result are significant 0.01 every subject and mean average 2nd time above mean average 1st time.

**Experts in the mould and die industry as well as enterprise representatives examine a standard vocational competency course for mould and die technicians:** Table 9 shows the skills for mould technician at the operation level consist of reading and drawing mechanical works, fine measurement, adjusting and assembling, mechanical works (lathe, milling, drilling, grinding and screwing), technical materials, metal forming, Mathematics in industry, English and safety in factory.

Skills for the expert operation level consists of industrial materials, mechanical drawing , metal shaping, advance mechanical in mould, design moulding, mechanical work by CNC, fine measuring, mould and die theory, mechanical work, maintenance mould, adjust and assembly mould, planning in process and technical English.

Skills for the management level consist of materials of engineering, advance mould and die theory, advance mechanical in mould, design moulding, adjust and assembly mould, advance fine measuring, advance metal

shaping, management in mould and die factory, simulation by CNC (CAD/CAM/CAE) and maintenance of moulds.

## CONCLUSION

According to the study, competencies required by personnel in the mould and die industry can be divided into three levels: moulding operators, moulding experts and moulding management. The item objective congruence or IOC for all three levels was high as the value was >80%. The reason for this was that the course competencies were defined by the enterprises themselves. The item objective congruence can be used to define standard vocational competency courses for the mould and die industry by the following steps: defining key purpose, defining key role, defining key function, defining unit of competence and defining element of competence.

The details come down to the elements of competence for different operator levels, starting with the standard operator who must be competent in reading and drawing mechanical works, fine measurement, adjusting and assembling, mechanical works (lathe, milling, drilling, grinding and screwing), technical materials, metal forming, Mathematics in industry, English and safety in factory. An expert operator level however, must be competent in using industrial materials, mechanical drawing, metal shaping, advanced mechanics in moulds, design moulding, mechanical work by CNC, fine measuring, mould and die theory, mechanical work, maintenance mould, adjust and assembly mould, planning in process and understanding technical English. The management levels standard competencies look like this: understanding the materials of engineering, knowledge of advanced mould and die theory as well as advanced mechanics of mould, design moulding, adjust and assembly mould, advance fine measuring, advance metal shaping, management in mould and die factory, simulation by CNC (CAD/CAM/CAE) and the maintenance of moulds.

As for analysis by Delphi technique, it was found that experts, educational institute representatives, related mould personnel development institute representatives and enterprise representatives agreed that the difference was that it was higher for second time. Most medians were at agree-the-most level. Most interquartile ranges were different byone only. Further, suggestions are that the course should be used to develop a plan for training mould and die technicians in enterprise and that the difference of competency between the people who attended this course and the technicians in enterprises is evident.

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The results of this study can be used as a guide in curriculum development of training courses for mould and die personnel. The needs of the industry help define the competency based curriculum including all learning packages and modules/training packages. Most of these courses run at a development level (training personnel from scratch) instead of using existing knowledge and experience (Recognition Prior Learning: RPL). They allow workers to develop their skills in a professional qualifications system and these qualifications allow learners to make global industry and educational connections. Former unemployed graduates can find useful employment and generate income for themselves and society, lessening their burden on the community. Personnel already working within the mould and die industry at a management level can also learn to meet the needs of the workplace by improving training standards. Then the entire workforce will be able to operate more efficiently and effectively as all well trained personnel will have the confidence to seek more knowledge, will appreciate their work and will have a higher degree of job satisfaction as they ascertain a higher compensation for their improved development. The benefits of a well trained workforce are also culminative and generational as personnel will help transfer their knowledge and life experience to future mould technicians via the educational system that provides the industry with its professional qualifications.

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