

## CHAPTER 2

### LITERATURE REVIEW AND THEORETICAL BACKGROUND

This chapter is divided into literature review and theoretical background mainly. The literature review will discuss about the comparison of this research and the other previous researches about the organizational structure and job descriptions. The theoretical background will discuss about the theories in supporting this research.

#### **2.1. Literature review**

Some previous researches related to construction of organizational structure had been done. Those researches will be the literature review and compared to this research.

Shodiq & Ghozali (2012) in a journal entitled "*Evaluasi Kesesuaian Struktur Organisasi Pengelola Teknologi Informasi dengan Rencana Jangka Panjang Instansi (Studi Kasus pada Dinas XYZ)*" evaluated current organizational structure using COBIT (Control Objectives for Information and related Technology) version 4.1. There were 11 business goals, 24 IT goals, and 7 working division that suitable with the company long term planning. A new ideal organizational structure and the job descriptions for each position in the structure also offered for the company.

Hong et al. (2012) analyzed the organizational structure from the business process of communication and broadcast industries in a journal entitled "A Methodology for Redesigning an Organizational Structure Based on Business Process Model Using SNA Techniques." Transfer-of-work metrics combined with SNA techniques was used for analyzing the relations. They recommended that financial management needed to be outsourced and decentralized, and human resource management and managerial accounting are combined with the division of general affairs and placed under CEO.

Febryanti (2013) did a research at PT. Multipanel Intermitra Mandiri Cikarang using structural dimension of work system and sociotechnical system for solving the poor coordination at that company. Suggestion to filled the empty level by the

under level and combined the positions with same function to decrease the horizontal specialization were given in this research.

This research was done at PT. ABC using several macro ergonomic approaches which were Macro Ergonomics Analysis of Structure (MAS) and Macro Ergonomic Analysis and Design (MEAD) method. The objective of the research was to develop new design of company organizational structure and job descriptions to make clear responsibilities and job description for each position, so the problem about doing too many jobs and doing the same jobs with other employees could be decreased and hopefully increases company benefits.

The table below is the comparison among the previous researches and this research, focusing about the object, objectives, methodology, and result in each research.



**Table 2.1. Comparison of several researches**

Researcher	Object	Objective	Methodology	Result
Shodiq & Ghozali (2012)	XYZ Service in Province Education and Culture	Comprehensive analysis about constructing ideal organizational structure	COBIT version 4.1.	Recommendation of organizational structure and job description for each position
Hong et al. (2012)	Business process from communication and broadcast industries	Propose methodology to derive organizational structure that is suitable for business process of the company	Transfer-of-work metrics combined with SNA techniques	Recommendation of combining and placing division in the current organizational structure
Febryanti (2013)	PT. Multipanel Intermitra Mandiri Cikarang	Propose new design of organizational structure based on analysis of the structural dimension of work system and sociotechnical system	Macro ergonomics analysis of structural dimension of work system and sociotechnical system	Recommendation of organizational structure and propose job description for positions that did not have
Ivanali (2017)	PT. ABC, textile industry in Yogyakarta	Redesign organizational structure and construct job descriptions	Macro Ergonomics Analysis of Structure (MAS), Macro Ergonomics Analysis and Design (MEAD)	New design of organizational structure and its job descriptions

## **2.2. Theoretical background**

Theoretical background will explain about the theories related to the research, the statements about the importance of organizational structure and job descriptions, and the macro ergonomics methods for developing the organizational structure and job descriptions. At the other hand, there will be explanation about validity test since the method used in gathering the data was questionnaires.

### **2.2.1. Organizational behavior and organizational structure**

The organizational structure of a company provides the boundaries through which members see the organization and their part in it (Jacobides, 2007). Organizational structure determines the quality of communication, decision making, reporting, and authorities of the organization (Shabankareh & Rastgari, 2012). Organizational structure includes the nature of layers of hierarchy, centralization of authority, and horizontal integration. It is multi-dimensional construct in which concerns:

- a. Work division especially roles or responsibilities including specialization, differentiation or departmentalization, centralization or decentralization, complexity; and
- b. Communication or coordination mechanisms including standardization, formalization and flexibility.

Those theories also can be found in a book entitled Organizational Behavior by McShane & Glinow (2000). They divided organizational structure into division of labor and coordination of that labor so employees are able to accomplish common goals. Division of labor refers to the subdivision of work into separate jobs assigned to different people, and subdividing the work will impact into job specialization because each job now includes a narrow subset of the tasks necessary to complete the product/ service. Work is divided into specialized jobs to make it potentially increases work efficiency, the employees master their tasks quickly because work cycles are very short. Less time is wasted changing from one task to another, and training costs are reduced because employees require fewer physical and mental skills to accomplish the assigned work.

Coordinating mechanisms are needed to ensure that everyone works smoothly. There are 3 types of coordinating mechanisms, informal communication, formal hierarchy, and standardization. Informal communication includes sharing

information on interdependent tasks as well as forming common mental models so that employees can synchronize work activities using the same mental road map. Informal communication permits considerable flexibility because employees transmit a large volume of information through face to face communication. This method is a vital coordinating mechanism in non routine and ambiguous situations. Large organizations can also encourage coordination through informal communication by forming temporary cross-functional teams and moving team members into a common physical area or can be called as co-locating. Beside it, the organizations can assign liaison roles to employees, who are expected to communicate and share information with co-workers in other work units. Where coordination is required among several work units, companies create integrator roles. These people are responsible for coordinating a work process by encouraging employees in each work unit to share information and informally coordinate work activities.

Formal hierarchy assigns legitimate power to individuals, who then use this power to direct work processes and allocate resources. The formal hierarchy also coordinates work among executives through the division of organizational activities. If the organization is divided into geographic areas, the structure gives the regional group leaders legitimate power over executives responsible for production, customer service, and other activities; and so do to product groups organizations.

Standardization is creating the routine patterns of behavior or output. Organizations standardize work activities through job descriptions and procedures. This coordinates work requiring routine and simple tasks, but not in complex and ambiguous situations. When work activities are too complex to standardize through procedures or goals, companies often coordinate by extensively training employees.

Organizational structure affects organizational performance directly (Hao et al., 2012). This affection depends on how company manages and runs their organizational structure. The needs of organizational structure which is suitable with the organization is essential (Shabankareh & Rastgari, 2012). How an organizational structure operates affects the company from its culture to its productivity, profitability, and knowledge management practices (Steiger, 2013). If

the organizational structure can not fit to the organization, it can hinder from quicker responding to the environmental changes (Idicula, 1994).

There are several types of organizational structures, such as tall and flat, functional, divisional, matrix, hybrid, team-based (lateral), and network structure. In its simplest form, a tall structure results in one long chain of command similar to the military. As an organization grows, the number of management levels increases and the structure grows taller. In a tall structure, managers form many ranks and each has a small area of control. The narrow span of control allows for close supervision of employees. Tall structures provide a clear, distinct layers with obvious lines of responsibility and control and a clear promotion structure. Challenges begin when a structure gets too tall. Communication begins to take too long to travel through all the levels. These communication problems hamper decision-making and hinder progress.

Flat organizations focus on empowering employees rather than adhering to the chain of command. By encouraging autonomy and self-direction, flat structures attempt to tap into creative talents of the employees and to solve problems by collaboration. Flat organizations offer employees to excel while promoting the larger business vision. That is, there are more people at the “top” of each level. For flat structures to work, leaders must share research and information instead of hoarding it. Flatter structures are flexible and better able to adapt to changes. Faster communication makes for quicker decisions, but managers may end up with a heavier workload. The heavy managerial workload and large number of employees reporting to each boss sometimes results in confusion over roles. Bosses must be team leaders who generate ideas and help others make decisions. When too many people report to a single manager, his job becomes impossible. Employees often worry that others manipulate the system behind their backs by reporting to the boss; in a flat organization, that means more employees distrusting higher levels of authority.

A functional structure is one of the most common organizational structures. The organization groups employees according to a specialized or similar set of roles or tasks. While functional structures operate well in stable environments where business strategies are less inclined to changes or dynamism, the level of

bureaucracy makes it difficult for organizations to respond to changes in the market quickly.

A divisional organizational structure usually consists of several parallel teams focusing on a single product or service line. Unlike departments, divisions are more autonomous, each with its own top executive--often a vice president--and typically manage their own hiring, budgeting and advertising. Though small businesses rarely use a divisional structure, it can work for such firms as advertising agencies which have dedicated staff and budgets that focus on major clients or industries.

The matrix structure offers a potential solution to the dilemma on divisional structure by combining or overlaying two structures. The most common form of matrix structure occurs in project-based organizations. Employees are assigned to a cross-functional project team, yet also belong to a permanent functional unit to which they return when a project is completed. Matrix structure usually optimizes the use of resources and expertise, making them ideal for project-based organizations with fluctuating workloads. This structure improves communication efficiency, project flexibility, and innovation compared to purely functional designs. It focuses technical specialists on the goals of serving clients and creating marketable products, yet by maintaining a link to their functional unit, employees are able to interact and coordinate with others in their technical specialty.

Very few organizations adopt a pure functional, divisional, or matrix structure. They combine some parts of various designs into a hybrid structure. Research suggests organizations need to develop structures and systems that maintain some balance of power and effectiveness across functional, product, geographic, and client-focused units.

Team-based structure is often called lateral structure because it is very flat and relies on extensive lateral communication with few organizational levels only. Team-based uses self-directed work teams rather than individuals as the basic building block of organizations. Teams are typically organized around work processes, such as making a specific product, and this structure is having a very flat hierarchy usually with no more than 2 or 3 management levels. Most

supervisory activities are delegated to the team by having members take turns as the coordinator. Team-based structure has very little formalization, almost all day-to-day decisions are made by team members rather than someone farther up the organizational hierarchy. Team-based structure is relatively new organizational form, but it has quickly become popular because it is more responsive to global competition. Teams empower employees and reduce reliance on managers. Employees with a high growth need are more motivated and satisfied and the company reduces overhead costs. Team-based tends to improve communication and cooperation across traditional boundaries. With greater autonomy, this structure also allows quicker and more informed decision making. Beside those benefits, this structure is more costly to maintain. Teamwork takes more effort to coordinate than the command control hierarchical system. Employees may experience more stress due to increased ambiguity in their roles, and team leaders experience more stress due to increased conflict and unclear career progression ladders.

Network structure is an alliance of several organizations for the purpose of creating a product or serving a client. This structure typically consists of several satellite organizations beehived around a core firm. The core firm coordinates the network process and provides one or two other core competencies, such as marketing or product development. The core might be the first contact with customers, but most of the product or service delivery and support activities are farmed out to satellite organizations located anywhere in the world. One of the main forces pushing toward a network structure is the recognition that an organization has only a few core competencies. Core competency is a knowledge base that resides throughout an organization and provides a strategic advantage. As company discovers their core competencies, they outsource noncritical tasks to other organizations that have a core competency at performing those tasks. This structure offers the flexibility to realign their structure with changing environmental requirements, it also offers the efficiencies that tend to occur when organizations focus on their core competencies compared to having all activities performed in-house by different departments. A potential disadvantage of this structure is they expose the core firm to the same market forces used to get the best resources. Other problem is that although information technology makes



worldwide communication easier, it will never replace the degree of control organizations have when manufacturing, marketing, etc are in-house.

### **2.2.2. Job description**

Job description is a dynamic reflection of the content and requirements for a position of any kind (Verboncu & Zeininger, 2015). Job descriptions also identify the tasks, duties, and responsibilities of jobs and job specifications list the knowledge, skills, abilities, and other characteristics needed to perform the job (Mathis & Jackson, 2004). Many researchers are describing the content of job description itself. According to Stybel (2010), job descriptions generally include a job title, reporting relationships, a summary of responsibilities, the level of decision-making authorized, and hiring requirements information. While Verboncu & Zeininger (2015) tell the content of job description is all about individual objectives and support elements needed to achieve objectives: processes (tasks), official authority (limits of competencies) and responsibilities (for the action initiated and decisions made). Pennell (2010) explains the written job description normally contains job title, duties to be performed, distinguishing characteristics of the job, environmental conditions, and the authority and responsibilities of the person holding the job.

There are two kinds of job descriptions used in the Human Resource practice, specific and general (Stanescu, 2004). Specific job descriptions include detailed tasks and responsibilities incumbent on the holder of the position, focused on detailed work planning and on work monitoring. This type is mainly used by bureaucratic organizations, where the frontiers between functions and hierarchical levels are clearly established. While general job descriptions is appropriate for plain organizational structures, and includes overall obligations and responsibilities. It can be used for a large range of similar positions from various departments of the organizations.

### **2.2.3. Macro ergonomic**

#### **a. Concept of macro ergonomic**

Conceptually, macro ergonomic is a top-down sociotechnical systems approach to work system design and the design of related human-job, human-machine, human-software, and human-environment interfaces. Although top-down

conceptually, in practice it involves top-down, bottom-up, and middle-out analyses and implementation (Hendrick, 2000). As a sub discipline, macro ergonomics is concerned with human-organization interface technology. The empirical science supporting this sub discipline is concerned with factors in the technological subsystem, personnel subsystem, external environment, organizational design, and with their interactions and is guided by sociotechnical systems theory. As a perspective, macro ergonomics provides certain guiding principles to aid the ergonomist, including participation, flexibility, joint optimization, joint design, continuous improvement of processes, and system harmonization. The primary focus of macro ergonomics is to design work systems that are compatible with the sociotechnical system characteristics of organization and to carry that work system design through to the design of human-job, human-machine, human-software, and human-environment interfaces to ensure a fully harmonized work system (Hendrick & Kleiner, 2001).

In Europe, there has been a strong tradition to investigate ergonomic problems within a holistic, systems context. "Macro ergonomic" builds upon this tradition by providing specific methods and tools that yield large-scale results. It is believed that meaningful and large-scale results are needed in competitive nowadays and turbulent work environments (Kleiner et al., 2006).

Macro ergonomic has the potential to improve organizations by ensuring that their work system designs harmonize with their critical sociotechnical characteristics. A widely accepted view among system scientists is that for all complex systems the whole is more than the simple sum of its parts. Accordingly, when organizations have been effectively designed macro ergonomically, and that effort is carried through to the micro ergonomic design of jobs, and related human-machine and human-software interfaces, improvements, such as reducing accidents and injuries by 50% to 90%, or greater, should be possible (Hendrick, 2000).

Macro ergonomics is not only reducing accidents and injuries happen in a company, but also offers personnel-related and material-equipment benefits. The personnel-related benefits from implementing macro ergonomics are:

- a. Increased output per worker.
- b. Reduced accidents, injuries, and illness.

- c. Reduced training time.
- d. Reduced skill requirement.
- e. Reduced maintenance time.
- f. Reduced absenteeism (Hendrick & Kleiner, 2001).

Macro ergonomic requires equal consideration to all major components of the system such as human, hardware, software, and organizational structure. It is important to pay attention to human and organizational aspects of the macro ergonomic process from early design phase (Azadeh & Nouri, 2005). Hendrick (2007) reported that using macro ergonomic in work, cause a 50% to 90% increase in efficiency of organizational and also a 200% increase in productivity.

Review of macro ergonomic methods by 1996, the development of new methods for macro ergonomic analysis, design, and evaluation of work systems had reached the point where the US Human Factors and Ergonomics Society's Organizational Design and Management (ODAM) Technical Group formally changed its name to the Macro-ergonomics Technical Group. The new methods designed for macro-ergonomics methods are the anthropotechnology, Systems Analysis Tool (SAT), Macro Ergonomic Analysis of Structure (MAS), and Macro-ergonomic Analysis and Design (MEAD) (Akbari et al., 2014).

#### b. Structural dimensions

The MAS method overcomes the problems of traditional organizational design approaches by integrating some empirically developed models to determine an effective structure for a work system. The MAS method combines the developed analytical models of the effect of 3 major sociotechnical system elements. The majors are the technological subsystem, personnel subsystem, and relevant external environment; and it is combined with the fourth major element, the structure of organization work system (Kleiner & Hendrick, 2008).

In order to apply the MAS methodology, it is a must to understand the basic elements of work system structure. The structure conceptually consists of 3 dimensions, they are complexity, formalization, and centralization (Bedeian & Zammuto, 1991; Robbins, 1983).

Kleiner & Hendrick (2008) in their journal explained about the MAS dimensions. Complexity refers to the degree of differentiation and integration in the work system structure. Formalization refers to the degree to which jobs within the work

system are standardized. Highly formalized designs are characterized by explicit job descriptions, extensive rules, and clearly defined standardized procedures covering work processes. The simpler and more repetitive the jobs to be designed into the work system, the higher should be the level of formalization. However, care must be taken to not making the work system so highly formalized that jobs lack any intrinsic motivation, fail to effectively utilize employee skills, or degrade human dignity. Centralization refers to where formal decision-making occurs. In highly centralized work systems, formal decision-making is concentrated in a relatively few individuals; lower-level employees have only minimal input into the decisions effecting their jobs. In highly decentralized requires lower level employees to have higher level of education and training or professionalism. It needs to be understood that work systems carry out two basic forms of decision making, they are strategic and tactical. Strategic decision making may require highly centralized, while tactical decision making may be highly decentralized. To differentiate centralized and decentralized, here are the characteristics when they are needed. Centralized is desirable when a comprehensive perspective is needed; when it provides significant economies; for financial, legal, or other decisions that clearly can be done more efficiently when centralized; when operating in a highly stable and predictable external environment; and when the decisions have little effect on jobs of the employees or are of little interest of them. For the decentralized, it is desirable when organization needs to respond rapidly to changing or unpredictable conditions; when grassroots input to decisions is desirable; to provide employees with greater intrinsic motivation, job satisfaction, and sense of self-worth; when it can reduce stress and related health problems by giving employees greater control over their work; to more fully utilize the mental capabilities and job-related knowledge of employees; to gain greater employee commitment to, and support for, decisions by involving them in the process; when it can avoid overtaxing a given manager's capacity for human information processing and decision making; and to provide greater training opportunity for lower-level managers.

It has mentioned above that complexity refers to differentiation and integration. Differentiation refers to the degree to which the work system is segmented into parts, the common types of differentiation are vertical, horizontal, and spatial.

Vertical differentiation refers to the number of hierarchical levels separating the chief executive position from the jobs directly involved with the system output. Horizontal differentiation refers to the degree of departmentalization and specialization. There are two commonly used ways to determine whether or not a work group should be divided into one or more departments. These are the degree of commonality of goals and time orientation. The more the subgroups differ either in goals or time orientation, the greater they should be structured as separate departments. Spatial dispersion refers to the degree that activities in an organization are performed in more than one location. Three different measures commonly are used to quantify the degree of spatial dispersion, they are the number of geographic locations comprising the total work system, the average distance of the separated locations from the organization's headquarters, and the proportion of employees in these separated units in relation to the number in the headquarters (Hall et al., 1967). Increasing any of vertical, horizontal, or spatial increases the complexity of work system.

As the size of an organization increases, the number of employees also increases and affects the vertical differentiation. The reason for this relationship is the practical limitation of span of control. Span of control refers to the number of people reporting directly to the next level in the hierarchy (McShane & Glinow, 2000). One manager is limited in the number of subordinates whom he can direct effectively. Thus, as the number of first level employees increases, the number of first line supervisors also increase. This requires more supervisors at each successively higher level and results more hierarchical levels of organizational structure. A major factor affecting span of control is the degree of professionalism (education and skill requirements) designed into jobs of employees. The higher the level of professionalism, the more employees are able to function autonomously and need less supervision. Other factors affecting span of control are the degree of formalization, type of technology, psychosocial variables, and environmental characteristics. At the other hand, the horizontal differentiation can increase the complexity level because it requires more sophisticated and expensive methods of control. The span of control depends on the presence of other coordinating mechanisms, a wider span of control is possible when employees perform similar tasks or have routine jobs. In these situations,

organization relies more on standardization of work processes to coordinate work (McShane & Glinow, 2000).

Integration refers to the number of mechanisms designed for ensuring communication, coordination, and control among the differentiated elements. The greater the differentiation means the greater the integration. Types of integrating mechanisms are formal rules and procedures, committees, task teams, liaison positions, and system integration offices. Having too few integrating mechanisms will result in inadequate coordination and control among the differentiated elements, while having too many will stifle the function of work system and increase costs.

#### c. Sociotechnical Elements

The MAS method combines 3 major sociotechnical elements with the structure of organization work system as mentioned before. The first element is technological subsystem. Perrow (1967) developed a knowledge-based classification scheme with 2 underlying dimensions of it. The first dimension is task variability, refers to the number of exceptions encountered in one work. The second dimension is task analyzability, refers to the type of search procedures one has available for responding to task exceptions. The search procedures range from “well-defined” to “ill-defined”. At the well-defined’s end of the continuum, problems are solved using rational-logical, quantitative, and analytical reasoning. At the ill-defined’s end, there are no readily available formal search procedures, and one must rely on experience, judgment, and intuition to solve problems.

The second element of the MAS method is personnel subsystem, there are 3 characteristics that are related with this element. The characteristics are degree of professionalism, cultural factors, and psychosocial aspects. Professionalism creates internal formalization of behavior through a socialization process that is an integral part of the education and training process. The lower the formalization, the higher the level of professionalism. The cultural factors discuss about the importance of considering the values, perceptions, mores and attitudes of the culture from which the work force is drawn. Psychosocial factors refer to the cultures affection to the work force.

The third element is the external environment. Negandhi (1977) identified 5 steps affection of external environment, they are socioeconomic, educational, political, cultural, and legal. Socioeconomic is about the degree of stability, nature of competition, and availability of materials and qualified workers. Educational is about the availability of facilities and programs, and the educational level and aspiration of workers. Political is about the government attitudes toward business, control of prices, and pampering of industrial worker. Cultural is about social status, values and attitudes toward work, the nature of trade unions and union-management relationships. Legal is about the degree of legal controls, restrictions, and compliance requirements.

One of particular importance to work system design is all specific task environments vary along change and complexity (Duncan, 1972). This one is called as environmental uncertainty. Degree of change refers to the characteristic of environment, dynamic or stable. Degree of complexity refers to the number of components that constitute an organization's relevant external environment. For stable environment, high to moderate vertical and horizontal differentiation, formalization, and centralization are the most suitable. For dynamic environment, low vertical differentiation and formalization, decentralized tactical decision-making, and high level of professionalism are the most suitable. After completing those steps above, weighting them are suggested to indicate that a moderately formalized or centralized work system would work best. The results would indicate that most jobs should be redesigned to require a somewhat lower level of professionalism or other things.

The complete explanation of MEAD procedure was given by Stanton et al., (2005) in their book entitled Handbook of Human Factors and Ergonomics Method. There are 10 steps in MEAD method, they are:

a. Scanning the environmental and organizational subsystems

Achieving a valid organization/environment fit and joint optimization are essential. Formal company statements about mission, vision, and principles are identified and evaluated with respect to their components in an effort to assess variances between what is professed and what is practiced. System scanning involves defining the workplace in systems terms, a process that includes defining boundaries. The organization mission is detailed in systems terms (inputs,

outputs, processes, suppliers, customers, internal controls, and feedback mechanisms). The system scan also establishes initial boundaries of the work system. In the environmental scan, the sub environments of organization and the major stakeholders within these sub environments are identified. Their expectations for the organization are identified and evaluated. Entities outside the boundaries identified during the system scan are part of the external environment.

b. Defining production system type and setting performance expectations

The production type can help determine optimal levels of complexity, centralization, and formalization as well. The system scan performed in the previous phase should help in this regard, and the analyst should consult available production models. In this context, key performance criteria related to the organization purpose and technical processes are itemized. This entails a determination of success factors for products and services, but it can also include performance measures at other points in the organization system, especially if decision making is important to work-process improvement.

c. Defining unit operations and work process

Unit operations are groupings of conversion steps that together form a complete piece of work and are bounded from other steps by territorial, technological, or temporal boundaries. Unit operations often can be identified by their own distinctive sub product and typically employ 3 to 15 workers. They also can be identified by natural breaks in the process. For each unit operation or department, the purpose/objectives, inputs, transformations, and outputs are defined. If the technology is complex, additional departmentalization may be necessary. If collocation is not possible or desirable, spatial differentiation and the use of computerized integrating mechanisms may be needed. If the task exceeds the allotted schedule, then work groups or shifts may be needed. Ideally, resources for task performance should be contained within the unit, but interdependencies with other units may complicate matters. In these cases, job rotation, cross training, or relocation may be required. The current work flow of the transformation process (i.e., conversion of inputs to outputs) should be flowcharted, including material flows, workstations, and physical as well as informal or imagined boundaries. The purpose of this step is to assess improvement opportunities and coordination problems posed by technical design



or the facility. Identifying the work flow before proceeding with detailed task analysis can be helpful. Once the current flow is charted, the macro ergonomist or analyst can proceed with a task analysis for the work-process functions and tasks.

d. Identifying variances

A variance is an unexpected or unwanted deviation from standard operating conditions, specifications, or norms. STS distinguishes between input and throughput variances. For the ergonomist, identifying variances at the process level as well as the task level can add important contextual information for job and task redesign to improve safety and quality performance. By flowcharting the current process and the detailed task analysis, which corresponds to the flowchart, the macro ergonomist or analyst can identify variances.

e. Creating the variances matrix

Key variances are those variances that significantly impact performance criteria and/or may interact with other variances, thereby having a compound effect. The purpose of this step is to display the interrelationships among variances in the transformation work process to determine which ones affect which others. The variances should be listed in the order in which they occur on the y-axis and the horizontal x-axis. The unit operations (groupings) can be indicated, and each column represents a single variance. The ergonomist can inspect each column to see if this variance causes other variances. Each cell thus represents the relationship between two variances. A blank cell implies that two variances are unrelated. The analyst or team also can estimate the severity of variances by using a Likert-type rating scale. Severity would be determined on the basis of whether a variance, or combination of variances, significantly affects performance. This should help identify key variances. A variance is considered "key" if it significantly impacts quantity of production, quality of production, operating costs (utilities, raw material, overtime), social costs (dissatisfaction, safety), or if it has several relationships with other variances (matrix). Typically, 10 to 20% of the variances are significant determinants of the quality, quantity, or cost of product.

f. Creating the key variance control table and role network

The purpose of this step is to discover how existing variances currently are controlled and whether personnel responsible for variance control require

support. The key-variance control table includes the unit operation in which variance is controlled or corrected; who is responsible; what control activities are currently undertaken; what interfaces, tools, or technologies are needed to support control; and what communication, information, special skills, or knowledge are needed to support control.

A work role comprises the actual behaviors of a person occupying a position or job in relation in a role set, while a role set is a group of people who send expectations and reinforcement to the role occupant. Role analysis addresses who interacts with whom, about what, and how effective these relationships are. This relates to technical production and is important because it determines the level of work system flexibility.

In a role network, the role responsible for controlling key variances is identified. Although there may be multiple roles to satisfy this criterion, there is often a single role without which the system could not function. With the focal role identified within a circle, other roles can be identified and placed on the diagram in relation to the focal role. Based upon the frequency and importance of a given relationship or interaction, line length can be varied, where a shorter line represents more or closer interactions. Finally, arrows can be added to indicate the nature of the communication in the interaction. A one-way arrow indicates one-way communication and a two-way arrow suggest two-way interaction. Two one-way arrows in opposite directions indicate asynchronous (different time) communication patterns. The relationships in the role network are now evaluated. Internal and external customers of roles can be interviewed or surveyed for their perceptions of role effectiveness. Also, the organizational design hypotheses can be tested against the detailed analysis of variance and variance control. The role analysis and variance control table may suggest, for example, a need to increase formalization. If procedures are recommended to help control variances, this increase in formalization must be evaluated against the more general organizational design preferences suggested by the environmental and production system analyses.

g. Performing function allocation and joint design

Preliminary allocations can be made to the human(s), machine(s), both, or neither. In the latter case, a return to developing requirements may be appropriate using four categories of criteria: technical feasibility, health and

safety, operational requirements (i.e., physical, informational, performance), and function characteristics (i.e., criticality, unpredictability, psychological). Technical changes are made to prevent or control key variances. Human-centered design of the following may be needed to support operators as they attempt to prevent or control key variances: interfaces, information systems to provide feedback, job aids, process control tools, more-flexible technology, redesigned workstation or handling system, or integrating mechanisms. After that, it is time to address knowledge and/or skill requirements of key variances and any selection issues that may be apparent. In the variance control table, we identified who controls variances and the tasks performed to control these variances. At this stage, we suggest personnel system changes to prevent or control key variances. This may entail specific skill or knowledge sets that can be acquired through technical training, formal courses, workshops, or distance learning.

At this juncture, organizational design hypotheses have been generated and iteratively adjusted as new analyses are performed. The next is taking the specifications for organizational design levels of complexity, centralization, and formalization and produce specific structures. Depending upon the level of work-system process analysis, this may require design/ redesign at the organizational level, the group/ team level, or at both levels.

#### h. Understanding roles and responsibilities perceptions

It is important to identify how workers perceive their roles documented in the variance control table. Through interviews, role occupants can participate in an analysis of their perceptions of their roles. Using the previously constructed table, expected roles, perceived roles, and any variances can be identified. Variances can be managed through training and selection as well as technological support. Essentially, two role networks are operating: the one needed and the one perceived. Any variation between the two can be reduced through participatory ergonomics, training, communication, interface design, or tool design.

#### i. Designing/ redesigning support subsystems and interfaces

The other internal organizational support subsystems may require redesign. The goal is to determine the extent to which a given subsystem impacts the sociotechnical production system, the nature of the variance, the extent to which the variance is controlled, and the extent to which tasks should be taken into account in the redesign of operating roles in the supporting subsystem units.

The method of function allocation, individual and cumulative allocations made on a provisional basis earlier can be further evaluated with respect to requirements specifications, including resources available at the time of implementation (including human and financial) and the total outcome. In addition to an audit of function allocation, interfaces among subsystems should be checked and redesigned at this juncture. Especially at the team and individual levels of work, the internal physical environment should be ergonomically redesigned if necessary to promote human well-being, safety, and/or effectiveness. Evaluating the technical and personnel variance analyses, we can assess whether there are physical environmental changes that will promote improvement.

j. Implementing, iterating, and improving

At this point, it is time to execute or implement the work-process changes prescribed, design interfaces, and allocate functions to the formal organizational structure. Based on the feedback from them, modifications to the proposal may be necessitated, which will require a return to the previous step.

The implementation of macro ergonomics changes sometimes can not be done into the work system directly. In some situations we start the implementation from the micro ergonomic step and give positive impacts first to make the company interests with the macro ergonomic programs (Dewi, 2007). There are 3 integration models of macro and micro ergonomic that has been developed, first is doing the micro ergonomic step and followed by macro ergonomic step, second is doing the micro ergonomic and macro ergonomic at the same time, third is doing the macro ergonomic step and followed by micro ergonomic step. It depends on the management system characteristics to choose the model that suitable to the company. The examples of management system characteristics are the ratio of the workers based on the gender, the age range of the workers, the origin of workers mostly, etc.

#### **2.2.4. Validity test**

Validity test is conducted usually when the method in gathering the data is distributing questionnaires. Since the research used the questionnaires for gathering the data, it will need validity test but the test was not conducted. Based on the theory from Sekaran & Bougie (2013), validity is a test of how well an instrument that is developed measures the particular concept it is intended to

measure. Validity test is used to make sure that we are actually measuring the concept that we set out to measure. This ensures that in operationally defining perceptual and attitudinal variables, we have not overlooked some important dimensions and elements or included some irrelevant ones. Kuncoro (2009) also explain about the validity test. He mentioned after identifying and defining the important variables conceptually, a type of scale has to be chosen. For choosing the suitable scale, the researcher has to choose the instrument that can measure correctly and consistent to achieve the objective of the research. This process is called as evaluation about the measurement scale and concern about the validity and reability.

