Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

A Model for Measuring Communication Problems in Service Processes

Dagoberto Alves de Almeida[a]

[a] Production Engineering and Management Institute, Federal University of Itajubá (UNIFEI), Brazil.

Tainá da Costa Neves[b]

[b] Brazilian Aircraft Enterprise (EMBRAER), Brazil

ABSTRACT

This paper proposes a model for measuring relationships in service processes from a knowledge management approach. The model analyzes the discrepancies between supplier's suppositions and client`s expectations by means of a semantic indicator. As a consequence, the model provides knowledge to promote communication improvements and better methods and procedures. The research was conducted by means of the Soft Systems Methodology. The research is related to the electricity supplying attendance chain of a major Brazilian utility Company. The study considers the service process dynamics of the energy restoring service in terms of the relationships among clients, Call Center, Control Center and field teams. As a research finding it may be said that miscommunication among the service chain nodes jeopardizes the quality of the relationship contributing to poor service. However, despite the importance of measuring the customer satisfaction it is equally relevant to measure how the service is produced, particularly, in terms of the personnel´s perceptions and their tacit and explicit communication. This paper contributes with a practical, useful and straightforward way of measuring relationships, particularly, the understandability supposedly provided by communication. The model also provides managerial intervention properly supported by effective communication, i.e., without misunderstanding along the service process line.

Keywords*: Interpersonal communication measurement, Service process*

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

lines, Electric Distribution Company, Soft System Methodology; Knowledge management.

INTRODUCTION

This research is based on the ground that a work, in order to be properly performed, must rely on well trained and motivated personnel. Accordingly, training and motivation is dependent on cognitive aspects, such as the worker interest in learning from a related piece of information. Information such as procedures, messages, norms and so on, is based on the idea that there should be an environment capable of allowing learning (Argyris, 1977), and personnel capable of understanding and adopting it. The assumption taken in this research is that learning is the basis for understanding, which by its turn, is dependent on appropriate interpersonal and procedural communication. In addition, good communication reduces misunderstandings between supplier`s suppositions and client`s expectation in service chains and, consequently, empowers relationships. The consequence is the production of better services as translated by a number of criteria such as the quality of the provided service, its cost and attendance promptness.

This paper deals with the exchange of information in service process chains. An algorithm is proposed to evaluate the degree of miscommunication along several attendance process stages of a service chain. A utility electric company case study provides the service chain to test the proposed model. The service chain is combined by three relationships: the customer makes requests to the call centre; which passes the requisition to the Operational Control Centre; which, by its turn, allocates tasks and resources to the field teams.

People communicate by combining tacit and explicit ways, i.e., verbally by means of conversation and formally through standardized rules. Accordingly, routines and procedures should allow understanding since they are actually vehicle of non verbal communication. The act of making methods explicit through a routine is based on the premise that methods are developed from a combination of the knowledge present in the current state of the art and, as well as, from personnel knowledge. Guarantee quality of communication is capital for the excellence of the provided service. As a consequence, measuring communication may provide proper managerial intervention, by

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

using and producing adequate methods by knowledgeable personnel.

LITERATURE REVIEW

Knowledge, as a consequence of reflected information, is created and used by people capable to interrelate by means of proper communication. In this manner, knowledgeable personnel are more capable to produce service with better quality since they perform processes that are known by themselves or should be known. Such reasoning conducts the following review. The premise that KM accounts for the attendance service process excellence is associated to the system capability to avoid any disruption that may jeopardize the expected system performance. The system performance, in terms of prompt and effective customer attendance, affects the very company's energy concession rights. Beforehand, KM approached as a problem-oriented domain must provide solution to interpersonal mistakes e failures, many of them misguided by inadequate methods and routines. Such issues consider knowledge as a company asset, which requires the intellectual capital to be preserved and in conditions to be constantly evolving (Liebowitz and Wright, 1999; Wilkins *et al*., 1997).

Nonaka and Takeuchi (1997) define information as a flow of meaningful messages. Still, Davenport and Prusak (1998) synthesize the same concept by simply stating that information is data that matters. Differently from data, information has a meaning. It is organized to accomplish some purpose. Thus, data becomes information when its creator adds meaning to it. Yet, Davenport and Prusak (1998) define knowledge as being a flowing mixture of experiences, values, information and skilled perceptions that supply context for evaluation and incorporation of new experiences and information. Knowledge is intrinsically associated to complex cognitive processes: perception, learning, communication, association and reasoning. Therefore, cognition depends on communication that, by its turn, is essentially a fundamental relationship issue (Mercer *et al*., 2005; Goodhew, Cammock and Hamilton, 2005; Moore, 2001). In accordance, communication is defined as a two way process of sending messages and listening shared understanding (Morgan and Hunt, 1994; Duncan and Moriarty, 1998). Actually, according to Lang (2004), anything that encourages or inhibits interpersonal communication affects knowledge transference.

Gudykunst (1993) defines communication competence as a

BJ Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

minimization of misunderstandings. Misunderstandings may happen between a particular supplier node (processing stage) and a specific customer node. Accordingly, among a bunch of people the possibility of being misunderstood is amplified and, as a consequence, escalating the odds of getting undesirable outcomes.

Misinformation may lead to miscommunication, i.e., a communication failure (Austin, 1962). However, miscommunication may happen even when the information is correct. In this case, cognitive reasons may play a major role, some of them provoked by different shared semantics, a common ground related to meaning, a fundamental element to the process of transmitting and understanding information. Schwartz (1998) alerts that shared semantics, despite being an essential part of interpersonal communication, is commonly taken for granted. It is only when communication breaks down developers initiate an introspective process in an attempt to determine where the lack of understanding lies.

Communication, knowledge and relationships are, actually, intangibles. Despite the undeniable importance of the intangibles they are rather complex to measure and their inherently surroundings subtleties bring difficulties to replicate any possible benefit. Despite their intangible nature, relationships and the intrinsic related communication aspect may be measured as stated by Roberts, Varki and Brodie (2003). Accordingly, strong interest in management approaches that use performance indicators has been increasing (Marr and Schiuma, 2003). As an example, Robinson and Morley (2006) point out that call centers could be better managed if a wider range of means and measures were used. However, despite their importance there was no reported measure explicitly related to communication among the service chain personnel, those ones responsible for getting things done. Such an issue becomes relevant since communication is recognized as a major organizational asset (Malmelin, 2007). In addition, Mukherjee and Malhotra (2006) pointed out that service personnel, particularly those related to Call Centers, suffer from inadequate role clarity and, as a consequence, jeopardize service quality perceived by their clients.

The client's quality perception depends, previously, on the system capability of producing quality along the processing stages. Though, quality seen from the operational viewpoint ought to rely on Garvin's manufacturing-based quality definition (Garvin, 1988), which states that quality should not

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

be, merely, an internal issue, but connected to the final customers' needs and expectations. Therefore, the merit of all production efforts supported by methods and procedures should allow customers, service providers, suppliers and operational personnel to formally and continuously understand each other in order to produce quality for the end customer. The designing and operation of a service process must consider how the processing stages will interrelate.

When measuring quality in services the focal viewpoint is the customer perception, as approached by models such as the SERVQUAL (Badri, Abdulla and Madani, 2005; Parasuraman, Zeithaml, and Berry, 1985). However, the question lies on how to measure quality service according to those responsible for providing the service? This research addresses the course of constructing quality along a service processing chain, without losing the customer perspective by having the interpersonal communication, based on tacit and explicit information, as a major pillar. Accordingly, communication as a service quality dimension must be based on *understandability*.

Understandability is the expected communication capability: tacitly provided by a meaningful dialogue; explicitly granted by suitable procedures, routines or methods. Actually, well designed procedures allow proper understanding among involved personnel, which, by its turn, help to criticize the current method and improve it. In the roll of service process, this research will adopt Lievens, Moenaert and S'Jegers (1999) definition of communication quality: *the degree to which relevant and understandable information reaches the intended information sources/receivers in time*."

Unfortunately, structured and formal ways of communication such as the ones provided by routines and procedures commonly disrupt their major goal of making the method understandable. Otter and Emmitt (2007) explain that team members from organizations using different information systems tend to have different understandings, opinions and rates of adoption, as well as different skills levels regarding specific Information Technology (IT) tools. Such interpersonal barriers may jeopardize the method design. Kelly (2000) lists some interpersonal barriers such as semantics and inconsistent verbal and nonverbal communication, absence of formal communication channels, technical and in-group language, and Information overload. The cognitive process of understanding what is requested and, as a consequence, transferring and aggregating meaningful information between service stages depends on the quality of the communication among people, and the way they relate to

BJ Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

one another. Nonetheless, Koulikoff-Souviron and Harrison (2007) verified that inter-organizational human resources practices, such as communication, are usually weakly prioritized and not clearly identified and supported and, as a consequence, informal processes emerged to help compensate the lack of flexibility of formal processes.

METHODOLOGY

Due to the empirical nature of mostly Operations Management (OM) issues, particularly when concerned to qualitative research, Action Research has presenting itself with the potential to contribute to OM knowledge and practice (Coughlan and Coghlan, 2002). The methodological approach applied in this research is the Soft Systems Methodology (SSM), an Action Research approach to organizational process modeling (Checkland and Scholes, 2004).

The SSM use to develop the Communication Measuring Model considered three cycles. The first cycle is related to preliminary assumptions surrounding the problematic situation, which was the poor service possibly derived from miscommunication along the chain. One of the issues considered by the “rich picture” of the real world was the root definitions. One of these definitions considered the criteria to evaluate service and communication. As the steps progressed the scenery became clearer, producing the first table of incongruence between clients´ expectations and suppliers´ suppositions (Diagnosis Matrix) and the concerning requests for improvements. The first cycle ends with the decisions of defining the service chain, accomplishing the improvements and developing an indicator capable of measuring the level of miscommunication along the line.

The second cycle starts with the mission of developing the so called Semantic Indicator. Once the improvements are accomplished the personnel involved is again confronted with the same enquiries and their answers are compiled in another table called Improvement Matrix. Both Diagnosis and Improvement matrices are measured with the Semantic Indicator. After deliberations on the collected data and on the consistency of the indicator the actors involved decided to set another cycle to develop a complete model capable of collecting communication data and measuring the relationship of the service line.

The third cycle establishes the model as presented in the next section. The model presents itself as capable of measuring misunderstanding along

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

the service chain (client → Call Center → Control Center → field teams). The expected outcome is quicker and better energy reestablishing as a consequence of an improved emergency attendance process.

Table 1 applies the SSM's seven stage methodology to the development of the Communication Measuring Model (CMM).

Table 1. Using SSM to develop the Communication Measuring Model

SSM	1st cycle Preliminaries	2nd cycle Model feasibility	3rd cycle Building the Model
1. Problem situation	The evidence: poor service along the attendance chain due to communication problems	An indicator to evaluate how the attendance service may be measured.	The development of a service model based on communication
2. Rich picture	Process flow diagrams; Norms, routines and procedures; Performance data on customer satisfaction, operational cost, lateness and quality service; Questioners and interviews with the service chain personnel and managers.	Additional interviews; Detailing process maps on the attendance chain.	The Matrices Diagnosis and Improvement, as well as, the respective Semantic Indicators; The current operational methods.

BJ Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

3. Root definitions	C: downstream service chain stations and the energy customer A: service chain personnel and the method designers T: Information supplied to information understood according to predefined evaluation criteria (Defining the questions to be enquired). W: communication with no misunderstandings along the service chain. Information exchanged along the line must be clearly understood. The service related to the electricity reestablishing process is expected to be improved. O: R&D coordinator and the Technical Department; E: The attendance electricity service chain (Customer à Call Center à Operational Control Center à field teams à Customer) and the data collection structure such as questioners, interviews, primary and secondary sources.	Alteration on the CATWOE: C: service chain downstream stations T: Information supplied to information understood supported by the Semantic Indicator according to the questions enquired previously (Diagnosis Matrix). to be improved. E: The attendance service chain (Customer à Call Center à Operational Control Center à field teams) and additional interviews.	The aim of the proposed model is to measure the quality of the communication along the service chain (call center, operations control center and field teams) to achieve quicker reestablishing of electricity provided by the emergency attendance process.

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

4. Model	Setting up a table (Diagnosis Matrix) capable to collect the communication views along the attendance service chain.	A Semantic Indicator to measure the communication along the attendance chain.	A service performance model: collecting data, measuring performance and intervening.
5. Agenda	*Go there and ask them* police. Collecting data from different perspectives along the service line to feed the Diagnosis Matrix.	Measuring the previous scenery (Diagnosis Matrix) with the Semantic Indicator. Calculating the Semantic Indicator (SI) for the improved scenery as described by the Improvement Matrix.	Feeding the model with historical data provided by the matrices Diagnosis and Improvement.

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

6. Debate	Workshops to deals with the Diagnosis Matrix: The need of improvements; The need of measuring how service personnel understand and exchange information; Discussion on the service chain related to operational communication; Selection of suitable performance criteria.	Evaluating the improvements according to the Semantic Indicator; Analyze the Semantic Indicator contribution to evaluate the communication quality to improve the service excellence; Evaluating the maximum improvement possible level; Considering the construction of a model to improve service level based on the communication approach.	Evaluating the Communication Measuring Model's capability and usage.

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

7. Action (decisions)	The customer node may be withdraw from the service chain since the overall customer satisfaction has already an indicator established by the Regulator Agency (IASC index: *Índice Aneel de Satisfação do Consumidor*); Developing improvements to overcome problems verified in the Diagnosis Matrix; The collecting data performance must be continuous (before/ after measuring and analysis). So, register the improvements findings (Improvement Matrix); Since the attendance service is based on how the information is understood along the attendance chain it is required to develop a service indicator related to communication.	Decision on the development of a model to measure the quality of communication along the attendance service chain; Developing improvements to achieve the maximum SI target according to the problems verified in the Improvement Matrix. Repeat this action till the maximum possible SI is achieved.	Training supervisors of each chain node (Call center, Operations Control center and Field teams) on the models data inserting and usage. Training managers on the models analysis, and as a decision making tool to orient interventions.

THE COMMUNICATION MEASURING MODEL

The model urges the ones responsible for setting up, operating and monitoring the service system to “go out there and ask them!” The Communication Measuring Model (CMM), starts from the perception that most rules do not satisfy its purpose simply because the basic assumption that the sender and the one who receives the information have not the

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

same understanding about it. In other words, it is a semantic problem. In order to avoid such a misconception this papers proposes an instrument to enhance communication effectiveness along the service process. Firstly, the model requires the capitalization of the personnel knowledge, usually tacit, into the method (explicit knowledge), what Nonaka e Takeuchi (1997) call *externalization*. Secondly, the use of the operational procedure must be continuously monitored in order to check if it is really fulfilling its purpose. The monitoring outcome must be translated into robust and formal knowledge, such as the method, procedure, or any explicit rule.

The CMM comprehends seven steps as follows: objectives definition; mapping process; collecting discrepancies; measuring misunderstandings; diagnosing misunderstandings; proposing improvements and; implementing the changes in order to obtain the improvements. The CMM considers all the described steps as illustrated in Figure 1.

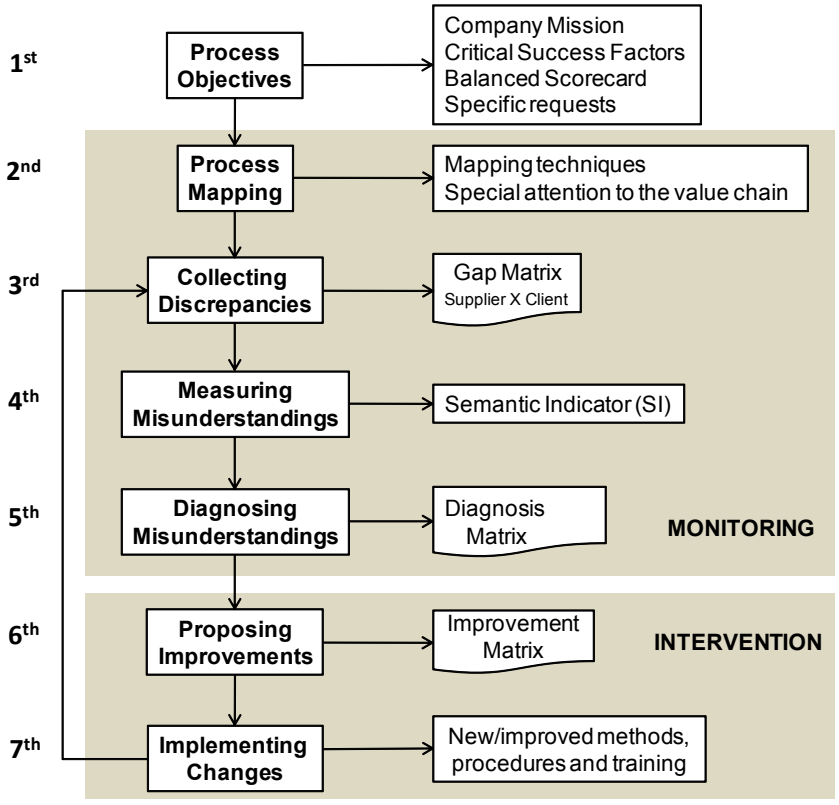

Figure 1: The Communication Measuring Model

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

Defining the Process Objectives (1st step)

This stage refers to the process aim considering that each activity of any company process should be designed to satisfy the very purpose of the organization. Usually, the misconception starts with the relationship between the process objectives within the company mission. The effectiveness of the company`s strategy aims will be feasible depending on their translation into measurable operational targets. The consideration of the associated critical success factors may contribute to develop processes aligned with the company's mission.

Process Mapping (2nd Step)

Once the objective is defined the process and its activities can be properly described. Learning and process improvements may be resulted from analysis on the available documentation, as well as, the input/output relations as represented in a process map. The development of process maps provides identification of critical interfaces, opportunities to be evaluated in a sensitivity analysis manner, detection of disconnected and illogical activities in the process under analysis and, consequently, providing the possibility of implementing new and better methods. After all, the adage "a picture worth more than a thousand words" should inspire the analyst to take advantage of the available modeling techniques to describe and analyze processes.

The CMM considers mapping techniques based on the underlying principle "you cannot manage what you cannot measure" and its consequence "you cannot measure what you cannot describe". In order to properly describe a process is necessary to highlight different views, starting from a contextualized overview towards a quite detailed description. Many techniques such as: the SWOT technique (Hill and Westbrook, 1997); Flowcharts (Goldstine, 1972; ISO, 1985; Barnes, 1980); the IDEF (*Integrated Computer Aided Manufacturing Definition*) series (Aguilar-savén, 2004; Tseng, Qinhai and Su,1999); the UML (Unified Modeling Language) (Jacobson *et al.,* 1998); and mapping process with value chain concepts (Abdulmalek and Rajgopal, 2007; McGuffog and Wadsley, 1999; Rother and Shook, 1999).

The mapping process is suitable in two distinct moments: to analyze an existing process or to design a new process. In the first case the adopted mapping technique has to provide means to detect the intrinsic value of each operation or activity. From many different definitions of value (Walters and

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

Lancaster, 1999), it might be simply understood as the result that justifies the effort (Zeithaml, 1988). Not every existing operation or activity is really necessary. Some of them may well be discharged and some of them may stay as long as they go through necessary improvements. The analyst may keep in mind the fact that all activities aggregate cost, but not all of them aggregate value.

The knowledge provided by the market should allow proper production ways to satisfy clients' expectation. Such ways are also dependent on knowledge throughout all internal processes and activities. However, whatever the adopted mapping technique, the information must be explicit, since it is the base to obtain knowledge. The knowledge perceives all the market, development, production and delivering chain, and may be understood as part of the value chain. Accordingly, the research driven axiom in this article is that *knowledge is dependent on well interpreted information, which is a communication issue*.

A process (service chain) is composed by a number of different activities and tasks, each one of them represented by nodes (operations) and connected by links, i.e., relationships, as depicted in Figure 2. Each node has the characteristic of being either client or supplier depending on its position in the service chain, downstream or upstream. So, node number three is simultaneously client and supplier; supplying node two and, as a client, receiving material or service from node number six.

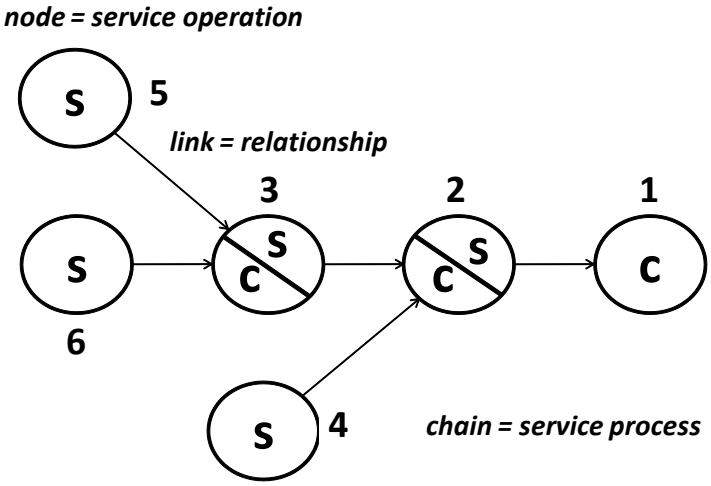

Figure 2: Client and supplier chain

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

Collecting Discrepancies (3rd Step)

In order to avoid misunderstandings is necessary to clarify the relationship between the adjacent nodes through a list of inter-related activities, since the specific purpose of each chain node is defined by the tasks requested by its clients.

Misunderstandings take place due to unrealistic assumptions and/or lack of capability to carry out the client´s expectations. It is not unusual to perceive that what the client expects from his/her supplier is far from what he/she receives, which generates poor service, frustration and conflicts, as well as, mistruth in further relations. Figure 3 depicts the requests and capabilities nodes and the possible misunderstandings surrounding the nodes relationship. Accordingly, the n's assumption (A_n) about the n+1's needs may not match the n+1's expectation (E_{n+1}) on the service provided by n.

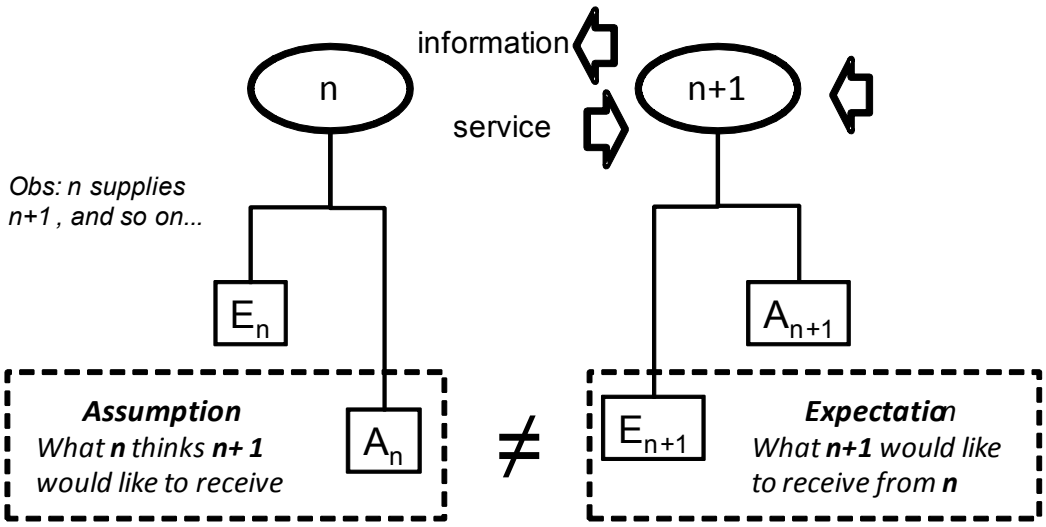

Figure 3: Assumptions and expectations along the service line

This stage produces the Gap Matrix, which focuses on a particular relationship, i.e., the link between the nodes n and n+1. The Gap Matrix tries to clarify any possible relationship misunderstanding in terms of its expectations and possible frustrations. Therefore, the Gap Matrix checks the supplier assumption (A_n) against the client`s expectations (E_{n+1}).

The criteria to evaluate the relationship along the line may consider

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

misunderstandings about a number of factors, such as the expected quality result (Q), the punctuality according to the planning (P), the flow velocity of the process in terms of lead time or cycle time (V), the resulting cost (C) and the flexibility to change and adapt according to clients and market expectations (F). Each one of these criteria has its own set of performance measuring:

- The Quality criteria may have the scrap or rework rate as performance measurement indicators;
- Punctuality may consider the due date performance rate, the lateness order rate, idleness rate, etc. All of them established by the production planning;
- Flexibility is related to the line capacity to adjust quickly in face of model and quantity changing requirements. Usual performance measure indicators are the setup time and the polyvalence rate to performing different jobs;
- Velocity is relevant due to its implication on delivering as promised. The existence of bottlenecks along the line affects the line capacity and disrupts the due date. Performance measures are the production rate, lead time, cycle time, lateness and tardiness rates and the idleness rate along the line;
- The activity cost must be compatible to its contribution to the final product or service market value. A suggested performance measure would be the processing time related to the total lead time.
- Others criteria that affect relationships among nodes may comprise courtesy, creativity, solicitude, etc.

A particular application must apply its own criteria and metrics. Nevertheless, a consensual way of defining standards and targets, as well as, ways of monitoring the ongoing process must be the base to evaluate the relationship in a client/supplier chain.

The observed discrepancies must now be quantified for each relevant criterion. The personnel involved in the analysis process may weigh the criteria parameters according to the following three-point scale (λ):

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

Level 2: Total concordance

Level 1: Partial discordance

Level 0: Total discordance

When an evaluation element is not applicable it simply does not participate on the calculation. However, when an evaluation element is not verified, despite being applicable, it will receive grade one. In this manner, grade one provides a certain measure of impartiality.

The maximum value per criteria is λ = 2. The lower the SI, the higher the misunderstanding level among involved personnel. The reason may be poor training or badly designed methods, a situation where the client may not receive what he wants. On the other hand, high SI values denote lower communication misunderstandings contributing to higher levels of service quality. The grades of each relationship for each adopted criteria may be summarized in the Gap Matrix, as depicted in Figure 4.

Criteria	Supplier (n)	Client (n+1)	λ
Q			
P			
V			
C			
F			

Figure 4: The Gap Matrix

Measuring Misunderstandings (4th Step)

A way of measuring possible discrepancies ($A_n \neq E_{n+1}$) along the service line is proposed by the Semantic Indicator (SI), as expressed in Equation 1.

$$SI = \frac{\sum_{i=1}^{m-1} \lambda_i}{m-1} \qquad (1)$$

Where:

λ quantifies the criterion adopted to evaluate the discrepancies of the

BJ Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

client supplier relationship (Q, P, V, etc.);

i denotes a specific node;

m represents the maximum number of nodes;

m-1 considers the maximum number of links (relationships).

The Semantic Indicator defines the level of discrepancy between client and supplier. Afterwards, the SI figure will be used as a reference for further improvements on the service chain relationship.

Diagnosing Misunderstandings (5th Step)

Weak links are a consequence of non compatible nodes, i.e., poor relationships are a result of the client's expectations frustrated by equivocated supplier's suppositions. Misconceptions are a potential focus of conflicts. The information collected from the Gap Matrix must be leveled. This stage is related to equalizing client´s expectations against supplier´s suppositions or vice-versa. Improvements may be accomplished by overlapping expectations with suppositions. Therefore, this stage prevents poor communication by guaranteeing a similar grammar among the service chain players. In other words, this stage tries to clear the misunderstandings and establish the truth.

In order to overcome the misunderstandings an agreement between client and supplier should be pursued. However, they could be, both, wrong, despite their agreement. Usually, the client's view may prevail since he is the recipient of task purpose. Once again, it may not represent the rightness, since the client's demands may be incorrect or unreasonable. So, an independent view may be required. A hierarchical superior, an external auditor, or a group of experts, including the involved service nodes, may be assembled to diagnose the process under analysis. Such analysis is synthesized in the Diagnosis Matrix that will declare the real picture of the service line current relationships.

Proposing Improvements (6th step)

At previous stages the incongruence presents either in the current work procedures or even due to the non-adherence to the current methods let to miscommunication along the service chain as detected by the Semantic

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

Indicator. Now, it is required to eliminate discrepancies through interventions oriented by new and better methods or ways of training/motivation. The improvements recommendations for each criterion of all relationships (links) will be attached to a so called Improvement Matrix. As considered when designing the Diagnosis matrix the development of the Improvement Matrix must also be accomplished by experts and client/supplier's orientations in order to avoid any misinterpretation among what is expected and what should be delivered.

Implementing Changes (7th Step)

The alterations implemented in the last step must again be evaluated by the Semantic Indicator. The cycle is repeated from the 3rd stage since it is necessary to collect eventual remaining discrepancies, which will be conceptualized, quantified and measured. In this manner, SI verifies if the suggested improvements brought the expected results from the premise that better performance is associated with high SI score.

The evaluation of the work procedure along the service line depends on formal documentation (procedures, norms, check lists, etc.) and all other primary and secondary sources that may help to study the operation of the service line, as well as, the mapping process and the semantic analysis. Actually, the new procedure will be a consequence of successive iterations assisted by the SI. The Improvement Matrix recommendations will guide the implementation of all actions, such as new methods and procedures and training programs. In a sense, formal and tacit ways of communicating and relating must be permanently reviewed. By taking into account the Semantic Indicator as an instrument to measure the degree of miscommunication along the service processing stages proper managerial interventions may be undertaken and, again, incorporated in the new procedures.

THE CASE

The case in analysis refers to the relationships among clients with the call center service provider (CC), the operational control center (COS) and a number of field service teams (FST) of major private Brazilian utility, electricity company, responsible for distributing energy (7.356 GWh) to 2.2 million customers (Neves, 2007). The company operations controlling, previously distributed for all concession area, was unified in January 2006. Nowadays, any intervention on the electric network is authorized and guided by a single control centre. The COS has 19 workstations with one operator per station: 9

BJ Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

for electricity distribution, 2 for high tension, 1 for supervision, 1 for the Scala® system and 6 for eventual contingency. Field teams are formed by 2 (light) and 4 people (heavy duty vehicle). Nearly 170 teams are deployed in 9 operational administrative centers, working in three 8 hours shifts, covering an area of 31.784 Km^2 of the Rio de Janeiro state.

Varied information, such as data and depositions were collected by means of direct observation, secondary sources such as norms and regulations, as well as, procedures and additional documentation available in the information system.

Information were also gathered by means of semi-structured interviews with 2 Call Center managers (1st and 2nd shifts), 3 COS managers and 9 operational supervisors. Yet, 12 questioners were distributed among the related personnel with 11 responses. The researchers accompanied a number of attendance services with field teams. All these information was compiled to set the process maps and the gap matrices as it will be shown in the next section. This information was collect from December 2006 to April 2007. The compilation process was accomplished in 3 workshops as defined by the 6th stage of Soft System Methodology (table 1).

The object of study is the service related to the customer's requests for restoring the energy supply. Usually, the service is mainly associated to repairs on the electricity distribution network.

The energy supply restoring service comprises a chain of activities that begins with the customer's complaints to the Call Center, which passes them on to the COS responsible for allocating the repairing tasks to the field service teams. Miscommunication throughout the energy reestablishing chain jeopardizes the quality of the service rendered to customers and must be restored as quickly as possible.

Failures in the energy restoring system bring many problems to users (homes, hospitals, companies, etc.), but also damage the concessionary performance and subject it to penalties and losses imposed by the Brazilian Energy Regulator Agency (ANEEL). In extreme situations the company may well lose its concession rights.

APPLYING THE COMMUNICATION MEASURING MODEL

The energy supply restoring service chain comprises three relationships

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

(links): the first link relates the customer (C) with the call center (CC); the second link is concerned with the relationship between the call center and the operational control center (COS) and; the last link comprises the nodes COS and field service teams (FST).

Process Objectives - 1st step

The company mission states: “Be a profitable company for its stakeholders, keeping corporative responsibility contributing to the community and respecting the environment”. One of the major operational tasks to fulfill those intentions is the company’s capability to promptly reestablish energy to its customers. As a consequence, the following objectives are driven:

a. The service provided by the call centre is to supply a promptly, friendly and effectively attendance to the company’s customers. Besides, such requesting must be unequivocally passed on to the next service stage;

b. The service provided by the COS refers to quickly programming and monitoring the field teams, that is, providing proper job allocation and clear orientation to the field teams as quick as possible;

c. The field teams must attend their designated emergencies, usually repairs, as quickly and efficiently as possible, providing quality service to the customers’ company.

Process Mapping - 2nd step

The restoring service process is detailed in Figure 5. There are 3 areas involved in the energy supplying attendance service, all of them with potential to jeopardize the excellence of the service process.

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

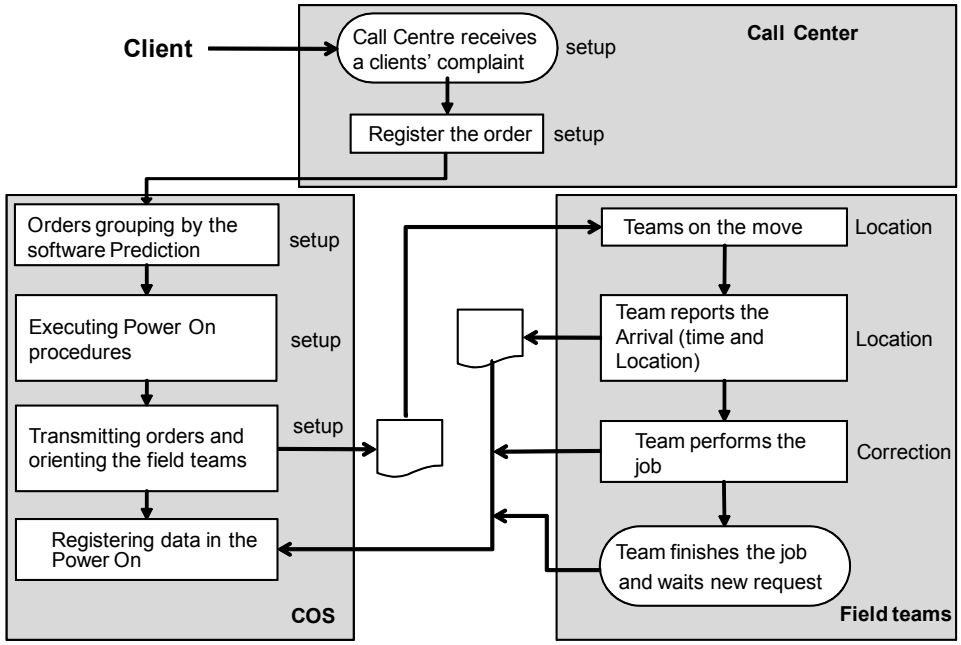

Figure 5. The attendance process service

An additional process map is depicted in Figure 6, which illustrates the Average Attendance Time (TMA). The TMA is a performance measuring indicator used by ANEEL to evaluate the rapidity of the attendance service.

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

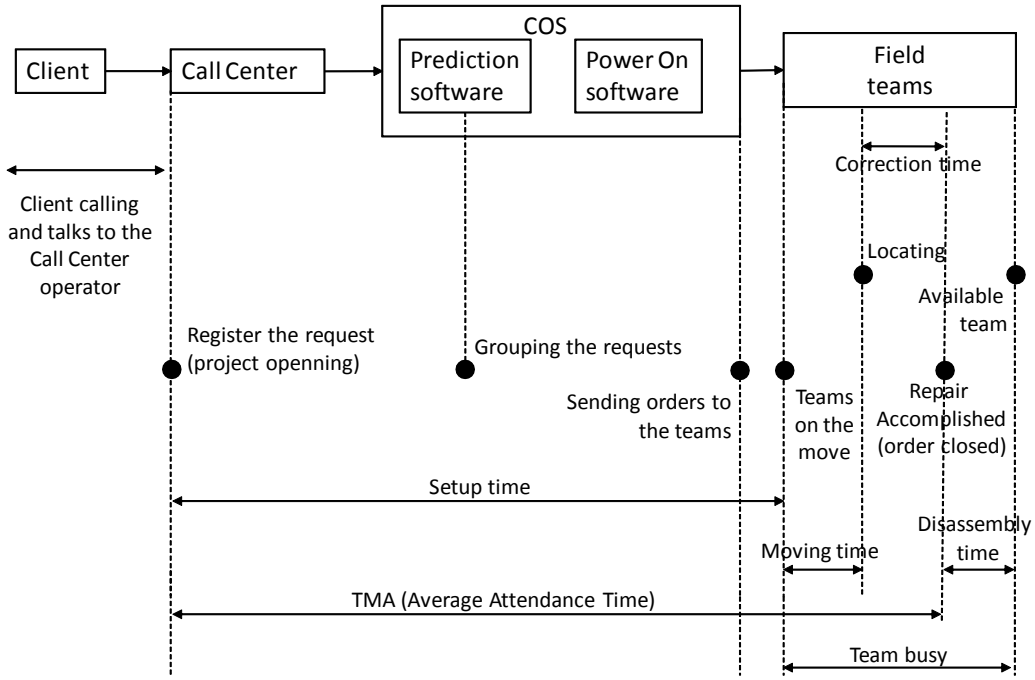

Figure 6: The average attendance time

The process depicted in Figures 5 and 6 define the requested activities. Though, solely the mapping process does not grant knowledge on the weaker points of the service process. It would be necessary to know how the service chain personnel transfer and comprehend information in order to generate knowledge to accomplish their tasks.

Collecting Discrepancies – 3rd step

Figure 4 presented the Gap Matrix, which identifies the suppositions and expectations for the three relationships links. The parameters considered relevant by the analysts to define the misunderstandings of the energy restoring service process were:

- Quality (Q) of the exchanged communication;
- Punctuality (P) was selected since meeting due dates along the chain is important to avoid any increase on the TMA;
- Flexibility (F) responds to the area´s ability to assist different

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

occurrences.

Table 2: The Gap Matrix on the Quality Criteria

Criteria	**Links**	Description	λ
Q	C/CC	Customers spontaneously complained by internet on the attendance they had received (impoliteness and fussy information).	0
		There was not mention that any client has complaint on the CC personnel reports with the exception of impolite behavior, but from some customers.	
	CC/ COS	No data incorrectness was registered by the CC personnel.	0
		COS complaints on data incorrectness.	
	COS/ FST	The COS managers affirm that the company is setting up a new technology based on Palmtop® communication device and GPS system that will improve the quality of the rendered service.	1
		FST expect clearer directions, as well as, delivered on time	

Table 3: The Gap Matrix on the Punctuality Criteria

Criteria	**Links**	Description	λ
P	C/CC	Complaints from clients about dropped lines and excessive delaying time	0
		According to the CC manager the waiting time was similar to average.	
	CC/ COS	Not verified.	1
	COS/ FST	COS blames FTS for the high TMAs.	0
		FTS accuses COS for taking too long for instructing them “on what to do”.	

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

Table 4: The Gap Matrix on the Flexibility Criteria

Criteria	**Links**	Description	Λ
F	C/CC	Not applicable.	-
	CC/ COS	CC things that queues are growing either due to the necessity of more training for the COS personnel or to the need of increasing their workforce.	1
		COS does not admit any necessity of flexibility but agrees on the increasing of the workers number.	
	COS/ FST	COS complains that its task is complicated by the fact that the field teams are too specialized.	0
		FST replies by saying that their training level is adequate to satisfy the services requirements.	

At this stage Tables 2, 3 and 4 have to be fulfilled with numbers capable of expressing the satisfaction/dissatisfaction relationships level as defined previously. There are three links with three attendance service parameters to be considered and a maximum of grade two for each one. The maximum grade that the process can obtain is eighteen. Table 5 presents the figures assigned by the workshop participants.

Table 5: Quantifying misunderstandings – 1st measurement

	C/CC	CC/COS	COS/FST
Q	0	0	1
P	0	1	0
F	Not applicable	1	0
Obtained value	0	2	1
Maximum value	4	6	6

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

Measuring Misunderstandings – 4th step

The Semantic Indicator defined by equation 1 may be expressed as equation 2.

$$\mathcal{S} = \frac{\sum_{i=1}^{m-1}[Q+P+F]_i}{m-1} \quad (2)$$

The figures from Table 3 produce a Semantic Indicator as follows:

$$\mathcal{S} = \frac{(C/C\ ) + (C\ /COS) + (COS/FST)}{4-1} \quad (3)$$

$$\mathcal{S} = \frac{(0+0)+(0+1+1)+(1+0+0)}{3} = 1{,}0$$

Diagnosing Misunderstandings – 6th step

The information obtained by the last stage must be verified in order to establish the reality. Table 6 reviews the investigation on data and information capable of verifying the opinions and suppositions of suppliers and clients of the energy restoring service process, alleged previously. Moreover, this stage provides fewer misunderstandings and also contributes to improve the service.

Table 6: The Diagnosis Matrix

	C/CC	CC/COS	COS/FST
Q	It was verified statistically that 8% of the clients complained about the attendance they had received.	Data inserting mistakes has grown due to bad communication between COS and Call Center.	Despite the use of new technology the quality of the service provided by the COS must improve.
P	Due to the lack of employees, there were complaints about the phone waiting time, which was verified by the software (higher than 2 minutes, at average)	It was not verified, but it should!	Field teams complain about wrong directions. The TMA has increasing steadily. Last year TMA was one of the highest. Both areas are responsible.

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

F	Despite being considered not applicable some workshop members believe that additional training is required (new technical skills and motivation) for the CC personnel.	The level of the COS personnel polyvalence is acceptable. Additional study is required to calculate the correct size of the COS workforce.	The field teams are overspecialized.

Proposing Improvements – 6th step

So far it has been measured the discordance along the energy restoring service. Now, it is required to establish ways to improve communication, the relationships among the chain nodes and, most of all, the quality of the service rendered to the final customer.

Considering that the highest relationship satisfaction level expressed by the Semantic Indicator on the attendance service process is 5.3 (16/3), there is ground to dramatic improvements. The workshop participants suggested some improvements from the diagnostic obtained in the last step. Table 4 synthesizes the managerial interventions adopted to overcome the problems presented in Table 7.

Table 7: The Improvement Matrix

	C/CC	CC/COS	COS/FST
Q	Training call center personnel on politeness and basic electricity utility technical understandings.	Developing a project to develop communication procedures for the COS and Call Center personnel. As a consequence, new methods will be passed on by means of a joint training program.	

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

P	Expand the number of phone lines and call center attendants. The CC claim on "similar to average" is not acceptable.	Verify the readiness between Call Center and COS.	Update addresses on the geographic information system.
F		Develop study to calculate the correct size of the COS workforce.	Start a program to review specialization on the field work force.

Implementing Changes – 7th step

The adoption of the recommendations presented in Table 3 improved communications along the line by reducing misunderstandings. The degree of miscommunication, as a synonymous of better relationships, is numbered as depicted in Table 8 and yields an SI equal to 3.0 (equation 4).

Table 8: Quantifying misunderstandings – 2nd measurement

	C/CC	CC/COS	COS/FST
Q	1	2	1
P	1	1	2
F	Not applicable	1	0
Obtained score	2	4	3
Maximum score	4	6	6
Potential improvement	50.0%	33.3%	50.0%

$$SI = \frac{\sum_{i=1}^{m-1}[Q+P+F]_i}{m-1} = \frac{9}{3} = 3.0 \qquad (4)$$

As it may be seen in table 8 there is ground for communications improvements in all links. Figure 7 illustrates an overall ground for improvements from 3.0 up to a limit of 5.3 (43.4%).

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

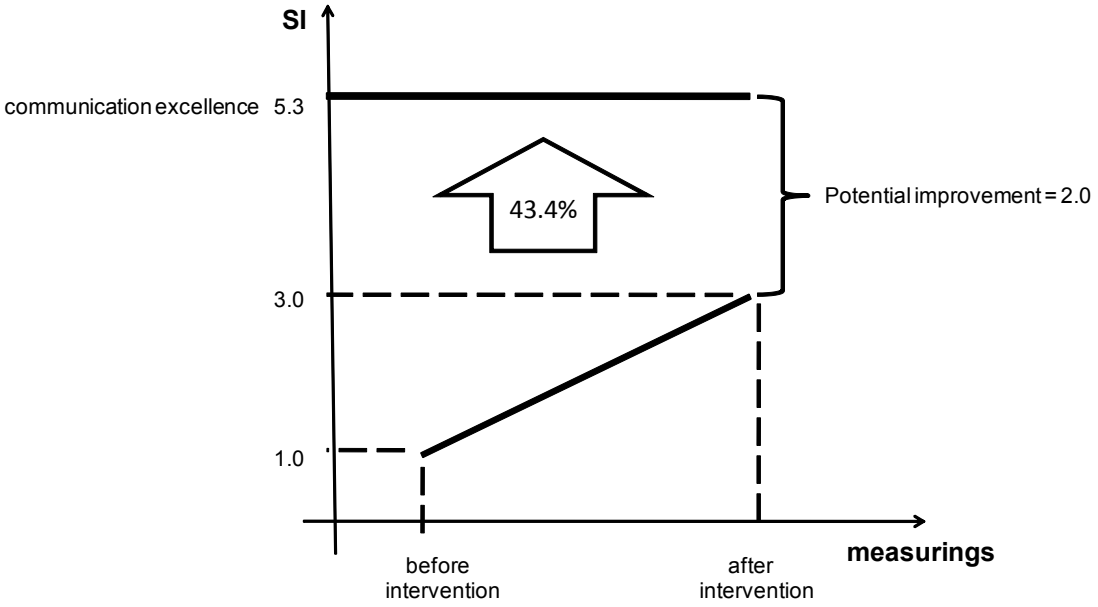

Figure 7**:** Measuring communication

CONCLUSION AND RECOMMENDATIONS

The achievement of the full potential improvement is dependent on improving relationships. Each operation node has socialization (tacit to tacit) as the main way of knowledge conversion along the chains relations (Neves, 2007). Externalization (tacit to explicit) has drawbacks, since errors registration did not take place as expected due to the fact that employees fear they can risk their relationships and their jobs. Nevertheless, there an ongoing technology updating process in order to count with state-of-the-art software to register information (data insert conference, fool proof computer programming logic and customers' recorded conversations), as well as motivational campaigns conducted by the Human Relations department. The internalization process (explicit to tacit) is accounted to be the responsible for many mistakes and frustrations along the service line, mainly, due to poor training and motivation.

The quality of the information, its availability and the misunderstanding level among the line personnel must be carefully evaluated by the ones responsible for developing an effective service line that excel customers' expectations.

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

The SI evaluation of the miscommunication level contributes to designing clear and easy-to-use procedures, since the possibility of intervening and monitoring results is the base of any manageable system. Beforehand, when a process is designed all efforts must be undertaken to make clear if what is expected is feasible by available personnel and facilities.

As any indicator the SI has only a comparative merit. However, the SI connects the information understanding and the consequent knowledge as the major point to be considered when measuring performance in service processes.

The proposed SI by measuring the degree of misunderstandings along the chain provided a simple and easy-to-use tool to allow manager to evaluate their interventions along the time, as long as personnel bother to "go out there and ask them". However, despite the increasing on the SI score it does not mean customer's complaints would be over. After all, the quality of the relationship is consequent of a number of factors besides the communication itself. Nonetheless, better communication translated by fewer misunderstandings contributes to improve relationships and, as a consequence, to the service rendered to the final customer. Moreover, the continuous approach presented in the proposed model allows analysis on the evolution of sceneries useful for training.

Recommendations for CMM further improvements may consider the use of the Likert Scale to state the responses. In addition, expressing quantitative concepts, as demanded to calculate SI, is a rather vague task. Techniques such as the Analytic Hierarchical Process (AHP) and even the Fussy Logic may provide interesting insights. As a new approach, additional applications with a statistical treatment on the collected data are required to consolidate the proposed model. Yet, further application in project management may consolidate the model contribution, as well as, for measuring relationships in supply chain management issue.

Finally, this research corroborates with the view that relationships can be measured as long as there are clear rules and criteria.

REFERENCES

Abdulmalek, F. A. and Rajgopal, J., (2007) Analyzing the benefits of lean manufacturing and value stream mapping via simulation: A process sector case study, *International Journal of Production Economics*, Volume 107, No 1,

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

pp. 223-236.

Aguilar-savén, R. S. (2004) Business process modeling: Review and framework, *International Journal of Production Economics*, Vol. 90, No. 2, pp.129–149.

Argyris, C. (1977) Double Loop Learning in Organization, *Harvard Business Review*, Vol. 55, No. 5, pp. 115-125.

Austin, J. A. (1962) *How to do things with words.* Harvard University Press: Boston, MA.

Badri, M. A.; Abdulla, M. and Madani, A. (2005) Information technology center service quality Assessment and application of SERVQUAL, *International Journal of Quality & Reliability Management*, Vol. 22, No. 8, pp.819-848.

Barnes, R. (1980) *Motion Time and Time Study Design and Measurement of Work*, John Wiley & Sons: New York, NY.

Checkland, P. and Scholes, J. (2004) *Soft Systems Methodology in Action*, John Wiley & Sons, Ltd.: Chichester, UK.

Coughlan, P. and Coghlan, D., (2002) Action research for Operations Management, *International Journal of Operations and Production Management*, Vol. 22, No. 2, pp. 220-240.

Davenport, T. H. and Prusak, L. (1998) *Working knowledge:* How organizations manage what they know, Harvard Business School Press: Boston, MA.

Duncan, T. and Moriarty, S. E., (1998) A communication-based marketing model for managing relationships, *Journal of Marketing*, Vol. 62, No. 2, pp. 1-13.

Garvin, D., (1988) *Managing Quality: The Strategic and Competitive Advantage*, The Free Press: New York, NY.

Goldstine, H., (1972) *The Computer from Pascal to Von Neumann*. Princeton University Press: Princeton, NJ.

Goodhew, G.; Cammock, P. and Hamilton, R., (2005) Managers' cognitive maps and intra-organizational performance differences, *Journal of Managerial Psychology*, Vol. 20, No. 2, pp. 124-136.

Gudykunst, W. B., (1993) Toward a Theory of Effective Interpersonal

BJ Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

and Intergroup Communication. Wiseman and Koester (Eds), Intercultural Communication Competence, Sage: Newbury Park, CA.

Hill, T. and Westbrook, R., (1997), SWOT Analysis: It's Time for a Product Recall. *Long Range Planning*, Vol. 30, No. 1, 46-52.

ISO (1985). Information processing - Documentation symbols and conventions for data, program and system flowcharts, program network charts and system resources charts, International Organization for Standardization. ISO 5807:1985.

Jacobson, I.; Booch, G. and Rumbaugh, J., (1998) *The Unified Software Development Process*, Addison Wesley Longman: Harlow, UK.

Kelly, D. (2000) Using vision to improve organizational communication, *Leadership & Organization Development Journal*, Vol. 21, No. 2, pp. 92-101.

Koulikoff-Souviron, M. and Harrison, A., (2007) The pervasive human resource picture in interdependent supply relationships, *International Journal of Operations and Production Management*, Vol. 27, No. 1, pp. 8-27.

Lang, J. C., (2004) Social context and social capital and enablers of knowledge integration, *Journal of Knowledge Management*, Vol. 8, No. 3, pp. 89-105.

Liebowitz, J. and Wright, K., (1999) Does measuring knowledge make cents?, *Expert Systems with Applications*, Vol. 17, pp. 99–103.

Lievens, A.; Moenaert, R. and S'Jegers, R., (1999) Linking communication to innovation success in the financial services industry: a case study analysis, *International Journal of Service Industry Management*, Vol. 10, No. 1, pp. 23-47.

Malmelin, N., (2007) Communication capital: modeling corporate communication as an organizational asset, *Corporate Communication: an International Journal*, Vol. 12, No. 3, pp. 298-310.

Marr, B. and Schiuma, G., (2003) Business performance measure: past, present and future, *Management Decision*, Vol. 41, No. 8, pp. 680-687.

McGuffog, T. and Wadsley, N., (1999) The general principles of value chain management, *Supply Chain Management: An International Journal*, Vol. 4, No. 5, pp. 218-225.

Mercer D.; Leschine, T.; Drew, C.; Griffith, W. and Nyerges, T., (2005)

Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

Public agencies and environmental risk: Organizing knowledge in a democratic context, *Journal of Knowledge Management*, Vol. 9, No. 2, pp. 129-147.

Moore, D., (2001) Visuospatial cognition and the communication of production concepts, *Work Study*, Vol. 50, No. 3, pp. 89-94.

Morgan, R. M. and Hunt, S. D., (1994) The commitment-trust theory of relationship marketing, *Journal of Marketing*, Vol. 58, No. 3, pp. 20-38.

Mukherjee, A. and Malhotra, N. (2006) Does role clarity explain employee-perceived service quality? A study of antecedents and consequences in call centres, *International Journal of Service Industry Management*, Vol. 17, No. 5, pp. 444-473.

Neves, T. I. P. C., (2007) *Estudo da dinâmica do trabalho em um centro de controle de operações segundo a abordagem da gestão do conhecimento*, M.Sc thesis, Universidade Federal de Itajubá, Itajubá, Brazil.(in portugese)

Nonaka, I. and Takeuchi, H., (1997) *The knowledge creating company* – how the japanese companies create the dynamics of innovation. Oxford University press Co.: Oxford, UK.

Otter, A. and Emmitt, S., (2007) Exploring effectiveness of team communication: Balancing synchronous and asynchronous communication in design teams. *Engineering, Construction and Architectural Management*, Vol. 14, No. 5, pp. 408-419.

Parasuraman, A.; Zeithaml, V. and Berry, L., (1985) A conceptual model of service quality and its implications for future research, *Journal of Marketing*, Vol. 49, Issue fall, pp. 41-50.

Roberts, K.; Varky; S. and Brodie, R., (2003) Measuring the quality of relationships in consumer services: an empirical study, *European Journal of Marketing*, Vol. 37, No. 1/2, pp. 169-196.

Robinson, G. and Morley, C., (2006) Call centre management: responsibilities and performance, *International Journal of Service Industry Management*, Vol. 17, No. 3, pp. 284-300.

Rother, M., Shook, J., (1999) *Learning to See: Value Stream Mapping to Add Value and Eliminate Muda*. The Lean Enterprise Institute, Inc.: Brookline, MA.

Schwartz, D. G., (1998) Shared semantics and the use of organizational

BJ Brazilian Journal of Operations & Production Management
Volume 2, Number 1, 2009, pp. 63-96

memories for e-mail communications, *Internet Research: Electronic Networking Applications and Policy*. Vol. 8, No. 5, pp. 434–441.

Tseng, M. M.; Qinhai, M. and Su, C., (1999) Mapping Customers' Service Experience for Operations Improvement, *Business Process Management Journal*, Vol. 5, No.1, pp. 50-64.

Walters, D. and Lancaster, G., (1999) Value and information: concepts and issues for management, *Management Decision*, Vol. 37, No. 8, pp. 643-656.

Wilkins, J., van Wegen, B., and de Hoog, R., (1997) Understanding and valuing knowledge assets: Overview and method. *Expert Systems with Applications*, Vol. 13, No.1, 55-72.

Zeithaml, V. A., (1988) Consumer perceptions of price, quality and value: a means-end model and synthesis of evidence, *Journal of Marketing*, Vol. 52, Issue July, pp.2-22.

ABOUT THE AUTHORS

Mr Dagoberto Alves de Almeida has got his PhD degree by the Cranfield Institute of Technology, UK, in 1992. Currently, Professor D. A. Almeida is the Coordinator of the Production Management Research Group of the Production Engineering and Management Institute of the Federal University of Itajubá (UNIFEI), Brazil. His research and consultancy fields are related to operations management.
Contact: + 55 35 36291159 – 36291150, dagoberto@unifei.edu.br.

Ms Tainá da Costa Neves has just got her MSc degree at UNIFEI, under Professor Almeida supervision. Currently she is working with knowledge management. at the Brazilian Aircraft Enterprise (EMBRAER).
Contact: taina@unifei.edu.br

ARTICLE INFO:

Received 10 January 2008
Accepted 22 January 2009