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Competency Model to Implement Smart Factory for Operator Level in Cosmetic Manufacturer (Case Study: PT XYZ)

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ABSTRACT

Manifestation on Smart Factory and Industry 4.0 is listed as one of PT XYZ strategic plans for the next five years. To fit that condition, company should define the competency model for operator level to work in the future manufacture.

The first step was to define the framework of competency model to accommodate the needs of users. The second step was defining the competency model content by reviewing job, task, and competency needed by operator to perform the job.

Author found that there are four technical competency and four non-technical competencies that are related to Smart Factory. The list were then arranged to illustrate the interrelation between competencies (Base and Pillar Competency Model) and in the form of Competency Matrix Mapping Model.

Keywords: competency model, cosmetic manufacture, industry 4.0, smart factory

INTRODUCTION

Recently, the condition of cosmetic business has been challenging for PT XYZ, one of the largest cosmetic manufacturing companies and the first originator of halal cosmetics in Indonesia. PT XYZ should increase its flexibility, productivity, and ensure the stability of its product's quality. Therefore, manifestation on Smart Factory and applying Industry 4.0 are listed as one of PT XYZ strategic plans for the next five years. The next challenge to be answered is how to develop people in manufacture in order to be ready to face the current and future condition. Human error and safety are still becoming the issue due to the lack of knowledge and awareness. Operator education level could also become the potential obstacle. Thus, to develop and recruit the people to fit the smart factory conditions, company should define the competency model for operator level to work in the future condition.

This study aims to create competency model that must be owned by PT XYZ employees at the operator level of the production department including knowledge, skills, and attitude in correspondence to the implementation of Smart Factory.

LITERATURE STUDY

Industry 4.0 and Smart Factory

The term Smart factory is related to Industry 4.0. Industry 4.0 discussed more general in the context of all industries, while smart factory mainly focused on the manufacturing or production aspect. Table 1 explains the different of keywords used to describe Industry 4.0 and Smart Factory.

General Production Process of Cosmetics

There are three main cosmetic form manufactured in the factory; liquid (example: perfume, skin toner), semisolid (example: lipstick, liquid foundation), and powder (example: eye shadow, face powder). Despite different form of cosmetic, generally all cosmetics are passing through three main production processes which are weighing - mixin or processing - packing (Figure 1).

Competency

There are several definitions of competencies that have been studied before. This study refer to several studies and use the summarized definition of competency which is: Competencies are characteristics and behaviors within individuals that become the contributors of superior performance in job situation and are learnable (Dubois & Rothwell, 2004), (Hay Group, 2009), (Le Deist & Winterton, 2005). Competency is also defined as the clusters of related knowledge, skills, attitude (K, S, A) that affects a major part of one's job (a role or responsibility) (Parry, 1996).

Knowledge: Knowledge is an understanding toward something which is acquired by learning or discovering process (Sanghi, 2016). Knowledge is often interpreted as the main object cognitive domain of learning, which by definition according to Oxford Learner's Dictionaries is defined as the process by which knowledge and understanding is developed in the mind. The classification of cognitive dimension was defined by Benjamin Bloom in Taxonomy of Educational Objectives which then revised by Anderson and Krathwol in 2001 to fit recent situation (Anderson et al., 2001).

Skill: Skill is the expertise that may involve physical or mental activities which is performed with ease and precision (Sanghi, 2016). There are two components of skill:

1. Hard skills indicate the specific capability to carry out a particular job (Sanghi, 2016)
2. Soft skills relate to the capabilities that are necessary in any position to interact with other people involved in the organization (Sanghi, 2016). Another definition of soft skills are non-technical, intangible, personality specific skills", characteristics and abilities of attitudes and behaviors rather than technical knowledge or talent (John, 2010).

Attitude: Attitudes is an important part of competency as it is directly give influence on how people behave and react toward the object in his surroundings, whether it is the form of a person, a physical object, a behavior, or a policy (Jain, 2014). For this research the author opted to refer to ABC Model (Eagly & Chaiken, 1998) and Technology Acceptance Model (Davis, 1989) to define attitude. According to ABC model, there are three main components of attitude:

1. Affective component is the emotional response such as liking or disliking an object.
2. Behavioural component or conative is a verbal or nonverbal observable action, favorable or unfavorable action to do something regarding the object.
3. Cognitive component is an evaluation of the entity that comprehend the individual opinion, belief or disbelief about the object (Jain, 2014).

Technology Acceptance Model was used to predict user acceptance and willingness to use technology and information system. There are two factors which affecting the user acceptance of technology (Davis, 1989):

1. Perceived ease of use: the level of user's belief that using a particular system would be free of effort or easier to use than another system.
2. Perceived usefulness: the level of user's belief that by using particular system could enhance their job performance.

For this study, Knowledge, Skill, and Attitude (KSA) are categorized into two approaches according to its relativity to specific job task as seen in Figure 3. In the further writing, Author will used technical competency as the term to define knowledge, hard skills, and attitude that are related to specific job. While the term personal skill/non-technical skills are used as a synonym for soft-skills.

METHODOLOGY

The first step to define the competency model was defining the framework of competency model hence it could accommodate the needs of users. The next step was defining the content by adopting the steps stated by Sanghi (2016). The improved steps are:

1. Review job and organization-related information
2. Write major job tasks (current condition)
3. Write major job tasks (smart factory condition)
4. Write knowledge, skills. and attitude needed
5. Group related Knowledge, Skills. and Attitude to certain competency

Author also defined the required soft-skills by comparing company's competency profile to literature regarding Industry 4.0. Primary and secondary data were used during the development of the model. The primary data were obtained through interview and discussion to related leaders on manufacturing division while the secondary data were focused on previous studies related to Industry 4.0 implementation in manufacturing industry and company's competency profile. There are eight interviewees who were involved during gathering data: (1) Production General Manager. (2) Improvement Manager and Smart Factory Project Owner, (3) Five Production Section Heads, (4) Factory Training Department Manager and Former Production Assistant

FINDINGS AND DISCUSSION

From data analysis, there are four job-related competencies (technical competency) and four main soft-skills (non-technical competency) that are directly supporting the implementation of Smart Factory as seen in Table 2 and Table 3.

In addition, there are four main requirements of competency model:

1. Able to illustrate the interconnection between the different processes of production, the issue of technology changing, knowledge, hard skills, soft skills, and attitude acquired.
2. Able to map the position of particular operator in terms of ability to handle machine and the expertise in certain production process in specified cosmetic form
3. Easily illustrated the flow for competency fulfilment for operator
4. Applicable and easily understood by users and training organizer

There are two competency models generated to answer those requirements; (1) The Base and Pillars is to illustrate the flow of operator's competency requirement, (2) Competency Matrix is more focus to map the position of every operator in terms of ability to handle machine and the expertise in certain production process.

Base and Pillars Competency Model of Smart Factory: This model is able to capture the bigger picture of smart factory's competencies and how they were interrelated with each other. As seen in Figure 4, there are three main parts of this model, which are:

1. Soft-skill/Personal Competency: Positioned in the lowermost to show that these competencies are necessary for all operators despite their specification in one certain machine or form of cosmetic
2. Basic Technical Competency: It shows that these job-related competencies are also necessary for all operators as the pre-requirement before starting work.
3. Specific Competency Related to Process or Specific Machine and Tools or Specific Cosmetic Form: Are put in parallel position to show their equality. The back and forth arrows are to show the interrelated between each other. For example, after we specified the operator position in mixing, we should also know the specification in the machine. Particularly for *Specific Machine and Tools*, the level of machine technology is written in multilevel stages from manual to robotic to accommodate the situation where operators should master the lower level first before continuing to the next step.

There is also some part of the competency model that defines more detailed.

1. Shaded boxes: competencies are directly related and supporting the implementation of Smart Factory or Industry 4.0
2. Capital A in the red circles: embedded to the competencies which required particular attitude to ensure the competencies are made in to action

Competency Matrix Mapping Model of Process and Machine Technology: The criteria for the competency model requested is the usefulness for mapping one's level of ability. As seen in Figure 5, the horizontal axis shows the expertise level of an operator in the aspect of production process. While for the vertical axis, as increasingly shifted down, the more expert an operator in the aspect of machine handling.

CONCLUSIONS

To develop competency model and define the competencies needed by operator, author first had to identify on the main activities done by operators. Those activities or tasks were listed based on the current process and the future possible changes of technology.

After activities and tasks are all defined, related knowledge, skills, and attitude to perform those activities were determined by referring to personal interview and literature. The knowledge, hard-skill, soft-skill, and attitude mentioned are then grouped into technical and non-technical or soft-skill.

This study has provided the insight of how competencies are listed and how the list is elaborated in two competency model. As the model will be used as the guidance for operator training plan, the relevance of the model should be obtained. Whereas the writer in this study was limiting the data of the study from literature and interview only, further study can develop broader insight by observing the relevance of the competencies by creating curriculum, conducting training, and conduct quantitative research to gain input related to the impact of the competency-based training to actual performance.

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FIGURES AND TABLES

Figure 1. *General Production Process of Cosmetics*

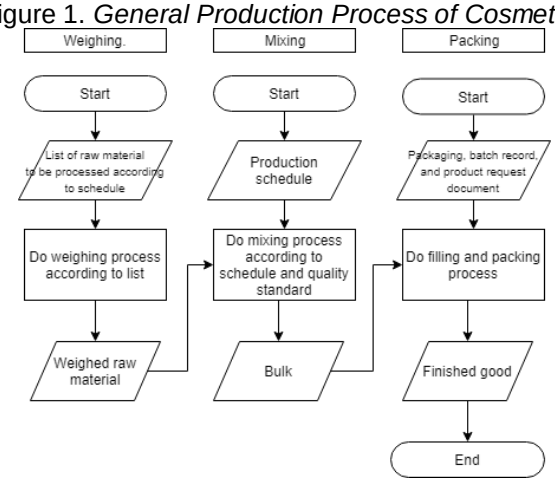

Figure 2. *Davis' Technology Acceptance Model (TAM)*

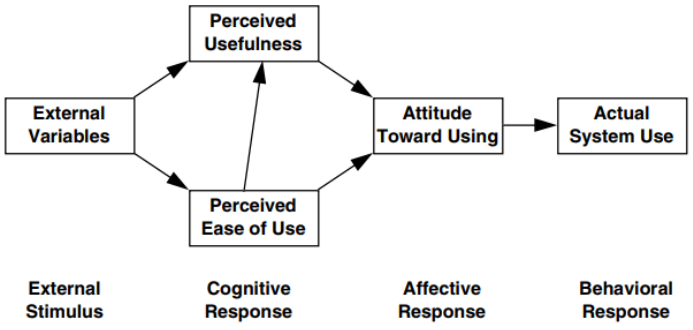

Figure 3. *Classification of KSA*

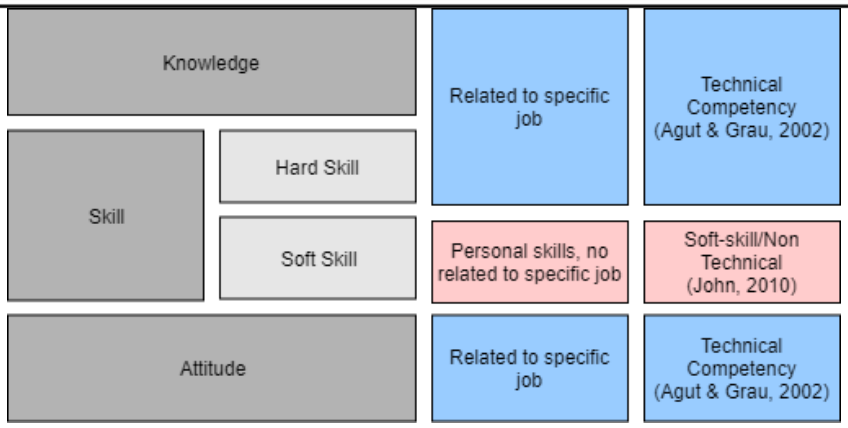

Figure 4. *Detailed Base and Pillars Competency Model of Smart Factory in Cosmetic Manufacturing*

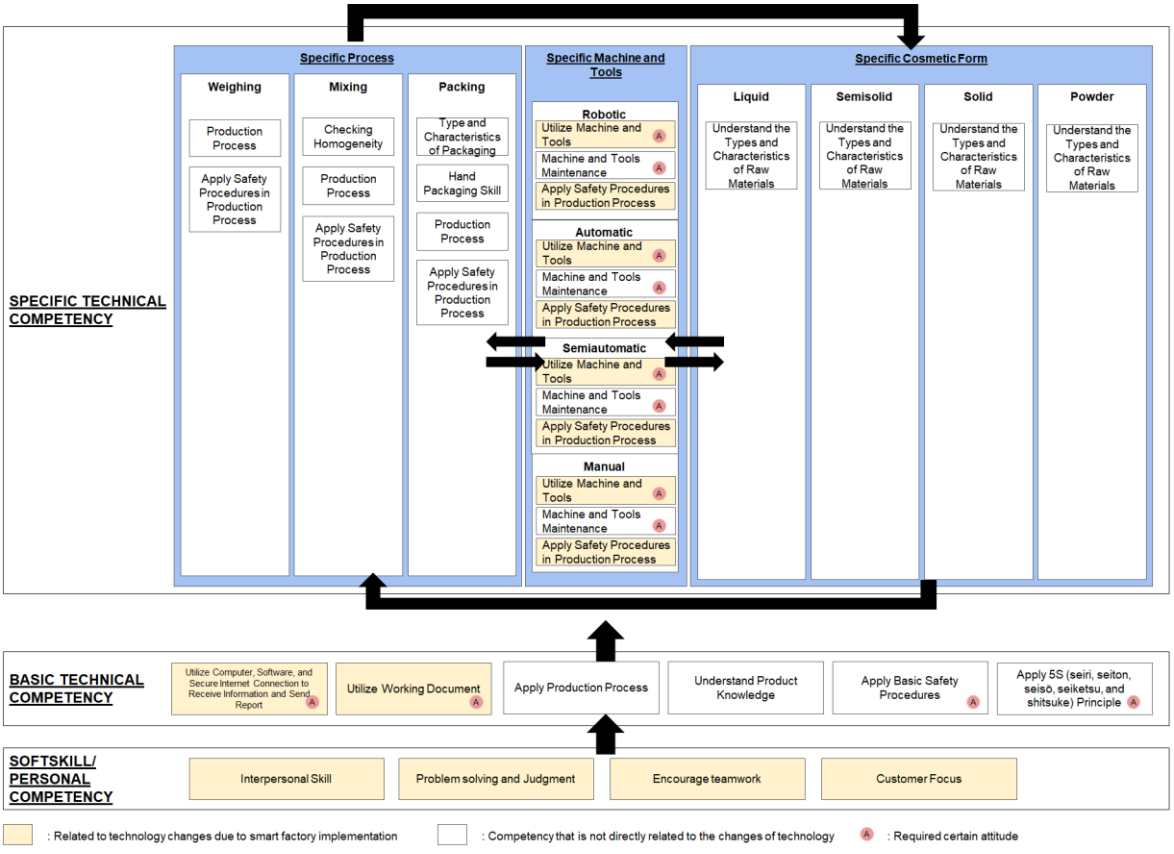

Figure 5. *Example of Competency Matrix Mapping for Liquid Cosmetic Form*

Cosmetic Form Liquid

		I	II	III	IV	V	VI	VII	Element of Competency
		Packing	**Weighing**	**Processing**	**Packing and Weighing**	**Packing and Processing**	**Weighing and Processing**	**Weighing, Processing, and Packing**	
A	**Basic**	Utilize Working Document							Receive information
									Apply the information written on the document
									Knowing procedure according to the batch record and write necessary update
		Apply Production Process							Remember General Production Process
		Utilize Computer, Software, and Secure Internet Connection to Receive Information and Send Report							Using a secure internet connection
									Apply procedure to update flow report using a computer
									Apply procedure to open a document supporting the work
									Using file management software on the computer

		Apply Basic Safety Procedures							Apply the basic safety procedures in factory
		Understand Product Knowledge							Knowing the types of products from each preparation
		Apply 5S (seiri, seiton, seisō, seiketsu, and shitsuke) Principle							Understand the definitions, principles and application of 5S
									Understand how to read the zone of responsibility area and 5S standard in the area
									Apply 5S standard in the area
B	**Manual**								
C	**Semi Auto**	I-C		III-C		V-C			
D	**Auto**								
E	**Robotic**								

Table 1. *Keyword Comparison of Industry 4.0 and Smart Factory*

Highlighted Points	Industry 4.0	Smart Factory
Main Characteristics	• Information and **communication network** • **Extensive automation** (Adolph, Anlahr, & Bedenbender, 2016)	• **Connected** and flexible manufacturing system • Continuous **stream of data** • **Connected operations** and productions systems to learn and adapt to new demands (Sjödin, Parida, Leksell, & Petrovic, 2018)
Scope	**All production relationship** among suppliers, producers, and customers (Boston Consulting Group, 2019)	Focused **mainly on manufacturing** (Sjödin, Parida, Leksell, & Petrovic, 2018)

Related Technology	**Big data analytics, Autonomous robot,** Simulation, Horizontal and vertical system **integration,** Internet of things, Cyber security, Cloud, Additive manufacturing, Augmented reality (Boston Consulting Group, 2019)	**Assistance systems, autonomous,** real time production and quality control, predictive maintenance, **integration** and alignment (ROI Management Consultants, 2016)

Table 2. *Technical Competency of Smart Factory*

Competency	**Elements**	**Knowledge**	**Hard Skills**	**Attitude**
Utilize Machine and Tools	Understand the type of engine and specification	x		x
	Knowing the type of tool and its usefulness	x		x
	Understanding how to work and able to use machinery and tools	x		x
	Apply work instructions of machine operations	x	x	x
Machine and Tools Maintenance	Apply the procedures of sanitation machinery	x	x	x
	Apply maintenance-related work instruction	x	x	x
	Doing daily preventive maintenance process		x	x
Utilize Computer, Software, and Secure Internet Connection to Receive Information and Send Report	Using a secure internet connection	x	x	x
	Apply procedure to update flow report using a computer	x	x	x
	Apply procedure to open a document supporting the work	x	x	x
	Using file management software on the computer	x	x	x
Utilize Working Document	Apply procedure to receive information	x	x	x
	Apply the information written on the document	x	x	x
	Apply procedure according to the batch record and write necessary update	x	x	x

Table 3. *Non-technical Competency of Smart Factory*

Non Technical Competency of PT XYZ	Elements of Non Technical Competency of PT XYZ	Example of Behaviour for Operator Level (As written in PT XYZ Document)	Required Non Technical Competency for Smart Factory
Interpersonal Skill	Shows sensitivity, caring and empathetic in interacting with others	Show respect to others	- Social skills (a) - Team working abilities (a) - Emotional intelligence and personal acceptability (b), (c)
Problem Solving and Judgment	Make recommendations and alternative solutions that have the value of anticipatory / innovative	Offers an alternative solution from existing idea/imitative	- Reasoning Problem Solving and Ideation (b) - Analytical thinking and innovation (b) - Mindset for continuous improvement and lifelong learning (a), (b), (c) - Creativity, originality, and initiative (b), (c)
Encourage Teamwork	Moving people to achieve a common goal	Cooperative team member	- Social skills (a) - Team working abilities (a) - Emotional intelligence and personal acceptability (b), (c)
Customer Focus	Identify Customer Needs	Being able to identify the needs of customer from next process' explicit symptom (directly declared)	- Social skills (a) - Communication skills (a)
	Improving the service quality standards	Deliver standardize service and quality according to standard operating procedure	- Mindset for continuous improvement and lifelong learning (a), (b), (c) - Trust in new technology (a) - Dependability, reliability, integrity (c)

Sources

(a) (Gehrke, et. al, 2015)

(b) World Economic Forum: Future of Jobs Survey Report 2018

(c) ETA Automation Industry Competency Model Clearinghouse, 2018