

STRUKTUR PEKERJAAN BAGI SEKTOR PEMBUATAN BAHAN – BUKAN LOGAM

(Occupational Job Structures for

Material Manufacturing – Non Metal Sector)

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1. LIST OF PANEL AND FACILITATOR

List of Panel Expert for the Development of Occupational Analysis for Material Manufacturing – Non Metal Sector

PANEL									
NO.	NAME	DESIGNATION & COMPANY	SUB SECTOR	EXPERTISE					
1.	Khudairi Abu Sari	R&D and Production Manager Rohas Composites	Composite	 Production Engineering Services Quality Assurance 					
2.	Mazidah bt Hasbullah	Manager Mass Composite Technology Sdn. Bhd.	Composite	 Materials Procurement Production Engineering Services 					
3.	Mohd Harizan Rasip	QA Manager Rohas Composites	Composite	 Materials Procurement Production Engineering Services Quality Assurance 					
4.	Mohd Zain Abdul Aziz	Managing Director/ Principle Consultant Multi Skills Training Consultancy Sdn. Bhd.	Composite	 Materials Procurement Production Engineering Services Quality Assurance Maintenance 					
5.	Mohd Fairus Ahmad	Consultant Multi Skills Training Consultancy Sdn. Bhd.	Composite	 Production Engineering Services Quality Assurance Maintenance 					
6.	Zuhide Ramli	Production Manager Labplus Sdn. Bhd.	Polymer	 Production Engineering Services Quality Assurance Maintenance 					

7.	Wira Jaafar	Manager Labplus Sdn. Bhd.	Polymer	 Production Engineering Services Quality Assurance 				
8.	Yusoff Mohamed hani	Production Executive Jebco Sdn. Bhd.	Polymer	 Production Engineering Services Quality Assurance Maintenance 				
9.	Mohd Hafizi Nordin	Researcher Plastics Technology Group SIRIM	Polymer	 Production Engineering Services Quality Assurance Maintenance 				
10.	Saidin Karim	Senior Researcher Pusat Teknologi Seramik, SIRIM	Ceramics & Glass	 Materials Processing Production Finishing R&D Quality Assurance 				
11.	Doll Said Ngah Senior Researcher Pusat Teknologi Seramik, SIRIM		Ceramics & Glass	 Materials Processing Production Finishing R&D Quality Assurance 				
12.	Ali Sabri Salahuddin	Manager Johan Ceramics Berhad	Ceramics & Glass	 Materials Processing Production Finishing R&D Quality Assurance Maintenance 				
FAC	FACILITATOR							
1.	Ahmad Ramdan M Yus	of	Malaysian Academy of Creative Technology Sdn. Bhd. (MACiT)					

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5. EXECUTIVE SUMMARY

Recognizing the importance of skilled human resource, the Department of Skills Development, Ministry of Human Resource, Malaysia has requested an Occupational Analysis to be carried out on the Material Manufacturing – Non Metal sector to evaluate the requirement of skilled manpower in this sector.

For this Occupational Analysis, Material Manufacturing – Non Metal sector can be defined as the whole material manufacturing industry, which not relating to metal and other products manufacturing. However, this analysis only focusing on Ceramic & Glass, Polymer and Composite sub sector.

In conducting the Occupational Analysis on the Material Manufacturing – Non Metal sector, information on the material manufacturing industry was gathered through literature search, interviews and discussions with the industry experts and players from the industry. Visits to establishments and related public departments were also carried out. A workshop was held in an attempt to get better understanding on the sub sector structure, job titles and hierarchy, and the activities of the said sub sector.

The occupational analysis conducted on the Material Manufacturing – Non Metal sector has led the team to identify 10 job areas under 4 sub sectors. These job areas cover 140 job titles identified in this sector. The hierarchy of each job title is identified and their definition is well defined by the panels.

6. CONCEPT AND STRUCTURE OF MALAYSIAN SKILL CERTIFICATION SYSTEM

6.1 National Occupational Skills Standard (NOSS)

NOSS is defined as a specification of the competencies expected of a skilled worker who is gainfully employed in Malaysia for an occupational area and level.

6.2 Concept and Structure of Malaysian Skills Certification



Figure 1: Concept and Structure of Malaysian Skills Certification

7. INTRODUCTION AND BACKGROUND OF THE MATERIAL MANUFACTURING – NON METAL SECTOR

The definition of material production/manufacturing is the activity to change the natural resources into commodity the use of human labour, skills, and productive forces.

Material Manufacturing – Non Metal sector can be defined as the whole material manufacturing industry, which not relating to metal and other products manufacturing. Material Manufacturing – Non Metal Sector is inclusive of wood, rubber, palm oil, water, ceramics & glass, polymer, composite, chemical and concrete. However, wood, rubber, palm oil, water, chemical and concrete are already defined in Resource Based, Chemical and Building & Construction Sector.

The structure of Material Manufacturing – Non Metal Sector can be seen in the Table 1 below:

Descurse Desed				Other Non Metal Material			Chamigal	Building	
Resource Based			Manufacturing			Chemical	Construction		
Wood	Dubbar	Palm	Watar	Ceramics	Dolumor	Composito	Instrumentation	Concrete	
wood	Oil		water	& Glass	rorylliel	Composite	(Oil & Gas)	Concrete	

Table 1: Structure of Material Manufacturing - Non Metal Sector

For this Occupational Analysis, the focus area is on Ceramic & Glass, Polymer and Composite.

7.1 Ceramics & Glass

The word ceramic can be traced back to Greek term *keramos*, meaning 'burned stuff'. Ceramics can be defined as inorganic, non-metallic materials that are typically produced by heating or firing clays and other minerals from the earth or chemically processed powders. This definition includes not only materials such as pottery, porcelain, refractories, structural clay products, abrasives, porcelain, enamels and glass but also non-metallic magnetic materials, ferroelectrics, glass ceramics and a

variety of other products which were not in existence until a few years ago and many which do not exist today.

Ceramics can be divided into two classes: traditional and advanced. Traditional ceramics include clay products and silicate glass while advanced ceramics consist of carbides (SiC), pure oxides (Al₂O₃), nitrides (Si₃N₄), non-silicate glasses and many others.

7.2 Polymer

Polymer is any of numerous natural and synthetic compounds of usually high molecular weight consisting of up to millions of repeated linked units, each a relatively light and simple molecule.

There are three general groups of polymer materials, which are Thermoset, Elastomer and Thermoplastic.

i. Thermoset

Thermoset are polymers which do not melt when heated. Thermosets molecules are cross-linked by strong covalent intermolecular bonds, forming one giant molecule. Cross-linking is achieved in curing process initiated by heat, chemical agents or radiation. Before curing processing thermoset materials are stored in partially polymerized condition. Thermosets are stronger and stiffer than thermoplastics.

Common thermosets are:

- Epoxies (EP)
- Unsaturated Polyesters (UP)
- Phenolics (PF)
- Urea Formaldehyde (UF)
- Melamine Formaldehyde (MF)
- Alkyds

ii. Elastomer

Elastomers are polymers possessing high elasticity - may be reversibly stretched at high degree. Elastomers consists of long lightly cross-linked molecules.

Common elastomers are:

- Polyisoprene (natural rubber)
- Butyl
- Nitrile
- Neoprene
- Ethylene-Propylene
- Hypalon
- Silicone

Elastomer may be strengthened by vulcanization process (heat treatment in presence of chemical agents). Vulcanization results in increase of cross-linking of the molecules. Vulcanized elastomers are elastic for small deformations.

iii. Thermoplastic

Thermoplastics are polymers, which soften (becomes pliable and plastic) and melt when heated. In the melted conditions thermoplastics may be formed by various methods (injection molding, extrusion, Thermoforming).

No new cross-links form (no chemical curing) when a thermoplastic cools and harden. Thermoplastics may be reprocessed (re-melt) many times.

Common thermoplastics are:

- Thermoplastic Low Density Polyethylene (LDPE)
- Thermoplastic High Density Polyethylene (HDPE)
- Polypropylene (PP)
- Acrylonitrile-Butadiene-Styrene (ABS)
- Polyvinyl Chloride (PVC)

- Polymethylmethacrylate (PMMA)
- Polytetrafluoroethylene (PTFE)
- Polyethylene Terephtalate (PET)
- Nylon
- Polyimide (PI)
- Polycarbonate (PC)
- Polysulfone (PSF)

7.3 Composite

A composite material is made by combining two or more materials to give a unique combination of properties. The above definition is more general and can include metals alloys, plastic co-polymers, minerals, and wood. Fiber-reinforced composite materials differ from the above materials in that the constituent materials are different at the molecular level and are mechanically separable. In bulk form, the constituent materials work together but remain in their original forms. The final properties of composite materials are better than constituent material properties. The main concept of a composite is that it contains matrix materials. Typically, composite material is formed by reinforcing fibers in a matrix resin. The reinforcements can be fibers, particulates, or whiskers, and the matrix materials can be metals, plastics, or ceramics. The reinforcements can be made from polymers, ceramics, and metals. The fibers can be continuous, long, or short. Composites made with a polymer matrix have become more common and are widely used in various industries.

Spray up, blow, injection and compression moulding utilize short fibres, whereas filament winding, pultrusion, resin transfer moulding, hand layup, autoclave moulding and roll wrapping use continuous fibres. Polymeric-based composite materials have become common engineering materials and are designed and manufactured for various applications including automotive components, sporting goods, aerospace parts, consumer goods, and in the marine and oil industries.

Typically, most common composite materials, including fiberglass, carbon fiber, and kevlar, include at least two parts, including the resin. Polyester resin, tends to have yellowish tint, and is suitable for most backyard projects. Its weaknesses are that it is UV sensitive and can tend to degrade over time, and thus generally is also coated to help preserve it. It is often used in the making of surfboards and for marine applications.

Vinylester resin, tends to have a purplish to bluish to greenish tint. This resin has lower viscosity than polyester resin, and is more transparent. This resin is often billed as being fuel resistant, but will melt in contact with gasoline. This resin tends to be more resistant over time to degradation than polyester resin, and is more flexible. It uses the same hardener as polyester resin (at the same mix ratio) and the cost is about the same.

Epoxy resin is almost totally transparent when cured. In the aerospace industry, epoxy is used as a structural matrix material or as a structural glue.

7.4 Skill Worker Requirements in Local Industry Sector

According to Malaysian Department of Statistic report, total workforce in the country as at December 2008 stands at 10.66 million workers. From this total, more than 8.3 million workers (78.9%) are registered workers having only secondary education. This statistic reflects critical requirements for skills industry certification to enhance bring up knowledge workers in the country. As such, Department of Skills Development, Ministry of Human Resources direction's and effort to increase skill certification must be supported by all Ministries, Agencies, Government Link Companies (GLC) as well as all Industries as a whole.

Material manufacturing (non-metal) directly employs more than 130,000 workers or 1% of the total workforce, whereas other related sectors such as electrical machinery and electronic, transport equipment, chemicals and chemical products employs more than 5.25 million workers. Within

manufacturing sectors, non-metal (ceramics, glass, polymers / plastics and composites) manufacturing sector in both primary and non-primary forms is one of the major industries comprising more than **1,600 manufacturers** with wide range of products for various uses. Among others, the sector components, electrical and produces auto electronic parts, telecommunications components, construction material, household goods, packaging materials, maritime. defence bottles. and aerospace components, etc.

Out of the 130,000 workers working directly in the sector defined in this OA, polymer or plastic sub-sector registered most number of employees, with more than 100,000 workers. As a whole, the Material Manufacturing (Non-Metal) sector is registering employment and company growth of more than 5% annually for the last 7 years, mainly contributed by polymer and composites sub-sectors growth throughout these years. As the sector is expected to continue to register growth into the future, the implementation of skills certification for this sector is very critical.

In terms of contribution to the Gross Domestic Production (GDP), the sector continues to register significant growth since late 1990s, with a number of years registering double-digit growth. In monetary values in 2008, the sector directly contributes to an estimated value of more than RM3.76 billion (Non-metallic material products), and indirectly contributes to RM19.03 billion (Chemicals and chemical products), RM32.02 billion (Electrical machinery and Electronics) and RM6.8 billion (Transport equipment) or direct and indirect contribution of 2.9% and 47% of National GDP respectively.

7.5 Industry Competitiveness at International Level

Malaysia is the 18th largest export nation worldwide and ranked 29th out of 118 countries by the "Global Enabling Trade Report 2008" published by the World Economic Forum. The largest export revenue earner is Electrical machinery and Electronic products, which contributes more than 40% of

total export revenue in 2008. Directly, Polymer and Composites subsectors are recording export growth over the past few years, registering Singapore, Germany, Japan, UK and US as the country's major trading partners for the sector.

Within the sector, the industry is expanding in the area of plastic packaging, electrical machinery and electronic products, automotive components as well as marine and aerospace components. The industry has to increase its innovation, production quality and standards in order to distinct itself from other low-cost producers from China and India. The industry players are expected to invest more in Research, Development and Innovation to enable it to remain competitive globally. In ensuring the industry effort to drive innovation is achievable, the skills certification for this Material Manufacturing (Non-Metal) sector is critical, to enable the enhancements of industry workers supporting to increase value added manufacturing effort.

Based on the reports published by MIDA and MITI, investments, both domestic and foreign, continue to register growth during the recent years. However, dependencies on foreign skilled workers for the industry are still relatively high. At the same time, customers, mostly from developed nations, are requiring higher standards in terms of environmental impact as well as product quality in general. Among others, competition for the local industry in the global market comes from Thailand, China, India, Indonesia and Taiwan. Potential export market customers for the industry are EU countries, USA, Japan as well as China and India.

8. METHODOLOGY OF OCCUPATIONAL ANALYSIS

In conducting the occupational analysis, brainstorming sessions were held in accordance with guidelines as outlined by Department of Skills Development in terms of scope of study, time frame and representation by panel of Material Manufacturing – Non Metal experts from both public and private sector as stipulated in the letter of offer.

There were several approach used in this occupational analysis. The different approach was used to make sure all the information were well collected and to get better understanding of the sector itself.

8.1 Literature Research

Literature research on the Material Manufacturing – Non Metal sector was carried out to get some insight on the scope, policy, program and activities in the context of Malaysian scenario. The scope covered under this research includes definitions, current analysis of the sector/sub sector, current status of the Material Manufacturing – Non Metal sector, skilled workers requirement in the local industry and the industrial competition at international level.

8.2 Identifying The Industry Players

The literature search findings were used as a guide to identify the scope of occupational study and analysis. From that, players from the sub-sector of Material Manufacturing – Non Metal were identified and short listed for further communication, contact and interviews. A pool of experts from the industry has been contacted and interviewed. Some kind of working relationship has been established with these experts.

8.3 Analysing Information

Based on the activities done as above, substantial data and information were collected. The data and information were discussed and analysed in several in-house workshops attended by key players and experts from the industry.

During these sessions, attempts to reframe the Material Manufacturing – Non Metal sub sector in Malaysia were made using the following framework:

- i. Scope of the Material Manufacturing Non Metal sector and its sub sector;
- ii. Job Area;
- iii. Job Title;
- iv. Hierarchy Structure (Level 1 8);
- v. Occupational Definition.

8.4 Workshop

A workshop on the Material Manufacturing – Non Metal sector was held, attended by experts in the field of Material Manufacturing – Non Metal. The objectives of the workshop are:

- Present the preliminary findings on:
 - Outline of Job Title
 - Career structure
 - Hierarchy structure (Level 1 8)
 - Occupational Definition
- Conduct Occupational Analysis Session
- Validation of the findings

9. FINDINGS

Based on the Occupational Analysis carried out as outlined in the methodology, the findings of this study are as follows:

9.1 Scope of Material Manufacturing – Non Metal sector in Malaysia

Material Manufacturing – Non Metal can be defined as the whole material manufacturing industry, which not relating to metal and other products manufacturing. However, this analysis is not including concrete, chemical, wood, and rubber as they are already defined in Building & Construction, Chemical and Resource Based Sector.

Material Manufacturing – Non Metal sector in Malaysia is categorically divided into 6 sub sectors/job area namely Ceramics & Glass, Polymer, Composite, Materials Management, Quality Assurance and Maintenance. From the 6 sub sectors mentioned, a total of 10 job areas are identified existed in Malaysia. These job areas are illustrated in *Addendum 1: Job Area in Material Manufacturing – Non Metal.*

For this analysis, there are two common job areas for the three sub sectors. The two job areas, Quality Assurance and Maintenance share similar tasks and responsibilities in each of the sub sector. Hence, the two job areas are identified as general job areas in the Material Manufacturing – Non Metal sector.

9.2 Job Title and Hierarchy

In the Occupational Analysis conducted for Material Manufacturing – Non Metal sector, the job title and hierarchy are defined from the current practice in the industry. Examples of job title and its hierarchy are shown in Table 2.

L	PRODUCTION						
(VE)	THERMOSET						
IT	THERMOSET INJECTION MOULDING	THERMOSET COMPRESSION MOULDING					
L8	THERMOSET PRINCIPAL SPECIALIST						
L7	THERMOSET SPECIALIST						
L6	THERMOSET SENIOR TECHNOLOGIST						
L5	THERMOSET TECHNOLOGIST						
L4	INJECTION MOULDING ASSISTANT TECHNOLOGIST (THERMOSET)	COMPRESSION MOULDING ASSISTANT TECHNOLOGIST (THERMOSET)					
L3	*INJECTION MOULDING TECHNICIAN (THERMOSET)	*COMPRESSION MOULDING TECHNICIAN (THERMOSET)					
L2	*INJECTION MOULDING JUNIOR TECHNICIAN (THERMOSET)	*COMPRESSION MOULDING JUNIOR TECHNICIAN (THERMOSET)					
L1	- NO LEVEL -						

Table 2: Examples of Job Title and Hierarchy

Details of Job Title and Hierarchy in Material Manufacturing – Non Metal sector are explained in *Addendum 2: Job Title and Hierarchy in Material Manufacturing – Non Metal.*

9.3 Occupational Definition

Each sub-sector in the Material Manufacturing – Non Metal sector is further refined by identifying and defining the job titles involved. Each job title is given an occupational definition as specified in *Addendum 3: Occupational Definition in Material Manufacturing – Non Metal.*

9.4 Critical & Non Critical Job Title

The critical job title can be defined as the job title that really needs certification from JPK as their number in the current market/industry is great and increasing.

	SUB SECTOR / JOB AREA		LEVEL								
			L1	L2	L3	L4	L5	L6	L7	L8	
		Critical	0	6	6	0	0	0	0	0	12
1.	Ceramics & Glass	Non- Critical	0	0	0	7	7	7	7	7	35
		Critical	0	12	12	0	0	0	0	0	24
2.	Polymer	Non- Critical	0	0	0	13	5	6	6	6	36
	Composite	Critical	0	1	1	0	0	0	0	0	2
3.		Non- Critical	0	0	0	3	3	3	3	3	15
	Materials Management	Critical	0	0	0	0	0	0	0	0	0
4.		Non- Critical	0	1	1	2	2	2	0	0	8
	Quality Assurance	Critical	0	0	0	0	0	0	0	0	0
5.		Non- Critical	0	0	0	0	0	1	1	1	3
6.	Maintenance	Critical	0	0	0	0	0	0	0	0	0
		Non- Critical	0	0	0	1	1	1	1	1	5
Total			0	20	20	26	18	20	18	18	140

Table 3: Critical and Non Critical Job Title

From the occupational analysis carried out, there are 38 job titles defined as Critical and 102 job titles defined as Non-Critical. Details on the critical & non-critical job titles can be found in the *Addendum 4: Critical and Non-critical Job in Material Manufacturing – Non Metal.*

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- 19. www.plastics-malaysian.com

- 20. Approved Adopted NOSS:
 - i. AC-010-1/2/3 Composite Operator/Senior Operator/Technician
 - ii. G-080-3 Foundry Technician
 - iii. H-095-5 Tooling Engineer
 - iv. H-100-3 Industrial Technician
 - v. H-301-5 Quality Assurance Engineer (Manufacturing)
 - vi. J-010-1/2/3 Injection Moulding Operator/Line Leader/Supervisor
 - vii. J-011-1/2/3 Extrusion Pipe & Profile Operator/Line Leader/Supervisor
 - viii. J-012-1/2/3 Rotational Moulding Operator/Line Leader/Supervisor
 - ix. J-013-1/2/3 Compression Moulding Operator/Line Leader/Supervisor
 - x. J-014-1/2/3 Blow Moulding Operator/Line Leader/Supervisor
 - xi. J-020-4/5 Plastic Production Assistant Manager/Manager
 - xii. S-026-1/2/3 Advanced Ceramic Production Operator/ Senior Operator/ Supervisor