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# Manufacturing Insights Skills Training®

-Innovative Technical Learning Module to Develop High Performance Workers-

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## ABSTRACT

Malaysia has been ranked as the world's top manufacturing location in the new suitability index by Cushman and Wakefield. The manufacturing sector in Malaysia has created many employment opportunities and requires a constant supply of competitive manpower to achieve a sustainable business growth. Consequently, Malaysians can expect an abundance of career prospects from the many technical departments in the manufacturing industry provided that they have the right skills, attitude and qualifications. Unfortunately, many graduates and existing workers are lacking in the required technical knowledge and skills in meeting the industry demands. In reality, hundreds of thousands of graduates remain unemployed because they lack certain skills that employers are looking for. Mismatch between the skills and knowledge obtained by students and qualification required by the industry is the main cause for today's graduates' unemployment. Industry practitioners often urged local higher learning institutions to review their curriculum in order to produce graduates who can meet the industry needs; whereas academicians argue that it is a misconception that it is a university's responsibility to prepare graduates to plunge into the working world. Engineering students and existing technical workforce are urged to look for LLL program in engineering and technical topics in order to improve their job skills. The proposed Manufacturing Insights Skills Training (MIST) is an innovative technical soft skills learning module for the higher learning institutions and the industry to adapt into their LLL system. MIST will focus on the study of various manufacturing variables (including process and materials understanding) and how they can impact the manufacturing quality and productivity. The objective of MIST is to improve employability skills and to develop high performance technical workforce in order to alleviate some of the dilemmas faced by the many stakeholders.

**Keywords:** Manufacturing industry; graduates unemployment; manufacturing insights skills training; technical soft skills; high performance technical workforce

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## 1: INTRODUCTION

Malaysia enjoyed a steady economic growth from being an agriculture-based economy in 1970s to industrial-based economy in 1980s. The manufacturing sector in Malaysia has created many employment opportunities and requires a constant supply of competitive manpower to achieve a sustainable business growth. As long as there is a new product to launch, industrial activities such as metal stamping, plastic moulding, die casting, tools and dies making will never phase out. It is a prerequisite process to produce and supply parts, as well as components used to assemble vehicles, telecommunication, electrical and electronics, computers, health care products and infrastructures (Hooi, 2016).

Today, manufacturing industry is no doubt a key player in the nation's economy. According to Binks (2014), Malaysia has been ranked as the world's top manufacturing location in the new suitability index. The importance of the manufacturing sector to the economy is evidenced in its contribution to the gross domestic product (GDP), external trade and job creation, as shown in Table 1.

Table 1: Major Indicators of the Manufacturing Sector, 2010-2020

| **Indicator** | **2010** | **2015** | **2020** | **10th Plan Achieved** | **11th Plan Target** |
|---|---|---|---|---|---|
| Contribution of manufacturing sector to GDP (RM billion in 2010 prices) | 192.5 | 243.9 | 312.5 | 1,110.9 | 1,417.3 |
| Annual Growth Rate (%) | 12.1 | 4.7 | 4.4 | | |
| Share to GDP (%) | 23.4 | 23.0 | 22.1 | 23.1 | 22.5 |
| Total exports of manufactured goods (RM billion in current prices) | 489.6 | 636.7 | 812.8 | 2,801.3 | 3,677.9 |
| Share to Total Export (%) | 76.6 | 81.8 | 83.4 | 76.4 | 82.8 |
| | | | | **Average Annual Growth Rate (%)** | |
| Share to Total Employment (%) | 17.0 | 18.0 | 18.2 | 3.9 | 2.5 |

*Note: 2015 numbers are estimated and 2020 numbers are forecasted*

*Source: Economic Planning Unit and Department of Statistics Malaysia*

However, the share of Malaysia's manufacturing exports in the world market is declining, facing stiff competition from emerging economies, particularly in the electrical and electronics (E&E) subsector. The manufacturing sector has not evolved to respond to changing global demands, producing products that are also manufactured by many other countries. In the 11th Malaysia Plan 2016-2020, strategies will be introduced to chart a new direction for the manufacturing sector to produce high value, diverse and complex products. Focus will shift from quantity to quality and broad-based incentives to performance-based incentives (Economic Planning Unit, Prime Minister's Department, 2015).

Statistics also showed that the composition of the exports are changing from primarily raw materials to manufactured goods, indicating a move towards more complex products. The shift towards producing higher value and more complex products requires skilled, creative and innovative personnel with technological knowledge to constantly improve products and processes. However, in reality manufacturers face difficulties in hiring skilled and specialised worker. More than 40% of firms reported vacancies for skilled production workers due to a lack of talent with the required soft skills and relevant technical skills.

While firms are unable to attract local talents due to the relatively lower remuneration offered, local workers continue to demand higher pay because of inflation. Hence, local manufacturers can no longer produce cheap products without having low production cost. As Malaysia gears up to transform its production-based economy to knowledge-based economy, there are an abundant of career advancement prospects for engineering graduates in the manufacturing industry. A high performance knowledgeable-workforce (K-workforce) is thus considered to be the most important factor for future success in achieving our economic transformation plan.

## 2: MANUFACTURING INDUSTRY IN MALAYSIA

The manufacturing sector is a long established industry in the country but the labour intensive, high reject rate, low yield, poor technical level and the lack of research and development lie behind the seemingly mutual facade of this field. Manufacturers and their employees should learn to work smarter rather than harder, otherwise in years to come they can

best be assembler. The sluggish technological advancement of the manufacturing sector will definitely affect the advancement of other National Key Economic Areas (Economic transformation programme, 2010).

To sustain the economic growth and compete in the global market, manufacturing industry requires a constant and adequate supply of manpower that is competitive and highly skilled. Ironically, there is a growing trend for our manufacturers to hire foreigners to fill up technical positions, such as technicians, machinists, foremen, supervisors, designers and engineers in addition to the already un-checkable large pool of low qualification operators.

Manufacturers need to produce profitable advanced goods rather than low price consumer goods. The traditional 3R – Reject, Rework and Replace manufacturing culture needs to be changed into the more technological based of advanced 3R – Research, Review and Reengineer to ensure high income careers and profitable operations.

Manufacturers are generally concerned about quality and productivity. They preferred to hire staffs who can contribute to their manufacturing quality and productivity improvement, as well as company growth. Unfortunately, in recent years graduates and existing workers are lacking in the required technical knowledge and skills to meet the industry demands. The industry believes that local universities have a mission to develop quality human capital and competent workforce to fill up the many technical vacancies. Employers often urged local teaching institutes to review their curriculum in order to produce graduates who can meet the industry requirement.

It is understandable that many employers are reluctant to spend extra money to train their employees for basic skills which could be a cost burden especially during economic downturn. Many companies seem great at running their business but they may not be necessarily good at training their staffs. In order to develop K-workforce, many of them hired professional training services from industry-training providers to provide employees' re-skilling and up-skilling to keep up with human resources needs in the industries.

## 3: EDUCATION INSTITUTIONS IN MALAYSIA

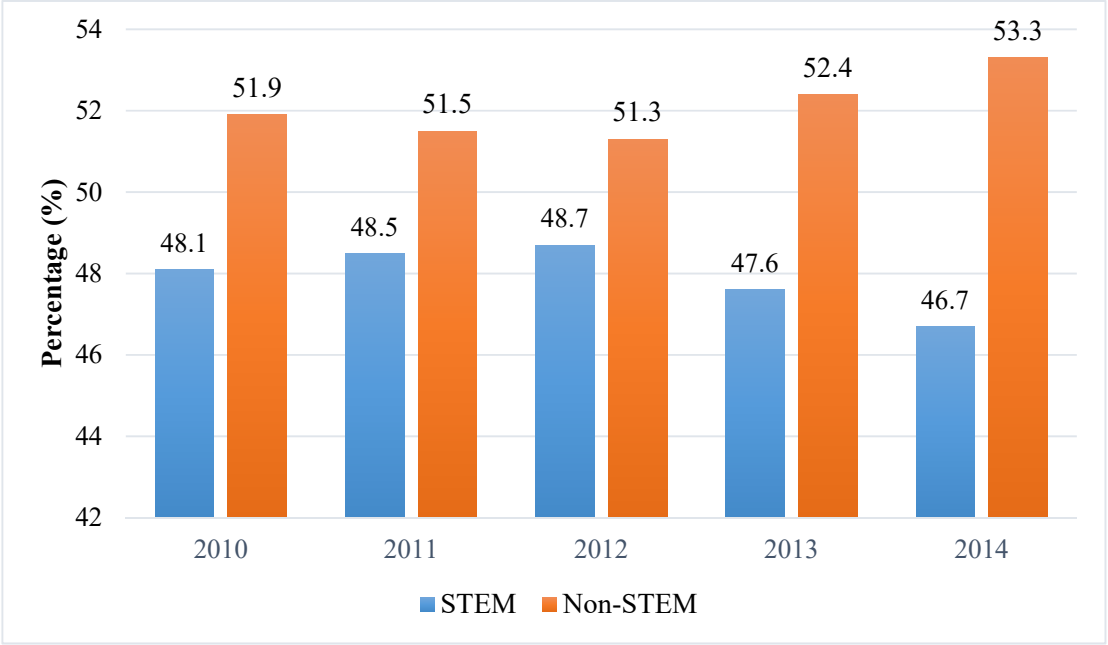
Higher Education Institutions (HEIs) play a very important role in producing good quality workforce for the industry while the industry makes full use of these products to become more competitive in the local and foreign market.

Many universities are not producing "work ready" graduates because the country's education system is too exam-oriented. In recent years, many companies do not trust new graduates, who may have learned mountains of theories but lack of applicability. In addition, there are also universities that offer courses that are not as relevant to the industry.

An economy based on creativity and innovation needs technical human resources with strong foundation in mathematics and sciences. There are plenty of technical careers available offered by the manufacturing industry who is using science and technology to produce technical products. The increase in the number of STEM (Science, Technology, Engineering and Mathematics) students and engineering graduates is paramount to meet the nation's need for technical workforce who can implement and maintain the many economic development projects.

Malaysia had set a target ratio of 60:40 science-to-non-science students at the Upper Secondary School level but instead of coming closer to that "ideal" ratio, the country is drifting further away from its target, as shown in Figure 1. According to the Academy of Sciences Malaysia (2015), science is not appealing to students due to a theoretical teaching approach that is textbook-based and examination-oriented. Without the large number of science students, there will surely be a corresponding limitation in the ability of universities to produce the number of engineering graduates needed.

Figure 1: Percentage of Students enrolled in STEM and non-STEM streams in National Schools




*Source: Education Ministry*

With waning interest in STEM among school children, Malaysia may have to turn to foreign workers to achieve Vision 2020. The situation will get worse if nothing is done to spark interest in the sciences at school level soon.

Local secondary schools and HEIs have to seriously analyse and review their curriculum and introduce LLL subjects that are relevant to the industry needs and produce both marketable programs and graduates. The curriculum of the institutions of higher learning should be developed in accordance with the development of technology.

The delivery of science and technical subjects also needs improvement. It is important for the educators to focus on applicability. Students are memorizing theories rather than exploring and getting to know new information on the latest happenings in the industry related to their courses. They focus more on theoretical knowledge compared to hands-on experience. It is essential to study the theories but relating the theory to the actual practical work is much more important.

On the another hand, majority of the lecturers teaching engineering subjects at local HEIs are lacking of industrial exposure which has resulted in limited focus on manufacturing issues in their formal education curricula and cause inadequate understanding and appreciation of technical science among students and graduates. Education institutions should establish smart partnerships with industry-training providers in search for improved learning approaches that will complement their existing syllabus and attract students, as well as provide a superior blended LLL process.

Academic qualified industry practitioners with a wealth of teaching experience along with strong industrial background will be more effective to present various engineering theory & subjects in terms of industry applications. Trainers from the industry can give the students insights on issues within the industry that need to be tackled. This will train graduates and students to have a strong fundamental and applied engineering knowledge, as well as make the purpose and meaning of technical science learning become transparent and more interesting.

Industry talks and carefully planned industry training subjects instructed by qualified industry trainers can help to bridge the gap between the principle knowledge study and industrial practice. Such industrial skills LLL activity also provide platform in bringing the industry practitioners into academic learning institutes & enhancing the industry network building.

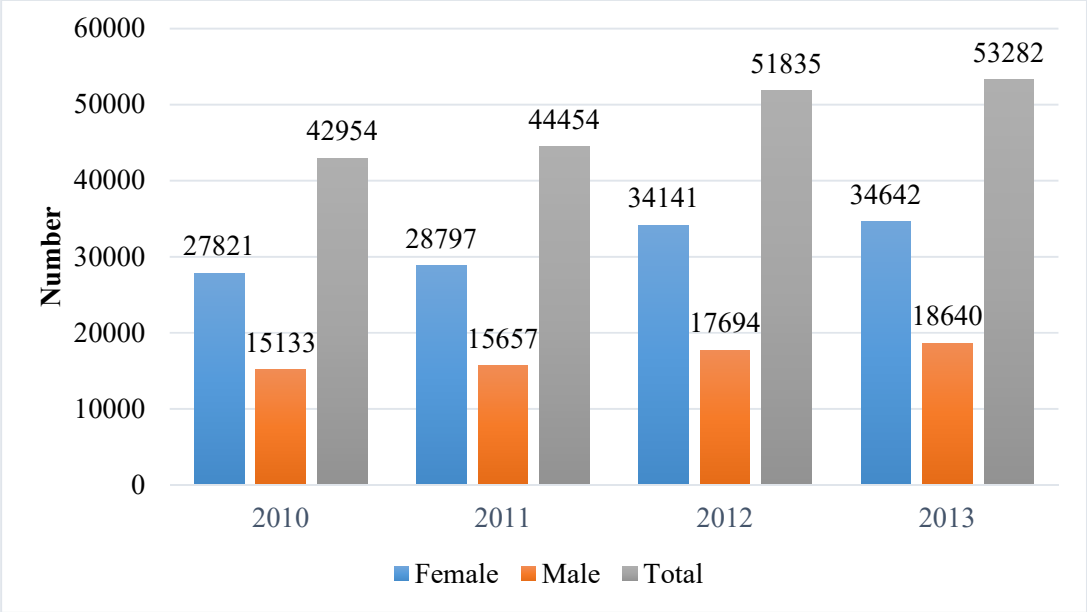
Turning the industry into classroom learning should be emphasised by HEIs in their curriculum transformation process. This move would also be in line with the key aims of Malaysia's Education Blueprint (Ministry of Education Malaysia, 2015) and will enable students to immerse in the real world environment much earlier.

## 4: GRADUATES AND UNEMPLOYMENT

The number of unemployed graduates from local universities is appalling. According to statistics as announced by the former Minister in the Prime Minister's Department Datuk Seri Abdul Wahid Omar on 12 May 2015, there are 161,000 graduates among the 400,000 unemployed in Malaysia ("Graduates among 400,000 currently unemployed," 2015).

Close to 50,000 university graduates end up unemployed yearly, revealed by the current Human Resources Minister Datuk Seri Richard Riot Jaem ("50,000 Malaysian grads flood the job market," 2015). Between 2010 and 2013, unemployed female graduates outnumbered their male counterparts. Statistics show that female graduates have less chances of being employed as compared to the male graduates, as shown in *Figure 2*. The large pool of unemployed graduates represents a wasteful investment of scarce resources. With a flood of fresh graduates, individuals are having a tough time finding jobs in an increasingly competitive labour market.

Figure 2: Number of Unemployed Graduates between 2010-2013




*Source: Ministry of Human Resources*

The mismatch between skills and knowledge obtained by students and qualification required by the industry is the main cause for today's graduate unemployment. The criteria used by today's HR practitioners to interview and hire fresh graduates in the order of priority are character, communication skills, working knowledge, job experience and educational qualifications. Employers will not bother to ask about the last two if graduates fail in the first three criteria as it serves no purpose to look at their certificates.

English proficiency has been an issue of concern for unemployed graduates in the past decade and is far from being solved. In fact, it does not look like it will be solved any time soon.

It is interesting to note that although English proficiency and positive work attitude are important, staying current on industrial issues and acquiring useful applied technical knowledge are more crucial to engineering fresh graduates. The services sector, in particular, might require employees who possess the right soft skills such as communication and interpersonal skills. While for the manufacturing sector, manufacturers are more concerned about applicants with technical competencies to improve manufacturing quality and productivity.

A lot of graduates are jobless owing to their poor attitude. Employers are turned off by their application due to the lackadaisical attitude and lack of drive to improve. Many undergraduates' lifestyles are centred on entertainment, mixing with a tiny circle of friends and cocooned in a world of their own. They should seek opportunity to engage with people of varied background and diverse experiences, participating in extra-curricular activities, attending useful LLL courses, networking with the industry, develop critical thinking, discussing and debating their assignments and improving their interpersonal skills. Otherwise, upon graduation, they swell the ranks of the unemployed and under-employed graduates. Instead of becoming independent and productive citizens, they need further nursing from the Government. In addition, the lack of work ethics among youths also lead to a low drive to achieve success, and low team spirit and work preparedness.

In today's global economy, a post graduate degree is no longer a wish-to-have but need-to-have (Sobri, 2015). Graduates must realise as more people come to possess higher education degrees, they must attempt to add value to their primary academic credentials to distinguish themselves from others with similar degrees in a competitive labour market.

Good training programs, including external courses, are vital in acquiring useful employability skills and in improving job performance efficiency. Having relevant employability skills can help graduates to get a job. They can also help them stay in a job and work their way to the top.

University students should graduate with a diploma or degree and an additional "higher-order thinking skills" based on the listed employability skills (Robinson, 2000), as shown in *Table 2*, which will give them an edge in the job market.

Table 2: The Three Skills Set of Employability Skills

| Basic Academic Skills | Higher-Order Thinking Skills | Personal Qualities | |
|---|---|---|---|
| • Reading<br>• Writing<br>• Science<br>• Math<br>• Oral Communication<br>• Listening | • Learning<br>• Reasoning<br>• Thinking Creatively<br>• Decision making<br>• Problem Solving | • Responsible<br>• Self Confidence<br>• Self Control<br>• Social Skills<br>• Honest<br>• Have Integrity<br>• Adaptable and Flexible | • Team Spirit<br>• Punctual and Efficient<br>• Self Directed<br>• Good Work Attitude<br>• Well Groomed<br>• Cooperative<br>• Self Motivated<br>• Self Management |

*Source: Dr. Jacquelyn P. Robinson, Community Workforce Development Specialist, Alabama*

The academic chase is not about getting a diploma or a degree. Graduates cannot be assessed solely on academic excellence or achievement. Many graduates cannot perform, contrary to the paper qualification they have. Our (examination-oriented) education system must produce problem-solvers of the highest quality. With the right skills, attitude and qualifications, graduates can find jobs and retain employment in the manufacturing sector.

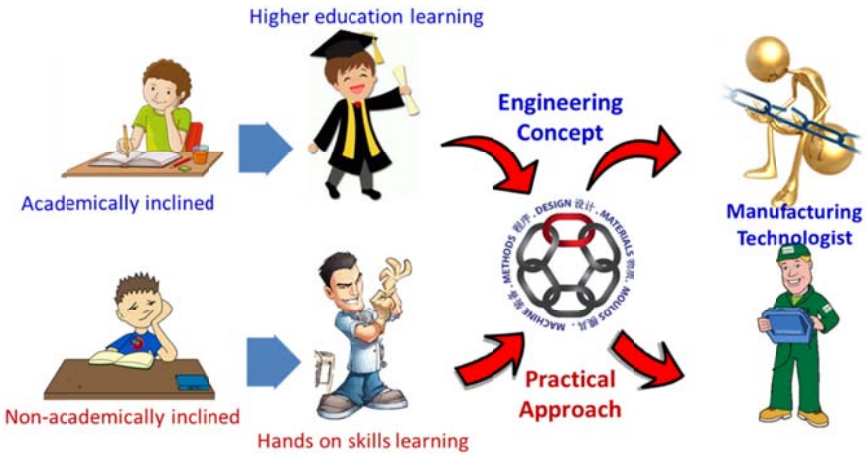
## 5: TECHNICAL VOCATIONAL EDUCATION AND TRAINING (TVET)

Initiatives under the 11$^{th}$ Malaysia Plan (2016-2020) are projected to generate approximately 1.5 million new jobs by 2020, of which 60% needs TVET-related skills (Economic Planning Unit, Prime Minister's Department, 2015). The 11 MP aim is to push the proportion of skilled jobs from the current 28% of employment to 35% by 2020. TVET is a cornerstone of these efforts and is being highlighted intensively lately. TVET graduates are highly employable but not necessary high-income earners unless they have the advanced knowledge, skills and attitudes that employers look for. A typical student turns to TVET only as a last resort (*see Figure 3 below*).

The statement of local TVET graduates can earn much more than university graduates is arguable. It is no doubt that TVET can be a springboard to entrepreneurship and high growth sector. However, the reality is TVET graduates most often not end up as tradesmen who try to earn more income as compared to desk-or-factory-bound jobs. A study by recruitment firm

Randstad showed that young Malaysians prefer stable job security over flexibility ("Young Malaysians prefer security over flexibility," 2016). The preference for a more traditional workplace could stem from the actual Malaysian economic outlook that made our millennials more concerned about securing and retaining a job rather than worrying about benefits such as flexible work schedules as a tradesman or entrepreneur.

Figure 3: TVET & Higher Education + MIST Learning




*Source: Metalloy Consultant Services PLT*

It should be known that majority of TVET graduates are diploma holders and are working as technicians in the manufacturing industry. Their pay has remained low and unchanged much over the past decade. By contrast, it is only logical for technical employees to prove their worth with extra cutting edge skills before asking for a higher pay from their employers. A hands-on TVET graduate who knows how to run a CNC-EDM machining can only produce the "shape" of a tool. On the contrary, an experienced machinist with metallurgical know-how is regarded as a high performance worker who can produce both the "shape" and the "property" of a desired tool, and this type of worker surely deserves a higher pay.

The increase in TVET student intakes at this stage is only to fill up the quantity needed by the industry but the quality level has yet to be confirmed. A high performance technical worker with multi-disciplinary who can help to raise the manufacturing quality and productivity certainly deserves a higher pay. TVET graduates must know that their TVET qualification should not be viewed as an end in itself, or as a pass just to secure a high paying job. They can

claim further success if they can acquire additional technical competency in order to upgrade their technician level to become assistant engineer or other specialist positions.

## 6: HUMAN CAPITAL DEVELOPMENT PROGRAMMEMES

As students and graduates are prepared for the workplace, the skills of existing workers should also be refreshed. For the past, graduates' lack of required working knowledge and skills in meeting the industrial needs has been constantly debated. The same criticism is not exempted from a substantial number of existing employees. There is a constant demand for new skills, hence both future and existing workers need to be retrained and re-educated to acquire such skills. The Malaysian government has a practical channel for employers to train and retrain their workers through the Human Resources Development Fund (HRDF) launched in 1993 by the Ministry of Human Resources.

Certain ministries have drawn up special programmes to enhanced human capital development plan. For the past, millions have been spent in attempt to retrain unemployed graduates and workers but the effectiveness seems disheartening. Various factors could have contributed to this situation, such as improper training programmes, poor trainers, inadequate delivery system or even trainees' inability to absorb new knowledge.

Advancements in science and technology have resulted in shorter product cycles, emergence of newer and more advanced engineering materials and sophisticated material processing techniques. All of these are forcing manufacturers to seek for diverse workers who are multi-skilled. To improve the competency of existing and future workers, there is a need to come up with teaching models that are practical and useful.

Manufacturing industry (MNCs or SMEs) are looking for technical workforce that comes with basic skills (formal education knowledge relevant to the vacancy) and armed with specialised skills and competencies (applicable working knowledge) in order to be ready for the job and provide immediate contribution to the manufacturing quality and productivity improvement. To them, soft skills such as personal quality and communication skills should have been done during the students' tertiary education. On the other hand, employers feel that English proficiency is not a top priority for entry-level technical employees. To them, language

proficiency can be catch up later while working as employees are given more opportunities to communicate with their peers. It is not even an “issue” should the working environment practise a common local language among the workers.

Essentially all technical employees (including engineers, supervisors and technicians) want to perform a good job, but most have never received the skills and confidence building tools necessary to do so. Employers must realise that HR development is a long term capital investment programme. Investing in continuous professional training demonstrates a commitment to the staffs. This will help to enhance company loyalty and morale, as well as reduce staff turnover. A commitment to develop employees’ competence is also an impressive selling point for both current and future customers.

Many technical employees and engineering graduates are lacking of critical skills in solving manufacturing problems. One ought to know that quality control may be able to point out a defect but to solve the problem it is vital to retreat back to the basic with a solid technical know-how. This allows employees to find the root cause, suggest solutions, test it out, monitor the results and finally to resolve the problem forever. Profitable operation can only be achieved with less rejects but not frequently fixing the rejects (*See Figure 4 below*). In addition, without the strong fundamentals of science know-how, it is impossible to conduct R&D projects for product and process improvement.

Figure 4: Problem Solving Techniques


*Source: Metalloy Consultant Services PLT*

At the same time, an ideal training programme should not tie up the trainees for too long to achieve its outcomes. Short-term LLL courses (1 day to 3 months) are ideal for target audience who have the time and financial constraints to attend the training. It should be noted that most graduates worry not only about their future employment but financial support as well; while employers cannot allow their technical personnel to be away for too long to receive training as they worry the production will be interrupted. Long duration training programme will exhaust the stakeholders financially, physically and mentally.

Engineering students, graduates and existing technical workers are urged to look for technical training programme for continuous upskilling to improve their employability and job performance.

## 7: TECHNICAL SOFT SKILLS TRAINING COURSES

Technical short courses have not received similar popularity in Malaysia as compared with non-technical short courses. According to surveys, most of the soft skills training are inclined towards providing management, finance, IT, personality development, strategic planning and marketing skills. Such situation limits the scope of capability of trainees as they are mostly trained in managing people, things or process. These trainings do not teach them to become skilled in creating, designing, improving, manufacturing and troubleshooting products and technology with the most effective manner. This scenario reveals that there is a void in our present education and training system as it shows fewer “technical soft skills” courses; shortage of competent technical trainers, and lack of interest and awareness from industry and participants.

The general perception of “soft skills” programme refers to personal quality developing programme while “hard skills” programme means job skills training course. Soft skills are more subjective. They include personality-driven skills like etiquette, getting along with others, and patience. These skills are more difficult for an employer or professor to teach, and are harder to measure. A hard skill is one that can be easily measured or quantified. They are often learnt on the job or through education and training. Hard skills are especially important in knowledge-based fields, such as medicine and engineering. A hard skill for technical personnel in a

manufacturing factory, for example, would include working knowledge of process and materials understanding.

More precisely, technical skills can be categorized into “Technical Hard skills” and “Technical Soft skills”. “Technical Hard Skills” refer to hands-on job skills while “Technical Soft Skills” refer to the in-depth technical studies which teach learners the ability to apply science to reason a technical problem in different production scenarios and subsequently to suggest proper technical solutions for solving the problem (see *page 21*).

While “Technical Hard Skills” hands-on training courses are available at many technical institutions as well as in industry apprenticeship scheme, industry trainer-led “Technical Soft Skills” LLL programmes are very much restricted and should be introduced and promoted to train students, unemployed graduates and existing workers as future high performance workers. An effective short term technical soft skills course is of great help even for graduates from humanities-based courses to apply for technical posts in the industry. Industry-training providers and qualified industry trainer with industrial background will be useful and effective to fill up the vacuum in technical short courses development and delivery.

Today’s economy meant getting multiple jobs and on-going development to build transferable skills and competencies. HR personnel from both education institutions and the industry must reconsider the relevance of the programme offered. The challenge is to prepare future and existing workers with enough competencies, skills and flexibility.

In a real working world, employees are often assigned to a specific task & tends to overlook other manufacturing factors which are outside their responsibilities. Often, many of these preceding and external factors can give direct or indirect impact on the product quality and productivity issues. Technical personnel must first understand the associated factors and how they affect the process in order to process with confidence. A highly trained multi-skilled and multi-discipline technical staff can tackle the quality and productivity problems in a more efficient and controllable manner. Technical soft skills training programmes to develop know-how in all these manufacturing variables are invaluable working skills. This is perhaps a missing link study for manufacturing improvement and a very much sought after job skills to develop high performance technical workers.

## 8: MANUFACTURING INSIGHTS SKILLS TRAINING

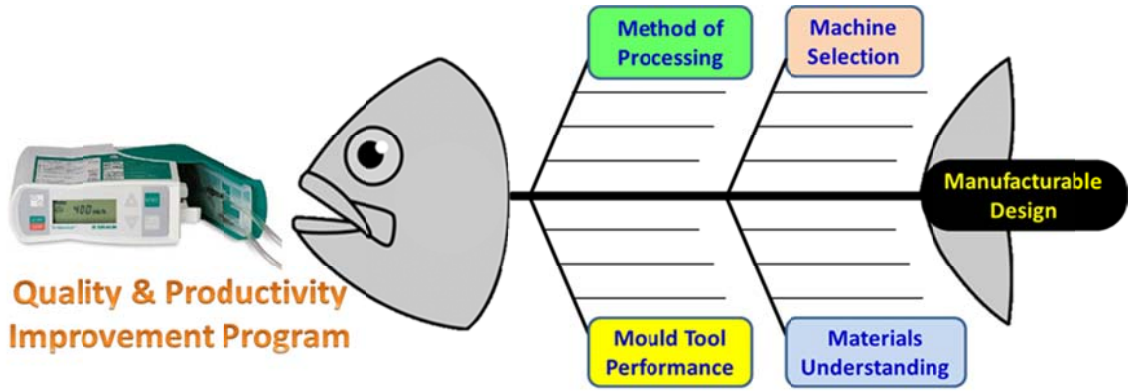
Today's manufacturing technology has become highly sophisticated and should be regarded as science but not magic in order to maintain consistency. For the past, we have seen many training institutions offering hands-on or technical hard skills training courses but with limited focus on applied engineering theory to explain the scientific reasoning of ″what″, ″why″ and ″how″ of a manufacturing issue. Such situation limits the scope of trainees' capabilities as they are mainly trained in learning and reading technical drawing, operating machinery and using tools, running a production process, maintaining equipment and measuring quality. The proposed MIST course is to upgrade the trainees to become technically inclined in order to be able to create, design, improve, manufacture and troubleshoot products and technology based on scientific principles and proper engineering procedures.

Many manufacturing issues can be linked to design problems, inappropriate materials selection, poor machines understanding, inferior moulds tool performance, incorrect processing control and incompatible supporting equipment. Each of these factors can affect employers, customers and suppliers' products quality and also their business profitability. The fact is profitable manufacturing relies on competent workforce with a sound knowledge in **M**aterials; **M**achine; **M**ould; **M**ethods and **M**anufacturable Design *(the* **5M** *variables as shown in Figure 6 below)* in order to troubleshoot quality and productivity issues. MIST will impart this valuable & practical 5M knowledge and train the trainees (existing and future technical workforce) to become multi-skilled and multi-discipline technical staffs who can solve complicated manufacturing problems in a more efficient and controllable manner.

MIST offers applied engineering theory to give a solid understanding of the hows and whys of many engineering practices in order to bridge the gap between technical hard skills and soft skills learning. This will introduce science and engineering procedures to the manufacturing process by removing the uncertainties and hence be able to provide a consistent and repeatable production result. High performance employees with strong theoretical foundation will be able to explain logical reasoning on a manufacturing issue rather than depending on guesswork. Certainly in a real production world there are inherent variations and constraints found in the manufacturing process which can limit the theoretical perfection, but many have shown that

higher quality levels can be attained by those willing to put engineering principles into the effort to improve quality.

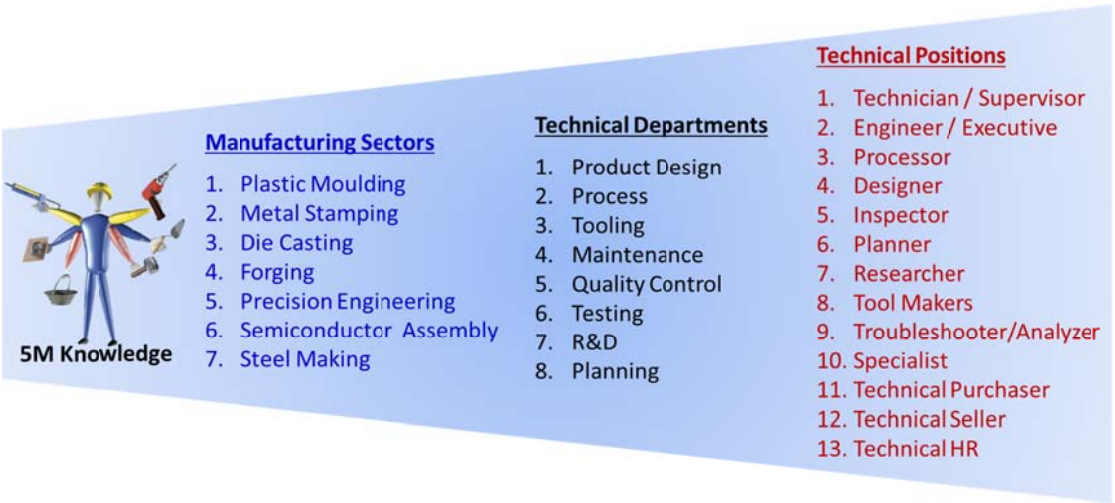
Figure 6: 5M Technical Soft Skills Training




*Source: Metalloy Consultant Services PLT*

MIST participants armed with this 5M knowledge will be provided with a vast choice of technical employment in various sectors and departments, as shown in Figure 7 below.

Figure 7: Technical Employment Opportunities for MIST Trainees




*Source: Metalloy Consultant Services PLT*

The proposed MIST modules will combine the vast working experiences from a group of industry practitioners to present current and relevant technical topics to the trainees. In the

limelight of high technology development, MIST offers a missing link study in manufacturing improvement to provide our technical workforce an important working knowledge and higher order thinking skills.

MIST modules present a new approach of technical learning by linking the various engineering disciplines with industrial use. It is an innovative and effective technical human capital development programme to benefit the trainees, education institutions, the manufacturing industry, and the nation who will be gearing to become an industrialised and technological society in the near future. Some of the benefits of MIST include:

**For the trainees:**

1. Develop and strengthen pre-industry technical competency.
2. Acquire important and long lasting working knowledge (5M) to enhance employability and for future career advancement.
3. Train to be multi-skilled and multi-disciplinary technical personnel.
4. Network with peers in manufacturing industry.

**For the education institutions:**

1. Provide ″Missing Link Study″ in various engineering subjects to complement existing formal education syllabus.
2. Produce confident and marketable graduates.
3. Create awareness and interest in STEM learning.
4. Utilize existing expertise and facilities to generate income for institutions.

**For the manufacturing industry:**

1. Address manufacturing issues that concern manufacturers.
2. Prepare high performance technical workforce for manufacturing improvement.
3. Encourage technical details study to perform effective troubleshooting and R&D tasks.
4. Introduce science and engineering procedures to existing manufacturing practices for sustainable growth.

**For the nation:**

1. Train knowledgeable workforces to support country's vision of becoming an industrialized and technological society.
2. In line with Government's policy for industry-academy partnership programme.
3. Promote country's image by expanding it as cross countries and multilevel interaction education and training project**.**
4. It's a truly RAKYAT project that benefits many stakeholders.

## 9: CONCLUSION

Manufacturing industry plays a vital role in export promotion and as an engine of growth. It is not surprising that this sector can provide ample of job opportunities. To sustain the industry and economic growth, it is important to develop a knowledge-based economy rather than a labour intensive economy. Universities must review their education system and produce marketable graduates to meet the industry needs. Smart partnerships between higher education institutions and industry-training providers can impart the higher-order thinking skills among engineering students with greater pre-industry technical competency. For technical employment, English proficiency is not a major constraint but applicants must possess appropriate job skills to perform product quality and productivity improvement in the manufacturing industry. Students, unemployed graduates and existing technical workforce are urged to look for LLL programme in engineering and technical topics in order to polish up their working knowledge for better employability and higher pay of technical employment. Technical "soft skills" training emphasizes on engineering materials and process understanding is a missing link study for manufacturing improvement and a critical skill to develop high performance technical workers. The unique learning module of MIST offers industry-led technical soft skills training topics that are current and relevant to the manufacturing industry. Mastering the 5M knowledge through MIST study will train the trainees to become more agile with a solid understanding of how the engineering and science works and using these skills to solve problems and fit into various positions in a manufacturing environment. The Malaysian government, industry and education institutions should adopt MIST programme in their education and training syllabus to promote technical soft skills training for existing employees, engineering and TVET graduates.

## 10: ACKNOWLEDGEMENT

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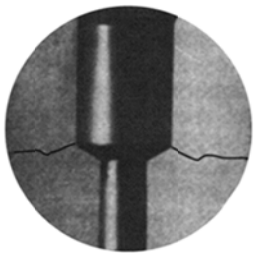
Appendix 1: Case Stories for Technical Hard Skills vs Technical Soft Skills

***Case1:*** A tool maker struggled to produce quality tools despite having invested multi-million machining equipment. The premature tool failure was due to poor heat treating practice.

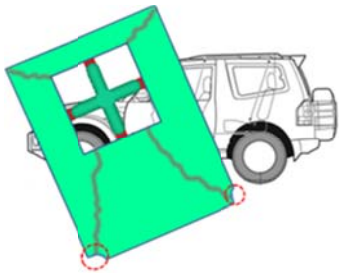


***Fact No.1:*** The hands-on machining work produces the "shape" but proper heat treatment ensures them usable and reliable. Heat treating is a missing link for parts quality improvement.

***Case 2:*** A second recall exercise by a car maker to replace faulty car components has jeopardized the company's product image. The problem recurs constantly as their vendors have failed to study & correct the failure causes.

***Fact No. 2:*** Quality control may point out the defects but the problem still need to go back to the basic to solve it forever. Technical soft skills know-how is used to reason a failure, suggest solutions & to remove the problem.

***Case 3:*** The initial greenish weld line in a moulded car door panel was solved by enlarging the sprue but at the same time resulting in a nozzle drooling problem. When the melt heat was lower, the part running short at the far corners.

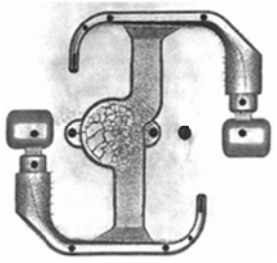


***Fact No. 3:*** A good product design cannot warrant a defect-free production without the support from a good mould design & proper moulding method. The study of all manufacturing variables is vital to solve manufacturing issues.

***Case 4:*** A metal stamper uses a larger blank to form a panel as the edge cracking tend to recur after forming. The cracked edge is then trimmed off by a secondary operation.

***Fact No. 4:*** Material has its strength & limit. Trouble-free manufacturing requires a complete understanding of material behavior (formability), process parameters, tooling design, machine capability & failure analysis.

***Case 5:*** An expensive die casting die cracks sooner than anticipated. The shop manager insists they've a set of guidelines on die preheating & die spray but investigation reveals that the floor operators either never or abuse the guidelines without the manager's notice.



***Fact No. 5:*** Floor workers who are running the actual production need to be trained & make known of their roles & acts on part quality & productivity.

***Case 6:*** To strengthen weld line, the DOE says you can use higher melt temperature & hold pressure but make sure you must fill slow!


***Fact No. 6:*** Using traditional DOE will give non-sensible result if the experiment is done without considering the processing knowledge!

Appendix 2: Manufacturing Insights Skills Training Proposed Technical Modules and Sub-Topics

**Module 1: PRECISION ENGINEERING**

| | |
|---|---|
| **PE01:** | Failures of Tools & Dies and Precaution |
| **PE02:** | Hardening Quality & Tooling Performance |
| **PE03:** | Tool Steels Selection & Tooling Improvement |
| **PE04:** | Carbide Materials & Hard Surface Coatings |
| **PE05:** | Tooling Properties, Testing & Control |

**Module 2: PLASTIC INJECTION MOULDING**

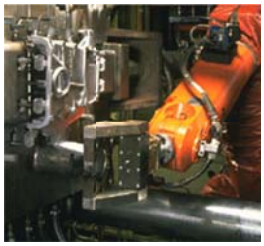
| | |
|---|---|
| **IJM01:** | Fundamentals of Moulding Engineering |
| **IJM02:** | Injection Moulding Defects, Causes & Solutions |
| **IJM03:** | Plastic Materials, Properties & Moulding Characteristics |
| **IJM04:** | Engineering Mould Design for Quality Moulding |
| **IJM05:** | Mould Performance on Moulding Quality & Productivity |
| **IJM06:** | Injection Machine Understanding & Process Optimization |
| **IJM07:** | Product Design and Secondary Operations |
| **IJM08:** | Processing Control for High Quality & Profitable Moulding |
| **IJM09:** | Process Parameters Understanding and Machine Settings |
| **IJM10:** | Practical Scientific Injection Moulding |

**Module 3: SHEET METAL STAMPING**

| | |
|---|---|
| **MS01:** | Sheet Metal Cutting & Process Control |
| **MS02:** | Sheet Metal Forming & Materials Formability |
| **MS03:** | Sheet Metal Bending & Stamping Design Guidelines |
| **MS04:** | Sheet Metal Surface and Thickness Strains Analysis |

**Module 4: SEMICONDUCTOR ASSEMBLY ENGINEERING**

| | |
|---|---|
| **SE01:** | Semiconductor Tooling Quality & Performance |
| **SE02:** | Leadframe Materials and Trim-and-Form Quality |
| **SE03:** | Encapsulation Moulding & Materials Control |
| **SE04:** | Hardening & Surface Coating for Semiconductor Tooling |
| **SE05:** | IC Package Defects & Failures Understanding |



**Module 5: DIE CASTING ENGINEERING**

| | |
|---|---|
| **DC01:** | Die Casting Process, Defects & Die Life Improvement |
| **DC02:** | Thermal Control for Quality Die Casting |
| **DC03:** | Metal Flow Control for Quality Die Casting |
| **DC04:** | Die Performance Control for Quality Casting |

**Module 6: FORGING TECHNOLOGY**

| | |
|---|---|
| **CF01:** | Cold Forging Tool Materials & Processing Control |
| **CF02:** | Troubleshooting Cold Forging Tools Failures |
| **CF03:** | Hardening Quality of Forging Tools |
| **HF01:** | Hot Forging Process, Materials and Die Life Control |
| **HF02:** | Engineering Materials for Hot Forging |
| **HF03:** | Hot Forging Die Quality & Performance |

**Module 7: MATERIALS ENGINEERING**

| | |
|---|---|
| **ME01:** | Metallurgy of Iron & Steel |
| **ME02:** | Steels & Its Heat Treatment |
| **ME03:** | Metallurgical Failures Understanding & Prevention |
| **ME04:** | Aluminium Alloys & Its Heat Treatment |
| **ME05:** | Stainless Steels & Processing Control |
| **ME06:** | Metallurgy of Properties of Copper |