Journal of the North American Management Society

Volume 10 | Number 1 Article 1

May 2016

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VOLUME 10, NUMBER 1 SPRING 2016

JOURNAL OF THE NORTH AMERICAN MANAGEMENT SOCIETY

NAMS
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Journal of North American Management Society, Spring 2016

The Impact Of Media Choice And Social Capital On Quality Improvement

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Abstract: In this paper, we analyze the differences between product and process quality improvement and suggest that the effectiveness of each type of quality improvement is facilitated by distinctive organizational contexts. Specifically, the level of organizational social capital and the richness of communication media are significant determinants of a successful quality improvement approach. Moreover, certain combinations of social capital and media may best fit with either product or process quality improvement. We discuss the possibility of constructing an organizational context that facilitates both types of quality improvement and call for future research to investigate this issue.

INTRODUCTION

This paper examines the impacts of media choice and social capital on product and process quality improvement. According to Dewar and Dutton (1986), product quality improvement focuses on fixing the problem without exploring the root cause, whereas process quality improvement emphasizes eliminating the sources of problems from the production process. A review of the literature implies that the determinant factors in product quality improvement are likely to induce different results in process quality improvement, and vice versa. When understanding the two types of quality improvements from the perspective of organizational learning, it becomes obvious that media choice and social context are likely to have significant impact on the efficiency and effectiveness of these improvement efforts. In this paper, we propose that rich media such as face-to-face communication (FTF) supports process quality improvement, whereas sparse media such as computer-mediated communication (CMC) facilitates product quality improvement. Moreover, the effect is likely to be amplified when the appropriate levels of social capital are present.

In the following, we review the literature on quality improvement, communication media, and social capital, we discuss the different underlying mechanisms for product and process quality improvement, and we postulate correspondent propositions. We also discuss the implications of the study.

QUALITY DEFINED

The goal of zero defects has long been the ultimate objective of progressive businesses, but, in reality, every process has some probability of creating a defect. In manufacturing industries, as explained by Evans and Dean (2000), "… quality is meeting or exceeding customer expectations" (p. 9). Similarly, in service industries, quality is defined by the customer. Fitzsimmons et al (2014) describe a service quality gap as "…the difference between a customer's expectations of a service and the perceptions of a service that is delivered" (p. 143). Traditional management attempts to assure that resultant quality meets expectations in both manufacturing and service by checking on outcomes. This is product quality assurance. Enlightened management relies more on preventive methods, such as process controls, process capability, error proofing, standardization, and other process improvements that ensure quality outcomes in the base process, rather than subsequently detecting defects and correcting them. This is process quality assurance (Dewar & Dutton, 1986).

PRODUCT VERSUS PROCESS QUALITY IMPROVEMENT

A simple way to distinguish product and process quality improvement is to look at the method and solution that people expect from the two. For Dewar and Dutton (1986), product quality improvement focuses on post hoc inspection and removal of product defects by repairing. The approach is to add investment to the existing system without changing the old components of the system. The change induced by product quality improvement fits the concept of incremental change (Dewar & Dutton, 1986). In contrast, process quality improvement emphasizes prevention by identifying the weaknesses in the production process and eliminating the "root causes", or the sources of product defects (Cole, 1990; MacDuffie, 1997). Such an approach goes beyond augmentation of the status quo, often requiring transformation in management style, practices, and relationships. The change introduced by process quality improvement is radical rather than incremental (Orlikowski, 1993).

From the perspective of efficiency, process quality improvement sounds more promising than product quality improvement since the former eliminates the root cause of the quality problem so as to prevent the defect. In reality, however, practitioners are far from being convinced by this opinion, because they perceive a much higher cost for process quality improvement than product quality improvement (MacDuffie, 1997). Besides higher costs, process quality improvement can also increase uncertainty in expectations, unless process metrics are well deployed. In many cases, executives support the process improvement concept, but the reality of their operations tends more toward "fix as fail." Because radical change involves many fundamental modifications without past experience and often conflicts with old rules, norms, and skills, it may trigger unintended side effects and negatively influence the results of the changes.

A further examination reveals that the requirements for product and process quality improvement are inconsistent, in that an organization good at product quality improvement may not have strong capabilities in process quality improvement, and vice versa. This inconsistency can be reflected from the comparison of the types of knowledge communicated, the forms of knowledge integration, and the scope of cooperation that the two kinds of quality improvement demand.

Product quality improvement requires mainly explicit knowledge transfer, reinforces the integrated operation by rules and routines, and encourages specialized practices within departmental boundaries.

One of the authors of this article actually managed the shop operations of a GM automotive assembly plant in the 1980's. GM at that time was very traditional in its methodologies, such that quality was "inspected in" and defects fixed either at the end of the line in the responsible department, or marked on a traveling "ticket" for repair at the very end of manufacturing. At the end of the factory, just before shipping, there was a dedicated department, euphemistically named "Car Conditioning." This area carried the high fixed cost of dozens of repair people, inspectors, supervisors, and material handlers. Vehicles with defects would be routed to this department, disassembled to get at the defect, parts swapped out, and then reassembled. In most cases, such repairs caused minor to severe collateral damage (e.g. paint scratches, dropped fasteners creating rattles, water leaks, and punctures in upholstery). As a result, finding and fixing defects seldom resulted in a vehicle that exceeded even modest quality expectations. Additionally, substantial costs were added to the not inconsequential base process costs, in order to repair that which was not done right the first time.

For such a system, explicit knowledge transfer is sufficient for pointing out the problem and assigning accountability for it. In this instance, quality improvement does not challenge the rules and routines of the current process. The system impedes knowledge flow across departments as well.

Such an operation echoes Grant's (1996) argument that the most efficient (or cost saving) knowledge integration is the one that accomplishes production with the least possible knowledge transfer and

communication and uses rules and directives for cooperation. According to Grant (1996), only a small amount of problems are so complex that they cannot be solved without communication. These problems will be assigned to teams, where meetings and knowledge transfer are promoted.

In reality, however, such teams may not work as well as theoretically imagined because, for an organization that is effective in product quality improvement, each set of tasks and skills is so highly specialized, and cross-department communication is so limited, that a common language for team coordination is likely to be underdeveloped (MacDuffie, 1997). Moreover, such systems also prevent change in processes. Cohen (1991) noted that people under formed routines "will miss 'obvious' opportunities for improved performance (i.e., they make the equivalent of three right turns when they could have made one left) (p.138)." This suggests that a rule-dependent system discourages process change while enhancing obedience.

In contrast to the above, process quality improvement needs both explicit and tacit knowledge communication, depends on group problem solving, and emphasizes experience and knowledge sharing across departments.

First, since a big part of production knowledge is developed through learning by doing, and cannot be precisely codified, explicit knowledge is not enough to describe the problem, nor is it efficient to solve the problem. Bodily experience (i.e., the experience through which tacit knowledge is learned with the body not the brain) is required to identify the issues in question, and to generalize and crystallize the corresponding solution (Nonaka, 1994). The co-author's experience with both Honda and Toyota over many years repeatedly confirm a practice of "…thoroughly understanding a condition by confirming information or data through personal observation at the source of the condition." (Marchwinski, Shook, & Schroeder, 2008, p. 26) The practice, in Japanese called "Genchi Genbutsu", means to go to the workplace and fully understand the actual situation in detail by talking to employees there, verifying data, and even trying to perform the process oneself to understand the root cause of difficulties

Second, the task of tracking the sources of problems calls for deep knowledge in all the tasks processed before the problems occur. In addition, a change in the process will impact the process after the problems occurrence as well. The complexity of tasks in an organization makes it impossible for any individual to grasp all the knowledge needed. Therefore, knowledge transfer and coordination is necessary, and the form of problem-solving team is inherently superior.

Third, a common language and a large amount of shared experience are critical for knowledge transfer (Grant, 1996; Nonaka, 1994). Common language facilitates both explicit and tacit knowledge communication with standardized terms and jargon for organization-specific situations. Shared experience embodies tacit common knowledge, which enhances the efficiency of coordination and allows people to help each other in the socialization and externalization process of knowledge creation during problem solving (Nonaka, 1994).

The author who ran GM assembly operations was later involved with the GM-Toyota joint venture in Freemont, California, known as NUMMI. The contrast between the Toyota Production System and GM's operations was remarkable. At NUMMI, when a defect occurred, the line was actually stopped and the problem resolved in the base operation, rather than the defect being passed on, covered up, and left for a dedicated repair department to fix later. The root cause for the defect was explored as a "kaizen project" and process improvement countermeasures were implemented. As a result, defects and stoppages became fewer and fewer, and end quality became better and better.

The system of process quality improvement may not fit the task of product quality improvement. Organizations promoting product quality improvement view quality problems as the result of low stability of their process. They expect experiential knowledge will decrease the variance of the products so that the

level of quality is kept high. Challenge to the process is not wanted because it may disrupt the learning curve and sacrifice progress in production efficiency (Argote, Beckman, & Epple, 1990). Toyota and Honda employ standardized work as a foundation of their production systems in order to capture the knowledge of a successful current process, reduce variability, and facilitate training of new workers (Narusara & Shook, 2009). At the same time, the standardized work is relentlessly challenged by efforts called "kaizen" to find even a slightly better way to "…create more value with less waste" (Marchwinski et al, 2008, p. 40). A culture of egalitarian work groups supports the principle that improvement is every employee's job. As further explained by Marchwinski (2008, p. 100), "…we need some study in classrooms, but kaizen is learned by actual practice." The balance between maintaining quality through strictly enforced standardized work and challenging the standards with improved new processes is maintained by rigorous validation of the new process for quality capability as well as for genuine productivity improvement.

The implication is that the two systems of quality improvement employ different assumptions and work toward different goals. They may not be compatible to each other, and the effort to combine them for premium benefit would be difficult and likely fruitless, since process quality improvement has been proven superior to "fix as fail" product quality improvement over decades of automotive production. Table 1 demonstrates the differences between the two types of quality improvement approaches.

TABLE 1: COMPARISON BETWEEN PRODUCT AND PROCESS QUALITY IMPROVEMENT

	Product quality improvement	**Process quality improvement**
Purpose	Reducing defects by post hoc repair.	Reducing defects by identifying the root cause.
Elements involved	Products with defects.	Process of operation from design through product delivery.
Results	Defects due to random error reduced as learning curve is extended; Defects due to systematic error remain.	Defects due to systematic error eliminated; New defects due to random error occur as learning curve is reset.
Impact to operation	None, learning curve develops without interruption; Rules and routines protected.	Extensive changes may be introduced in order to eliminate root cause; Roles and routines challenged.
Knowledge transferred	Explicit.	Explicit and tacit.
System requirements	Rules, routines, and directives, combined with specialization.	Knowledge sharing across departments, combined with shared experience.

MEDIA

The literature in information systems and communication indicates an interest in the effect of media richness over recent decades. In order to simplify the question, we compare the efficiency of the richest

(i.e., traditional face-to-face communication (FTF)) and the leanest (text-based computer-mediated communication (CMC)) media used for communication, basing the discussion on media richness theory (Daft & Lengel, 1986). The two media (i.e., FTF and CMC) can be distinguished by the codifiability of the information they can convey. FTF has an advantage in the richness of information it carries (Adams, Morris, & Van Scooter, 1999). It allows not only the textual information exchange (i.e., explicit knowledge transfer), but also non-verbal communication such as gestures and eye contact, which make tacit knowledge transfer possible. In contrast, CMC merely facilitates textual conversation, although it enables people to communicate when they are not physically together (Daft & Lengel, 1986).

Put into the context of quality improvement, both media are useful for product quality improvement. However, taking social context into consideration, CMC is likely to be more effective than FTF. In an experiment, Sussman and Sproull (1999) asked subjects to deliver positive or negative information about a resume to the student (confederate) who composed it. They found that people tend to distort more negative information, being less accurate and honest when they used FTF than when they applied CMC. The authors explain that CMC reduces social cues in communication so as to decrease the psychological discomfort of being a negative information sender. Since the feedback of a product defect is generally negative, using FTF to report the quality problems to those who are responsible for producing or fixing the problems would trigger difficult feelings that motivate negative information distortion. CMC is likely to eliminate such side effects and provide less biased information to the responsible department.

Moreover, although CMC does not convey rich information, it does have the capacity to accurately and reliably transfer codified information to many people in a short time. Such efficiency makes CMC superior to FTF in that noises from the context of rich media are partially eliminated through lean media. Meanwhile, the cost to maintain lean media is also relatively low because relationship building is not highly expected through lean media. Also, codified messages can be consistently sent to many people through CMC, whereas FTF are limited in size to direct message receivers and can distort information in the further transfer of messages. Since product quality improvement tends to focus on the static outcome rather than the interactive process that causes the outcome, communication through lean media can be sufficient for developing a solution.

In contrast to the practice of product quality improvement, CMC does not seem to have much advantage compared to FTF in process quality improvement. Not only is CMC's lack of capacity to allow a "bodily experience" of the quality problem, it also blocks people from observing the content of tacit knowledge. As CMC strips the rich contextual information off the problem description, it would be difficult for people with varied production backgrounds to make sense of the problem, let alone create a solution and collaborate to implement changes to the production process.

> *Proposition 1a: CMC is more effective than FTF in facilitating communication about product quality improvement.*
>
> *Proposition 1b: FTF is more effective than CMC in facilitating communication about process quality improvement.*

SOCIAL CAPITAL

Social capital in this discussion refers to collective or communal social capital (Leana & Van Buren, 1997), in contrast to individual or linking social capital (Burt, 2000). It is defined as "a resource reflecting the character of social relations within the organization realized through members' levels of collective goal orientation and shared trust (Leana &Van Buren, 1999, p. 540)." Nahapiet and Ghoshal (1998) maintain that the concept of social capital consists of three dimensions: the structural, the relational, and the cognitive social capital. In a social network, a high level of social capital is characterized by strong social ties (i.e., close relationships) and high density of the network.

It is evident that a high level of social capital is correlated with skillful tacit knowledge communication (Hansen, 1997, 2002), joint problem solving (Uzzi, 1997), and high information redundancy (Burt, 2000; Dunbar, 1995; Hollingshead, 1998; Uzzi, 1997). First, a high level of social capital is superior in tacit knowledge transfer, but inferior in explicit knowledge transfer, compared to a low level of social capital. Hansen (1999, 2002) maintains that strong and direct (i.e., information flowing from A to B without going through C) social ties are more effective in transferring non-codified knowledge than weak and indirect ties. On the other hand, weak and indirect ties are superior to strong and direct ties in transferring codified knowledge due to lower maintenance cost.

Second, a high level of social capital legitimizes joint problem solving and prevents opportunistic behavior. In a descriptive study of the New York women's better dress industry, Uzzi (1997) finds that networks with high levels of social capital carry such characteristics as trust, fine-grained (i.e., tacit) information transfer, and joint problem-solving orientation. These features result in motivating the self to bend for the benefit of the collective. For example, when the fabric provided by the jobber was flawed, the cutter changed the way of cutting so that the jobber did not suffer the higher costs of a flawed finished product (Uzzi, 1997).

Finally, a high level of social capital promotes knowledge sharing and an accurate assessment of an individual's knowledge domain, which facilitates coordination. Uzzi (1997) found that groups with a high level of social capital are efficient in sharing information, as members become similar in their knowledge background and understand what each other means promptly. Leavitt (1996) notes that academic "hot groups", which bear high trust among members, create their own norms, languages, and symbols for performing group tasks. Hollingshead (1998) suggests that intimate couples have higher transactive memory (i.e., the knowledge of who knows what) than less familiar couples.

In summary, groups with a high level of social capital are able to provide accommodations for process quality improvement, while those with a low level of social capital are likely to be more efficient in product quality improvement.

> *Proposition 2a: A low level of social capital is more compatible with high product quality improvement.*
>
> *Proposition 2b:A high level of social capital is more compatible with high process quality improvement.*

The fit between media and social capital has been examined in the literature of transactive memory. In his study of intimate versus less familiar couples, Hollingshead (1998) also found that intimate couples perform better in knowledge tests than less familiar couples only when using FTF. Their performance tends to be worse (although not significantly so) than less familiar couples when they use CMC. The performance of less familiar couples was not influenced by the use of media, with the mean of the CMC treatment higher (ns.) than that of the FTF condition.

Social capital may also moderate the effect of media richness on product and process quality improvement. Specifically, a low level of social capital is sufficient to support communication through lean media such as CMC. If the task can be described by codified information, even strangers can read, understand, and behave according to text messages transferred in CMC. Messages concerning produce quality improvement tend to fit in this scenario. Whereas a high level of social capital appears to be more than enough in processing codified information, it requires the high cost of unnecessary relationship building and introduces noises that distract people's attention to the focal information. Hence, we propose that a combination of low social capital and CMC is the most efficient method for product quality improvement.

Furthermore, a high level of social capital provides the mechanism to receive, analyze, and interpret the rich information channeled through FTF, thus maximizing the amount of useful information transferred during collaboration. In the opposite way, a low level of social capital hinders the group's ability to process and comprehend the information, even though FTF makes such information available. In conclusion, to make informed decisions and implement radical changes in process quality improvement, it is ideal to combine rich media such as FTF with a high level of social capital. Therefore, it is plausible to form the following propositions:

Proposition 3a: Groups with a low level of social capital using CMC will perform better than other combinations in product quality improvement.

Proposition 3b: Groups with a high level of social capital using FTF will perform better than other combinations in process quality improvement

DISCUSSION

We predict that an organization might be inherently adept for product or process quality improvement, depending on the communication infrastructures it possesses and the level of social capital it enjoys. When FTF is available and social capital is high, process quality improvement can be efficient and corresponding changes can be well accepted and implemented. On the other hand, if only CMC is possible and social capital is low, product quality improvement may be preferred and changes in process can be difficult.

It is unclear whether or to what extent product and process quality improvement can be integrated. According to Milgrom and Roberts (1995), organizations are better off only when they fit the environmental, social, and organizational context. Applied to the case of quality improvement, this perspective suggests that organizations that fit with product quality improvement should have better results when they only focus on product quality improvement rather than adopting mixed quality improvement strategies. Similarly, those adapted to process quality improvement are advised to stick purely to process strategy. Nevertheless, practitioners are interested in gaining the benefits from both approaches to increase their competitive advantage. Future work is needed to explore innovative ways to provide the flexibility necessary to accommodate the different requirements of these practices.

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