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# TIME for Performance Improvement: Targeting Innovation in Manufacturing Engineering

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**Abstract - Performance improvement capability is related to an organization's ability to utilize a fundamental asset, the knowledge that resides with its employees, together with learning from past projects and having good links to external knowledge sources. Firms that develop mechanisms to encourage conversation between individuals and teams to take place, particularly in today's post job security economic climate, can witness performance improvement at the individual and team level, and thence to the overall performance of the organization. This paper reports on performance improvement work that is taking place with the case study company, a post-lean organization, in order to develop its capacity for team and organizational learning and improve its performance in the global marketplace.**

**Keywords - communication and collaboration, innovation management, performance improvement**

## I. INTRODUCTION

The practices of organizations in their approach to intra- and inter-organizational teams and team working have moved from being closed in the previous century to being open in this. The ability of an organization to innovate and improve is related not only to its ability to utilize the knowledge of its own employees and learn from past projects, but also in having good links to external sources of knowledge [1].

Knowledge and information flow have long been determined key components for successful innovation to occur and for continuous product development [2] [3]. Business in the modern world encompasses multiple people and multiple organizations across many locations, with communication being a vital component of such cross-boundary collaboration. Information providers are not only proximate to their own physical location but increasingly exist across geographical and organizational boundaries [4] and, in the case study exemplar, temporally across different shift patterns: developing relationships that enable a good flow of information is crucial to success.

Interaction through professional and social networks brings about contact with people and ideas that may challenge the accepted way of thinking about things [4] [5] [6] [7]. Perceptive organizations create an environment that facilitates meaningful conversation and enables reflection and debate to flourish, particularly through

informal collaboration [8]. Firms that develop mechanisms to overcome barriers to innovation, through encouraging conversation between individuals and teams to take place, witness innovation and performance improvement at the individual and team level, and thence at the level of the organization overall.

Barriers to innovation are seen to manifest themselves in different forms. Loewe and Dominiquini, [9] identify six barriers in terms of having a short-term focus; lack of time, resources and/or staff; expectation from leadership of an earlier payoff than is realistic; management incentives not structured to reward innovation; the lack of a systematic innovation process; and holding of the belief that innovation is inherently risky. The lack of senior management support, in combination with a lack of knowledge or capability for learning about markets, is also likely to have significant negative impact on innovation performance (c.f. [10] [11] [12]). Bond and Houston [13] further extend theory and suggest three sets of barriers to the matching of successful technologies with market opportunities: technology and market; strategic and structural; and social and cultural barriers. They provide a framework of important barriers to innovation, identify the challenges that each pose to the firm and propose example approaches to overcoming these and other challenges. Barriers have also been identified as occurring at the level of the individual, the workgroup/team and the organization (see for example [14] [15]). Table 1 provides an overview of some of the barriers in relation to the sources of resistance.

TABLE I  
SOURCES OF RESISTANCE TO INNOVATION

Barrier	Source
Personal	history; safety; ability and/or knowledge; value of the innovation; motivation; psychometric profile; communication patterns
Situational	culture; rewards; beliefs; pressure; size; work group/organization cohesion
Culture	Beliefs; structure – team/flat etc; history; legacy; values of the organization and/or team; rewards and measures
Other	innovation source; industry chain or segment; ability for implementation

Zwrick [16] reviews employee resistance to innovation in relation to how future job security may affect co-operation when it comes to implementing change. While this highlights the importance of making sure that motivational factors and goals are all working in the same direction for an innovation to succeed, it takes little if no account of the post-lean, post-job security situation of the current, and global economic climate: strategies for overcoming barriers to innovation in such a climate are of critical importance.

Other significant barriers to innovation relate to the riskiness of the innovation, the costs involved in its implementation, shortage of capital, and how easy the innovation is to copy, together with the associated regulation and standards. Barriers to innovation may be attributable to any one factor or to the combination of a number of different factors.

Important enablers for innovation at the level of the team or working group have been suggested to include leadership and cohesiveness, together with group longevity, composition and structure. At the level of organizational innovation, resistance can be based on selective perception and the social systems factors of vested interests, rejection of outsiders, misunderstandings, incompatibility of innovation with organization structure, and lack of top level support.

A major source of resistance is regarded by many as being at the level of middle management, where vested interests and problems of motivation may be rife [17] [18]. Further issues with the potential to inhibit innovation include project based working patterns, lack of technology, and lack of time, resources and staff. Indeed, this last point features alongside other barriers to innovation that have been identified more recently [9]. In terms of the propensity to be innovative, an organization's culture may also have a detrimental effect. In a mature organization, the mechanisms that initially enabled success often inhibit the firm's innovation capability [11], [19]. Moreover, in a climate where long term employment can no longer be relied upon, the psychological contract between employer and employee has been shown to play a key role in innovation and organizational learning.

The purpose of this research, therefore, is to investigate why some firms and, perhaps more importantly, the people within them are slow adopters and often resistant to change, and to identify and implement appropriate intervention strategies to improve the efficiency of the innovation process. However, in order so to do requires a consistent method for assessing the current situation, identifying the issues, developing and managing the interventions and, alongside the gathering of the more conventional performance indicators (KPIs, for example), conducting post-intervention measurements to assess the effectiveness.

Given that it is people who are being dealt with rather than machines, use of a mathematical model is not applicable in this research work. Thus, the intention of the current research is to integrate the use of a number of tools and inventories in order to provide new insights to the

blocks and barriers at work within an organization and to direct and motivate change in the case study company. In identifying where intervention may help overcome organizational barriers to innovation and foster productivity improvement, further aims of this research are to improve knowledge about the innovation system and how it operates and to identify how involvement of workers in a post-lean environment can encourage and motivate learning from external sources.

The 'as-is' work reported here constitutes the first phase in a longitudinal study that measures the current situation and employs intervention techniques as a result of the findings, culminating in re-measurement after intervention has taken place.

## II. METHODOLOGY

The research methodology employed is case study based combining the action research element that has been used successfully in extant research [20] [21] [22]. This approach is based on collaboration between the research team and the organization, where the academic shareholders apply theoretical models and technological innovation to actual real-time problems, proposing, developing and applying solutions. Meredith [23] argued that the case study approach is useful in theory building and enables a rigorous and holistic investigation, and is recognized as a particularly good method for examining the how and why questions [24]. Case study research is also particularly suitable for developing new theory and ideas and can be used for theory testing and refinement [25].

The aim is to collect data via a number of techniques – interviews, workshops, observation - with the purpose of developing detailed information about a single case or a small number of related cases [26]. The case study research approach is applicable here as it facilitates the study of process related issues associated with a specific phenomenon over time; understanding of a specific phenomenon over time; and the use of a new perspective that allows better understanding of a specific phenomenon [27].

### A. Case Study Organization

Company A has been a major partner in a series of projects that have been investigating the role of work-based relationships and their impact on performance since 2001 [28]. A large manufacturing organization in the automotive parts industry, over the last decade Company A has implemented a lean strategy and reduced the workforce to less than a quarter of its pre-1990s size. This has been achieved through natural wastage, voluntary redundancy and system improvements without loss to the level of production: output now is no different to what it was in the 1980s. The remit of the current research project is to investigate the influences that promote and inhibit innovation in such a climate.

In partnership with Company A, the research team's contribution to the current project is to learn from and with key players in the innovation system, and through that interaction to improve knowledge about the system and how it operates. Analysis is taking place at the organization and production system levels, enabling detailed understanding of industry mechanisms and allowing ideas to be tested in their context of application.

However, facilitating access to subjects for research purposes has cost implications for participating organizations in terms of both time and money. Company A, therefore, has its own agenda for participation. It is unlikely that this research would have gained the level of organizational support necessary to carry out the research without the potential for accrual of benefits to the organization in terms of the opportunity for the organization to be in the forefront of activity in this field, and the ability to address some of its own concerns and problems. Thus, the main question to which Company A seeks answers is how to be far more effective in learning from external sources.

Existing instruments are used in the current research to measure performance and to identify the barriers previously shown in Table 1 that may inhibit knowledge utilization and hinder improvement.

### III. RESULTS

#### A. Organizational Culture

In accordance with Cameron and Quinn's procedures [29], the Organizational Culture Assessment Instrument (OCAI) instrument was administered to the group steering continuous improvement (CISG) within Company A: the CISG comprises a cross-section of employees from the shop floor to senior management. The OCAI was undertaken during a workshop session to gain a snapshot of the individual member's perceptions on the current climate and a forecast personal view of climate of the firm five years hence. Questionnaires were collected for later analysis and the session terminated with the scheduling of a feedback of results and discussion meeting. Analysis of the data revealed a range of differing perspectives that informed further discussion at the feedback session and subsequent activities.

Administering the OCAI is conducted conventionally as a catalyst for changing the culture. The purpose in undertaking the assessment with Company A was to gain some understanding and facilitate the sharing of other people's perceptions rather than to gain a consensus viewpoint on the current and future organizational culture. As such, the process was understood by all to be a useful undertaking in that it raised awareness of differing perceptions for the various participants and enabled indication of, and provided support for the next stage of the research work.

#### B. Organizational and Team Climate

Discussion with key CISG members assisted in the

identification of sample subjects for the collection of data on climate at the organizational and team levels. Subjects were targeted for inclusion based upon factors that include physical location in the organization; membership of work team having already undergone CI training; membership of work team as yet to receive attention from the CI process; and particular factions of employee: cell leaders and shift cohort for example. As with the CISG beforehand, the researcher undertook onboarding with each group of research subjects in order to introduce the aims and objectives of the research; to emphasize the confidentiality of individual responses and the separate affiliation from any other management agenda; and to gain commitment to the research process from those involved [30]. The KEYS [31] and TCI [32] questionnaires were administered simultaneously to the five different subject groups during a face to face session, and the completed questionnaires collected for later analysis. Adopting this process was highly efficient, both in terms of research time and effort and in having the least amount of impact on organizational process, providing access to a wealth of data in a relatively short period of time. Furthermore, the captive nature of the research subjects, in terms of organizational commitment to the research, guaranteed 100% response in the data collection process, effectively eliminating the problem of non-response [33]. Moreover, questionnaires had been previously annotated by subgroup and, while ensuring and maintaining the commitment to anonymity, were distributed accordingly to facilitate comparative analysis of the instruments per se and of responses by group in subsequent stages of the research.

#### C. KEYS

KEYS to Creativity (KEYS) [31] is an organizational survey that assesses the climate for creativity and innovation that exists within a workgroup, division or organization and, in so doing, measures the management practices that impact the workplace and encourage innovation, and can accurately identify the conditions necessary for innovation to occur. Operated by the Center for Creative Leadership (CCL), the KEYS instrument helps to identify elements in the workplace that encourage/discourage employees from working at their peak and can accurately identify the conditions necessary for innovation to occur.

Amabile's development of the KEYS instrument [31] has resulted in an information base comprising comprehensive data on more than 12000 individuals across more than 70 organizations. Comparative analysis with the overall database of company groups is returned as a standard report for each subsequent organization surveyed.

The standard report aggregates individuals' responses on all of the scales and provides graphical and textual results for the surveyed organization overall. Additional reports were generated for the current research providing comparative analysis by subgroup with organizational aggregated data.

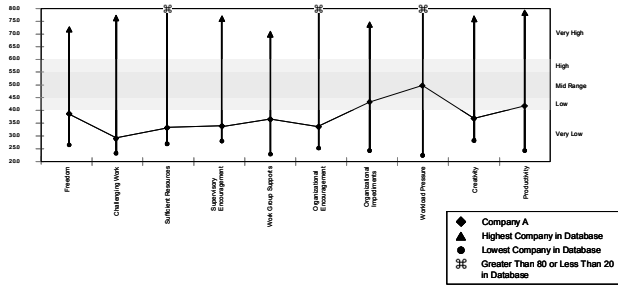


Fig. 1. Company A compared to KEYS database

Two thirds of the standard scores for organizations in the database fall between 40 and 60 and for every scale a higher score is generally associated with higher creativity. Thus standard scores of less than 40 are associated with very low creativity; 40-45 are considered low; 45-55 mid range; 55-60 high; and 60 plus very high creativity.

The results in comparison to the overall database for Company A are shown in Fig. 1, where it can be seen that, other than for the scale of workload pressure, the aggregate standard scores reside in the low and very low part of the graph.

This would suggest that the climate of Company A is very low on creativity and that specific measures should be undertaken to increase the climate of creativity throughout the organization.

### C. TCI

Anderson and West's Team Climate Inventory (TCI) measures work group climate and is intended as a team development tool. It measures four factors that have been shown to be predictive of effective team performance; provides an assessment of the team's strengths, weaknesses and effectiveness; and identifies areas that could most benefit from positive intervention. Analysis is undertaken by software provided, which incorporates facility for overall analysis by organization, by subgroup and for comparative analysis of subgroup with organization.

TCI scores are shown as a standard ten (STEN) profile, where scores below the 4th STEN highlight the need for structured and intensive intervention; scores between the 4th and the 7th indicate room for improvement on climate aspect; and climate aspects for the scores at the 8th STEN and above are considered sound, although a need would exist to continue monitoring and evaluating team procedures.

## IV. CONCLUSION AND FUTURE RESEARCH

This research investigates the influences that promote and inhibit innovation in a lean environment and, in so doing, it aims to identify how organization in a post-lean environment can be more effective in learning from external sources. A combination of existing instruments was deployed to provide far greater insight than what

would be revealed by the use of a single instrument. The blocks, resistance and barriers to innovation were exposed through a number of different perspectives; shedding light upon the structural, situational and/or competence problems that may inhibit knowledge utilization.

The OCAI afforded relatively easy access to differing perceptions of the case study organizational culture, both at the time of administration of the instrument and a perceived point five years in the future. Undertaking the assessment provided insight and understanding, and the facility for sharing other people's perceptions. Participants were encouraged to recognize the usefulness of the instrument for raising awareness of differing perceptions and enabling support for subsequent research activities.

The KEYS instrument provided insight to the organization's creativity at the level of pre-defined subgroups and the graph in Figure 1 shows that the aggregate standard scores for all but one of the scales for Company A reside in the low and very low part of the graph by comparison to the CCL database: the scale on workload pressure lies almost central to the mid range of the comparative data. While the results suggest that the organization is very low on creativity and that specific measures should be undertaken to increase the climate of creativity throughout the organization, Company A data is compared with aggregated data from across a wide range of industries, many of which are highly creative by their very nature. Thus, findings at the organizational level were treated with caution and attention drawn instead to further analysis taking place by subgroup in comparison to the organization's aggregate data, and the comparative analyses between subgroups.

Emphasis was also placed on organizational climate as a description of the work environment rather than of any one individual, where work environment is the personalities, styles, policies and interactions of many people: the findings serve as a focus for the group to improve work environment for creativity by strengthening stimulants and removing obstacles. Moreover, a health warning was also issued to the effect that it is only natural to focus on lowest scores as they likely point to areas for individuals/groups/organizations to target for improving.

Simultaneous administration of the TCI enabled assessment of the strengths and weaknesses of each subgroup, with results giving an indication of specific aspects of team climate reported at the time. Caution was also advised here when reporting back to the organization. The findings on team climate are not a direct reflection of a team's effectiveness; rather they serve as a focus for identifying strategies to help improve its effectiveness.

Research is currently underway to monitor measure and evaluate the innovation processes of specific subgroups using a longitudinal action research study. Detailed analysis of the results from re-application of the tools and inventories is currently being undertaken and will be reported upon at the conference and in further

publications. This will both contribute to and evaluate the development and introduction of structures being put in place to assist the innovation process.

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