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# Model-based fault analysis of communication between supervisors and their subordinates in the Japanese workplace

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## ABSTRACT

This paper uses model-based fault analysis to identify the functions and factors that may cause miscommunication between supervisors and their subordinates. In describing the system model, a system-engineering approach is used to clearly define behaviors and interactions between supervisors and subordinates in the Japanese workplace. Semi-structured interviews were conducted to extract system requirements, and the functional architecture is described. The system model was verified by interviewing business persons. Using the system model, we identify the major functions and factors disrupting communication.

## 1. INTRODUCTION

According to a report by the Japan Institute for Labour Policy and Training [1], the biggest factors contributing to long work hours and low labor productivity in the Japanese workplace are a lack of planning and an unclear vision communicated by supervisors to their subordinates. In a dynamic country such as Japan, supervisors tend to be vague when directing their subordinates, which often results in communication faults and reworking.

Beginning with seminal studies by Ohio State University [2], several taxonomies of leadership behavior have been proposed [3-7]. Yukl et al. described 12 categories of leader behavior [6], and Mintzberg functionally categorized it into 10 roles [7]. Although theories and research on leaders and leadership abound, followers and followership theory have been given short shrift [8-10]. Kelley defined the ideal follower [14], and Chaleff proposed four different follower styles [15]. Organizational studies of leadership [2-7] and followership [8-15] have identified individual activities such as short-term planning, clarifying task objectives and role expectations, and monitoring operations and performances; however, they do not specify how leaders or followers can achieve their ideal behaviors or roles. Moreover, these studies have the implicit premise that directions from leaders to their followers are correctly commanded and have not considered communication with regard to work direction from supervisors and their subordinates.

Studies on communication models have also been conducted [19-21]; however, mental models of the sender's encoding

process and the recipient's decoding process were not described in detail in those works. The processes associated with ambiguous encoding and decoding can complicate communication, resulting in misinterpretation. To identify the factors disrupting communication between supervisors and their subordinates, it is necessary to describe the thinking and decision-making processes of each actor and to clarify the flow from thoughts to verbal communication.

In this paper, with the aim of analyzing faults in communication related to work direction and vision, the behaviors of supervisors and their subordinates and the interactions between them are described via a model commonly used in systems engineering [23]. Our model's system of interest is a supervisor overlooking a life cycle of supervisor's system model in the frame of personnel-labor management. Analysis of requirements was conducted by means of a semi-structured interview with four workers in the automobile industry and verified on the basis of studies of leadership. The activity diagram defining supervisors' behavior was verified by interviewing 22 business persons in various industries. By analyzing faults in communication based on the activity diagram, we found three major functions and root causes that disrupt communications in the Japanese workplace.

## 2. LITERATURE REVIEW

Beginning with the Ohio State University studies [2] conducted in the 1940s and 1950s, several taxonomies of leadership behaviors have been proposed [3-7]. Yukl et al. described 12 categories of leader behavior, including planning

short-term activities, clarifying task objectives and role expectations, monitoring operations and performance, supporting, developing, recognizing, consulting, empowering, externally monitoring, envisioning change, encouraging innovating thinking, and taking personal risks [6]. Mintzberg functionally categorized 10 roles played by managers, namely, figurehead, leader, liaison, monitor, disseminator, spokesman, entrepreneur, disturbance handler, resource allocator, and negotiator [7].

Although theories and research on leaders and leadership abound, followers and followership theory have been given short shrift in the literature [8-10]. When followers have been considered, they have been envisioned as recipients or moderators of the leader's influence [11] or as "constructors" of leaders and leadership [12,13]. Kelley defined the ideal follower as participating in a joint process of achieving some common purpose [14]. He ascribed to "effective followers" an array of positive qualities, including self-motivation, independent problem solving, and commitment to the group and the organization. Chaleff proposed four different follower styles: implementer, partner, individualist, and resource, using axes ranging from low to high support and low to high challenge to the leader [15].

The effort to describe the relationship between leaders and followers can be seen in contingency or leader-member exchange (LMX) theories. The contingency theory of leadership views followers as a "situational" factor that leaders must manipulate to achieve specific outcomes [16]. LMX theory emphasizes transaction or exchange between leaders and followers [17]. The focus in LMX theory is on how leaders and followers engage together to generate high-quality work relationships that allow them to produce effective leadership outcomes [18].

These studies have clarified the ideal behaviors or roles of leaders and followers, but not how to achieve them. Moreover, these studies have the implicit premise that directions are correctly communicated from leaders and do not consider communication with regard to the work direction from supervisors and their subordinates. We should consider not only what leaders or followers *should* do in the ideal situation, but also how these roles and behaviors interact. To identify misinterpretations of communication regarding work direction and vision, we must clarify how these behaviors interact.

Studies on communication models describe exactly how a speaker or sender's intended meaning is conveyed to a recipient, listener, or receiver [19-21]. Shannon et al. defined a process by which a message is encoded and sent as a signal through a channel adapted for transmission; after passing through this channel, the message is then decoded before reaching the receiver at its final destination. They noted that noise or interference could be also carried as the signal passed through the channel [19]. Berlo presented several factors that influence the communication process between two people, including communication skill, cognitive level, and attitude [20]. Barnlund proposed a communications-transaction model that showed that an individual could both send and receive messages at the same time. He also indicated that, as information moved from one individual to another, the intended meaning of the message's

content may change because of differing personal filters for interpreting the message between the sender and recipient [21].

These studies have shown that when messages are exchanged between senders and recipients through noisy channels, there may be differences between the message that is conveyed and how the content is understood. However, there has not been sufficient discussion of how encoding and decoding are performed, and what factors inhibit the success of these processes. Moreover, it has not been considered that what senders want to convey may not be properly conveyed to others. Gilovich et al. identified the illusion of transparency, by which individuals often believe their internal states are more apparent to others than is actually the case [22].

The processes associated with ambiguous encoding and decoding may complicate communication and result in misinterpretation. To identify the factors that disrupt communication between supervisors and their subordinates, it is necessary to describe the thinking and decision-making processes of each actor and to clarify the flow from thoughts to verbal communication.

### 3. SUPERVISOR'S SYSTEM MODEL

By conducting a semi-structured interview, we extracted the functions that are important to communication between supervisors and subordinates. We used model-based system engineering to describe the functional expressions we obtained through the interview in a system model.

A semi-structured interview was conducted with four general-position workers below managerial level, working for marketing, human resources, domestic sales, and communications in the automobile industry in order to identify the requirements of the supervisor's system model from the subordinates' point of view. Comments from the interviewees were analyzed by an open-coding method that is the process of breaking down, examining, comparing, conceptualizing and categorizing the data and each data is given a label [24]. We obtained comments such as "sufficient explanation of background of tasks," "clear expectation for subordinates," "allocating tasks suitable to competence," "explaining concrete workflow," "providing supplemental materials," "sharing output images," and "giving proper feedback on what to revise". Twelve of these comments were given labels. For example, for "sufficient explanation of background of tasks," "clear expectation for subordinates," "providing supplemental materials," and "sharing output images," it is interpreted that specific definitions of deliverables and background of information of tasks are required. Therefore, these comments were labeled "sharing context, requirements, and objectives with subordinates". As a result, the final labels for the system requirements were "sharing context, requirements, and objectives with subordinates"; "giving subordinates direction"; "allocating tasks to subordinates"; "confirming subordinates' understanding"; and "giving subordinates feedback on the outcome". Some labels were included as actions in an activity diagram described later. The "sharing context, requirements, and objectives with subordinates" and "giving subordinates direction" labels are identified with the "clarifying task objectives and role

expectations” requirement identified by Yukl; “allocating tasks to subordinates” is similarly identified with “short-term planning,” “confirming subordinates’ understanding” with “consulting,” and “giving subordinates feedback on the outcome” with “monitoring operations”. The verification result indicates that the requirements of the supervisor’s system model are almost the same as what the leader should do in studies of leadership.

In this paper, a supervisor’s system model is addressed, though a subordinate’s system model is also described. A supervisor is defined as the system of interest, and the requirements extracted from the semi-structured interview are analyzed over the life cycle from the frame of personnel–labor management. This consists of assignment, operation, assessment, and retirement stages. The expectation of the supervisor’s system model is to properly order direction and evaluate outcomes in order to avoid long working hours and low labor productivity caused by communication faults and reworking in the Japanese workplace. According to studies of managers’ daily communications, their subordinates and senior supervisors are persons with whom managers spend the most time [25]. Therefore, senior supervisors and subordinates are defined as the external systems in the operations stage. In order to clarify the functionalities of the system, a use case diagram is presented in Fig. 1 and the behavior of the supervisor’s system model is clarified. The system of interest framed by the square has functionalities of “properly order direction and evaluate outcome,” which includes “understanding requirements,” “ordering direction and confirming understanding,” and “giving feedback” as use cases connected by dashed arrows. The system of interest has the senior supervisor and subordinate as external systems. Solid lines from each external system indicate interactions with the system of interest.

In order to describe how supervisors interact with their senior supervisors and subordinates, their behavioral details are first presented in a sequence diagram. Then, the functions of the supervisor are elicited from the sequence diagram; these functions and those gained in the interview are described using an activity diagram, and their actions are allocated to the logical component based on human information processing, including sensory processing, perception/working memory, decision making, and response selection, as identified by Parasuraman

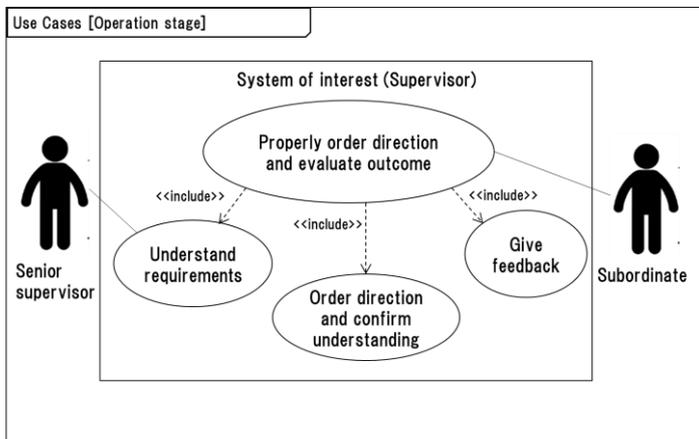


Fig. 1. SUPERVISOR'S BEHAVIOR IN COMMUNICATION, AS DESCRIBED BY A USE CASE DIAGRAM

[26]. In this paper, the logical components are defined as perception, judgment/determination, execution, and evaluation.

Figure 2 shows the activity diagram. The supervisors’ perceived context, requirements, and objectives from their senior supervisors serve as inputs to the perception component. These inputs are then transferred to the action of “understanding context, requirements, and objectives” in the judgment/determination component. The understood context, requirements, and objectives are next transferred to the execution component and shared with their subordinates as output. At the same time, the understood context, requirements, and objectives are transferred to “assign tasks” in the judgment/determination component. The assigned tasks are transferred to “give direction” in the execution component and the direction is shared with their subordinates as output. The direction is also transferred to “evaluate action and provide standard” in the evaluation component for preparation of future action in the next new direction to their subordinates. Supervisors receive their subordinates’ response or inquiry on the direction and recognize the status correctly in judgment/determination component. Then supervisors evaluate outcome or hypothesis and give feedback to their subordinates. If the context, requirements, and objectives are not well understood by supervisors, unclear context, requirements, and objectives are then sent as feedback to their senior supervisors. The process then restarts from the perception component. This iterative process makes communication much smoother.

To verify this activity diagram, we conducted interviews with 22 business persons with experience in the automobile, information technology, electronics, financial services, and education sectors; these included 10 managers and 12 general staff. Comparing the communication process described by the system models with their daily business communications obtained through interviews, we found that the activity diagram was almost the ideal supervisor behavior, as accepted by both senior supervisors and subordinates. Then, we interviewed the 10 managers to identify the functions and factors that disrupt communication. Fault analysis based on this activity diagram is described in the next chapter.

#### 4. MODEL-BASED FAULT ANALYSIS

In this chapter, communication faults are analyzed using the supervisor’s system model to identify where and how they occur among supervisors and their senior supervisors and subordinates. If subordinates receive incorrect output from their supervisors, model-based fault analysis can indicate what caused their supervisors’ actions in the system model.

Interviews with 10 managers from the automobile, information technology, and electronics industries were conducted to confirm whether they performed the communication process described by the supervisor’s system model. These managers, having careers spanning over 20 years, have adequate experience in directing numerous subordinates.

On the basis of our interviews, three major functions that disrupt communication were identified, as highlighted in gray with *italic type* in Fig. 2. These features are what managers say they cannot do well or skip in their daily business

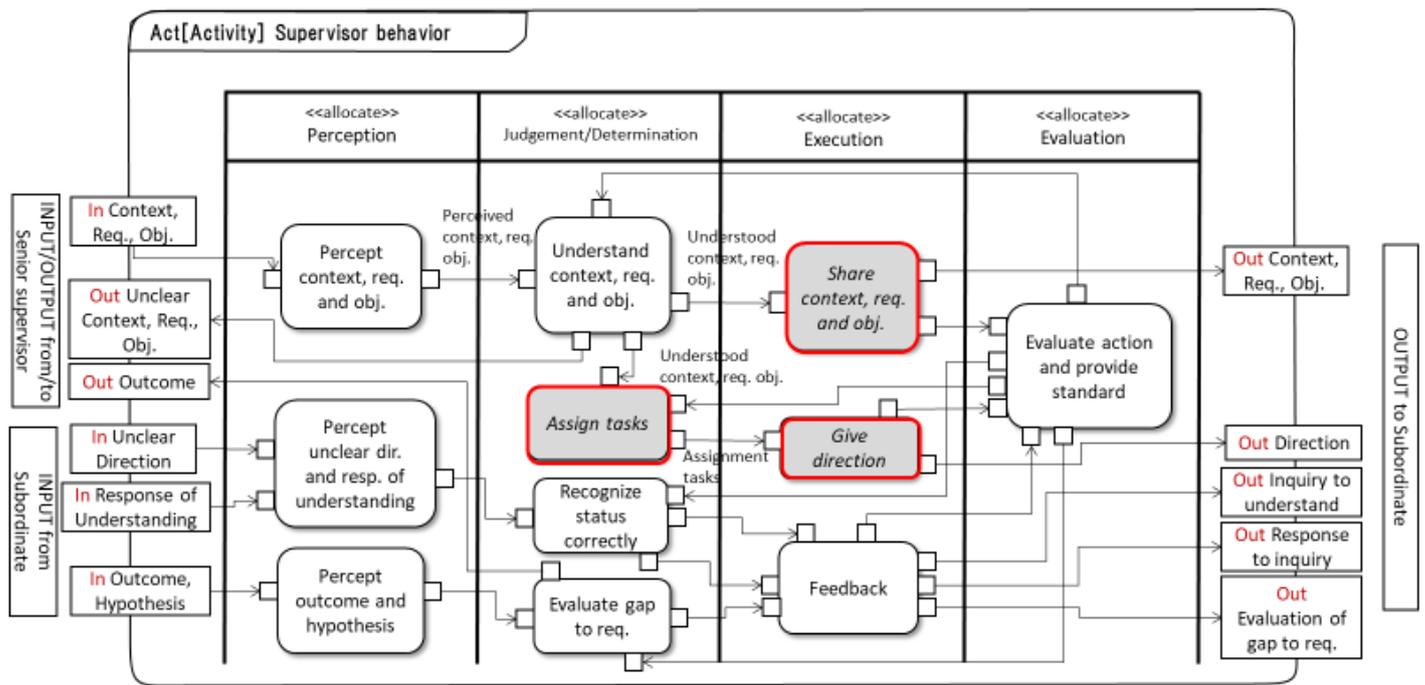


Fig. 2. SUPERVISOR'S BEHAVIOR IN COMMUNICATION, AS DESCRIBED BY AN ACTIVITY DIAGRAM

communication. These three functions are (1) “Sharing context, requirements, and objectives”; (2) “Assigning tasks”, and (3) “Giving direction”. Although “Sharing context, requirements, and objectives” and “Giving direction” are identified as Yukl’s “clarifying task objectives and role expectations” and “Assigning tasks” is similarly identified as “short-term planning,” most of the interviewed managers mentioned that all three functions may not occur regularly, whether intentionally or not.

Faults in the first function are interpreted as meaning that even though a supervisor understands the context, requirements, and objectives of the work direction, they are not capable of communicating it to their subordinates. When this context is not shared adequately, the subordinate's output will be inadequate. This interferes with the subordinate's correct understanding of their supervisors, which is described in the subordinate's system model (although we do not address it in this study). Faults in the second function are based on understanding the context, requirements, and objectives when the supervisor is unable to effectively assign tasks to their subordinates. When the assigned task does not match the capabilities of subordinates, the directions given to subordinates may not be appropriate. Thus, they may ask many questions or be at a loss. Fault in third function means that supervisors are not capable of communicating work direction or vision to their subordinates. There are two possible reasons for failure in this third function. The first reason is that the tasks assigned to subordinates are inappropriate and the direction is not properly transmitted to subordinates. The second reason is that although tasks assigned to subordinates are appropriate, the decision is not transmitted to subordinates because the method of communicating to subordinates is not appropriate. When directions are not conveyed correctly to the subordinates, it may affect their understanding, as clarified in the subordinate's system model.

The interview results tell us (a) that what people understand in their own mind through the perception and judgment/determination components may differ from what they share or communicate to others through the execution component and (b) that lack of ability may cause faults in communication.

By analyzing the system model and considering the activity diagram shown in Fig. 2, we find that supervisors' inability to determine whether their subordinates understand the context of the work direction causes faults in the three functions. Specifically, if supervisors communicate a direction without confirming that their subordinates are competent and understand the direction, communication can be misinterpreted. To eliminate the factors disrupting communication, supervisors should have the capacity to align their subordinates' competence with the context of the work direction.

We have identified and summarized the crucial keywords that clarify why managers cannot implement these three major functions well based on our 10 managerial interviews. Keywords for insufficient “Sharing context, requirements, and objectives” were “no time or busy to share context, requirements, and objectives”; “dependence due to long-term relationship between supervisors and their subordinates”; and “limited communication tools such as telephones, through which it is difficult to share visual images”. Keywords for difficulties in “Assigning tasks” were “lack of capability to identify the competence of subordinates when assigning tasks,” “difficulty in balancing between standardizing task volume or task quality among members of a team and maintaining members' motivation,” “difficulty in maintaining quality of outcomes under budget pressure,” “no time or too busy to assign tasks measuring up to subordinates' capability,” and “inflexibility of assignments due to team structure”. Keywords for insufficiency

TABLE I. FACTORS DISRUPTING COMMUNICATION

Functions	Factors	
	Lack of ability	Constraints
Share context, requirements and objectives	-	Time
		Communication tools
Assign tasks	Task assignment with in a team	Time
	Identification of subordinates' competence	Budget
	Keep subordinates motivated	Flexible assignment
Give directions	Abstraction control	Task discontinuity
		Task volume
		Communication tools

in “Giving direction” were “difficulty in balancing between having their subordinates work according to the detailed directions given to them and having them think about it with a degree of freedom in interpreting the directions,” “no time or too busy to give directions properly,” “task discontinuity for giving direction all at once,” and “limited communication tools”. These keywords are divided between a lack of ability that supervisors can control by themselves and constraints or given conditions that are beyond the supervisors' control.

Table I lists the root causes of communication misinterpretation in terms of the three primary functions, as categorized into a lack of ability and their constraints. The lack of ability includes the task assignment within a team, identifying the competence of a subordinate, upholding the motivation for assignment tasks, and abstraction control for communicating directions. It is suggested that the lack of ability to control the level of abstraction of expression leads to poor communication, which is the cause of improper direction (which was the third function). The constraints include time; communication tools for sharing context, requirements, and objectives; budget; the flexibility of assigned tasks; task discontinuity; task volume; and tools for communicating directions. A list of inability suggests areas in which supervisors need to be trained and implies that the list can be utilized for an education program. A list of constraints implies the possibility of generating a variety of system models. If the time constraint is not solved, some processes may be skipped, causing gaps in expectation between supervisors and subordinates. This tells us the supervisor's system model can be tailored depending on constraints.

In this work, we found that a system model description can effectively assist in finding the root causes of a communication fault between supervisors and their subordinates.

### 5. CONCLUSIONS

Taking a systems-engineering approach, we presented a system model for supervisors in the Japanese workplace. The activity diagram defining supervisors' behavior was verified by interviewing 22 business persons from various industries. We analyzed faults in communication using this activity diagram and found three major functions in which faults can disrupt communications. These were (1) “Sharing context, requirements, and objectives”; (2) “Assigning tasks”; and (3) “Giving direction”. We conducted further analysis to identify the root causes of misinterpreted communications, as categorized on the basis of whether they involve a lack of ability or external

constraints. In the organizational literature, these factors are not evoked as barriers to communication between supervisors and subordinates. The list of inability can be used for education, and the list of constraints implies that the supervisor's system model may vary.

We have identified a few points for future research. First, the supervisor's system model should be modified to include real-world constraints, task uncertainty, and emotional aspects that may cause troubles in relationships. If the ideal system model described in this paper is pursued too far, it will become difficult to apply it in reality; thus, it is necessary to construct a system model that can be easily accepted. Second, it must be shown that the supervisor's system model can contribute to smooth communication and behavioral change through field experiments in an organizational setting.

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