TRAINING IMPACTS ON PERFORMANCE: A CLUSTER DESCRIPTIVE ANALYSIS

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Work design remains an important issue, even considering this new technological era. Work organization demands an effective structure and synergy from human resources, exploring the best of employee’s complementary skills to achieve competitive advantages. The purpose of this preliminary study is to investigate training impacts on performance in a production cell of an optical fibers’ manufacturing company through K-means Clustering with three groups for descriptive analysis along with complementary boxplots of each cluster. Findings revealed training plays an important role on efficiency percentage, as instigated by organization’s leadership, although not all the three training levels presented the same impact. Sequentially, limitations are addressed. Since the present study was restricted to a small database, we direct uncovered topics to further research, expecting to expand our sample for advanced statistics tests and to develop a maturity model of capabilities. The value of this paper consists on connecting theoretical principles of operations strategy, employee empowerment and performance measurement to practice in a Brazilian manufacturing case study.

Keywords: operations strategy, work studies, employee empowerment, training, performance.
1. Introduction

Work organization has been challenged over the years. Globalization increased job complexity and changes in organizational structures have brought direct consequences in work organization. In this context, organizations seek different structures and effective techniques for a new management of their resources in order to achieve competitive advantages. This new environment awakens in organizations the need for job qualification, a faster speed of response and the expected flexibility to adapt to new changes that may occur within the current market dynamics (ZARIFIAN, 1997; LEE AND EDMONDSON, 2017).

Work changes are not limited to leaders with his team, since it has become an obligation for companies to expand and face adaptations based on their internal relationships, taking advantages of the full potential of their employees, creating structures that encourage their participation in the decision-making process (OLSSON AND BOSCH, 2018). Sociotechnical researchers argue that work with greater autonomy can favor productivity, reduce costs and bring consistent improvements in work environment, providing competitive advantage (MANZ AND SIMS, 1996; YIN et al., 2018). In this approach, employee empowerment has been a tool to meet all these current challenges demanded by stakeholders with workers at their best potential (MARX, 1997; SALERNO, 1994).

Empowerment reduces traditional managing costs and provides performance advances, but also implies investments on training and organizational changes (YIN et al., 2018; LEE AND EDMONDSON, 2017). Within this scenario of employee empowerment, the following research question is proposed for this paper: Does training play an important role on shop-floor workers’ performance? A case-study is used as a guidance to investigate the possible impacts of training on operator performance in a specific production cell in a Brazilian manufacturing company of optical fibers.

2. Theoretical Background

This section presents a brief theoretical background of the four most important themes considered relevant to this paper: operations strategy, employee empowerment, performance measurement and work environment studies. Employee empowerment in work studies are connected to performance measurement systems, since operational performance assessments are required to evaluate work structures. Therefore, a short review on operations strategy is the initial topic, since it is the common wider field of all others.
2.1. Operations strategy

Mintzberg (1987) defended the importance of multiple definitions for strategy, arguing the diversity of concepts is helpful for researchers to maneuver in this field. Porter (1996) contributed to Mintzberg’s reflection of strategy meanings for organizations and tried to differ strategy from operational effective, since it is important, but not enough. According to Porter, the essence of strategy is the choice to perform activities differently than competitors.

Hayes and Upton (1998) discussed strategic planning is commonly seen as a high-level game of chess, where a grand plan is formulated by top leaders, who sequentially moves the others inside the organization. However, it is actually much messier, since the strategy is only evident after its implementation and new opportunities are continually identified, demanding different new aspects of knowledge and capabilities. According to these authors, companies become vulnerable to their competitors when leadership misunderstand operations’ role importance and fail to recognize the success of strategy is only achieved when it reaches factory floors, service centers and computer rooms. Decades before, Skinner (1969) had also published a similar point of view, defending a missing link of manufacturing in corporate strategy, which indicates this view remained persistent over a long time.

According to Slack and Lewis (2008) operations strategy is the conjunction of strategic definitions and actions in the most relevant areas that places an organization in its competitive environment in order to achieve long-term objectives, ensuring its growth. The authors classify operations strategy decision areas in four distinct guidelines:

- Capacity: strategy that configuration of facilities and general level of capacity;
- Supply network: strategy applied for global integration of operations with each other;
- Process technology: development of systems, machines and strategic processes for organization’s competitive advantages;
- Development and Organization: a set of strategic and long-term decisions for the continuous improvement and establish how resources should be allocated within the organization and how hierarchical relationships should be used between these resources.

Employee empowerment plays an important role on the vast strategic decisions made in the “Development and Organization” section of operations strategy areas divided by Slack and Lewis (2008). Work organization involves the internal distribution of tasks and responsibilities and the respective involvement and management of resource efforts to achieve final products or services.
2.2. Employee empowerment

Empowerment is a work project approach that delegates decision-making power, autonomy and participation of employees in the management of companies. Empowerment is more than getting employee commitment, since it represents a higher degree of involvement in which employees are able to take decisions and assume risks without the intervention or permission of leaders (ELMUTI, 1997; OLSSON AND BOSCH, 2018; YIN et al., 2018).

Margulies and Kleiner (1995) suggest six steps for employee empowerment:

- Complementary skills: Treatment of employees as team members. Each one contributes with their respective abilities. Leaders are able to direct team members with the knowledge of their personal development.
- Communication: Supervision must care for its employees. Teams’ performance is only enhanced when leadership invest considerable time interacting and discussing personal issues with employees. It is necessary for management to ensure team members are recognized and rewarded as a team for the collective success.
- Strength reinforcement: Development of employees' strengths, instead of focusing on weaknesses. Balanced teams compensate for individual weaknesses in order to meet organizational goals. Employees and managers can develop an action plan to improve problem areas and the action plan should be part of the performance review.
- Training and development: Training programs provide skills, productivity and competence improvement, job turnover rates reduction through work satisfaction.
- Internal Alignment: Information share about strategic decisions and performance goals is essential for employees to understand the context and the directions to follow. It is a leadership responsibility to keep employees informed and involved with their respective results. Through this ongoing alignment, teams can motivate themselves and members can motivate each other.
- Delegation: Provide employees with tools and confidence to exercise their autonomy.

Many researchers agree with these empowerment pillars and defend performance measurement approaches to quantify short and long-term benefits (MACBRYDE AND MENDIBIL, 2003; BROWER, 1995; HESS, 2018). The authors also imply shared knowledge, rewards and autonomy levels must complement training programs, in order to prompt collective commitment beyond the technical learning (ELMUTI, 1997; HESS, 2018; OLSSON AND BOSCH, 2018).
2.3. Performance measurement

Performance measurement systems quantify the efficiency and effectiveness of business activities (NEELY et al., 2005). Melnyk et al. (2004) point out that performance measurements can provide three basic functions: enable managers to control and evaluate the performance of resources and operations, communicate performance to internal employees along with stakeholders and implement improvements through the identification of processes that do not reach the expected performance and demand interventions.

Bourne et al. (2000) reinforced the importance of continuously updating performance measurement systems over time in manufacturing companies and proposed a framework based on previous academic contributors to measure three phases: the design, the implementation and the usage of a performance system.

Slack et al. (2009) proposed global performance of an organization is segmented in five dimensions: quality, speed, reliability, flexibility and costs. Complementary, they also defend four types of performance standards:

- Historical performance, based on statistics of previous results;
- Target performance, focused on viable goals;
- Competitive performance, established to overcome competitors’ performance
- Ideal performance, based on projections hard to achieve but still provides a challenge to exceed theoretical limits.

Beyond these organizational performance metrics, the work structure and all workers responsible for organizational success must also play an important role in performance system designs (JACA et al., 2013; CIASULLO et al., 2017).

Macbryde and Mendibil (2003) suggest team and individual development must be measured in efficiency, effectiveness, learning and growth, together with job satisfaction. Human resource measurement systems imply not only process results and its execution time, but also skill development assessments along with personal growth and well-being.

Within this performance assessment context, work design and people development remain explored by many researchers, even considering this new technological era. Team composition and many possible cultural factors influencing performance are still investigated by recent studies (MÜLLER et al., 2018, MOURA et al., 2019; REZVANI et al., 2019) with the goal to analyze and hypothesize cohesion theories that provides exceptional performance in organization environment’s field.
2.4. Work environment studies

Work organization faced its first revolution with Scientific Administration and Ford production system in 1911. This approach brought standardization, rigid hierarchy along with low flexibility and few interactions among shop-floor workers (WEISBORD, 2011). Over time, new foundations appeared after Elton Mayo proved social factors had a strong influence on performance with his research experience in Western Electric between 1923 and 1933 (ZOLLER AND MULDOON, 2019). Decades later, Toyota’s Japanese approach also revealed as an opposition to Taylor’s principles, since they invested on the intellectual aspect of all factory members to overcome a challenging scenario and consequently succeeded through internal collective contribution (DENNIS, 2008).

The new approaches supported the reunion of planning with execution, demanding participation and involvement from shop-floor workers and no longer limiting them to follow mechanical tasks. Familiar with these principles, sociotechnical research was born after Tavistock Institute started to investigate the English coal mines’ case-study. Instigated by work members’ higher productivity levels trying a self-management work design in 1949, shared leadership and autonomy degrees became a strong research field in work environment (SALERNO, 1994; SIMONETTI AND MARX, 2010).

The defense of sociotechnical work systems gave an important attention to employee empowerment and team development as strategic projects to achieve competitive advantages. However, organizational learning and training programs involve high costs and a strong hierarchy commitment to delegate autonomy (MANZ AND SIMS, 1996). Therefore, performance benefits are only reached in the long-term, since deep organizational changes are an elementary premise to stimulate employee empowerment (HESS, 2018).

Recent work studies (JACA et al., 2013; CIASULLO et al., 2017) accomplished the old sociotechnical theory (MARX, 1997; SALERNO, 1994), investigating not only shared leadership effects on performance (MÜLLER et al., 2018), but also how individual aspects, such as emotional intelligence, affect social factors, like trust and conflict, and consequently, collective results. (REZVANI et al., 2019). Team development and training stages (MANGES et al., 2017; SIREGAR et al., 2018) and members’ psychological aspects (CHA et al., 2014) are also interesting studies on work structure current research agenda. The contribution of the present study is to investigate the training aspect of empowerment pillars and its possible impacts on performance.
3. Research design

This paper presents a case study of an optical fiber manufacturing company. Fourteen operators of the same production cell received different levels of training and their distinct performance results led leadership consider if training had a possible influence on efficiency. The three training levels for operators are:

- **Level 1** – Work execution training: the learning happens during work routine with senior workers and experience is achieved over time through successes and failures.
- **Level 2** – Internal training program: Quality and engineering department invest a teaching agenda with workers to explain detailed processes’ standard instructions.
- **Level 3** – Industry 4.0 course: A technical course at Pontifical Catholic University of Paraná is provided, involving higher costs on training and time for the operators to learn.

Most of the workers, eight of the fourteen members, attended the third level course, while four of them attended the internal training program and only two were limited to the first level “learning by doing” approach. The purpose of this research design is to investigate training possible impacts on performance, as instigated by company leadership. The method consists on a K-means clustering with three groups followed by a boxplot descriptive analysis, with no purpose of any inference statistics at this stage, since our data collection is still limited at this preliminary investigation. Figure 1 details the steps of the present research design.

![Figure 1 - Research Design](source: the authors (2020))

The results of the applied methods will provide a discussion with literature principles in the discussion section of the present paper. It is important to clarify we do not generalize or extend our conclusions to other realities, since our method was restricted to a single case-study descriptive analysis.
4. Results

K-means clustering with three groups, Figure 2, presents a descriptive analysis of performance behavior over training levels.

Figure 2- K-means clustering with three groups

Source: Company’s database (2020)

Training levels 1 and 2 do not seem to differ that much from each other in terms of performance efficiency, since K-means clustering approach grouped the same amount of their instances in two different clusters. On the other hand, it is perceptible a performance breakthrough in the third training level, with a single cluster predominance considering training level and efficiency percentage factors. A boxplot analysis from each cluster, Figure 3, is relevant to extend this descriptive analysis.

Figure 3 - Boxplot Analysis

Source: Company’s database (2020)
Performance average differences among the clusters is significant, since boxplots’ averages are visually remarkably distant from each other in efficiency percentage scale: 58.36%, 74.78% and 85.99%. It is important though to emphasize that Cluster 2 and Cluster 3 grouped instances from first and second training levels, therefore there is no apparent evidence that second level can possibly influence higher performance based on the present collected sample. Contrarily, Cluster 1 grouped exclusively instances with third level trained workers, which is noticeable a pattern identified by K-means approach. Even though Cluster 3 also presented high performance instances, it is visually meaningful that Cluster 1 presented exceptional performance compared to others and all its instances are composed by workers who attended the third level course at the university.

5. Discussion

The applied descriptive analysis has revealed the importance of training and preliminarily reassured the instigation of the leaders. Training is a special subject on employee empowerment and it meets work organizational field of strategy identified by Slack and Lewis (2008). The case-study company applied some concepts supported by literature principles of empowerment, such as complementary skills development, strengths reinforcement and training programs as suggested by Margulies and Kleiner (1995). Hence, the company could also benefit from theoretical principles, reaching superior performance through empowered workers with advanced knowledge of their tasks, and consequently more commitment to results and self-confidence to assume risks (OLSSON AND BOSCH, 2018; YIN et al., 2018).

Results also provide an interesting discussion to operations strategy’s literature principle (SKINNER, 1969; HAYES AND UPTON, 1998) that organizational success is achieved when it reaches operational commitment to strategy.

Findings contributed to support sociotechnical theory (MARX, 1997; SALERNO, 1994) and also dialogue to new work studies (JACA et al., 2013; REZVANI et al., 2019), since we have explored training programs as a key success factor to shop-floor workers’ performance. Additionally, this training link to performance can also provide a debate related to how the technical knowledge and the other possible achieved abilities, like leadership skills, enabled this performance enhancement. In this topic, an extended further study can contribute to identify which capabilities are reinforced during training programs and quantify these capabilities according to their respective importance level, providing the built of a maturity model.
6. Conclusion

The present study strengthens the hypothesis that investments on training can achieve superior performance, since cluster descriptive analysis presented higher levels of efficiency with workers from the most advanced level of training. Therefore, we positively answered the research investigative proposed question, identifying that training plays an important role on shop-floor performance. Our contribution to work organization in operations strategy field supports sociotechnical approach principles, presented by theoretical background section.

We can also address some limitations to direct following researches to cover some unexplored investigation topics. Firstly, this paper focused on measuring efficiency along with learning and growth. However, new linkages can possibly be found connecting training programs to job satisfaction and leadership skills. Considering this possible multidimensional data collection, we could also extend to more advanced statistics, since this study was restricted to a specific production cell in a small database. Secondly, we focused on individuals, not on team collective results and it would be interesting to analyze team evolution together with individual development. Finally, a maturity model identifying training capabilities with importance levels, as debated in discussion section, is also an important extension for this research.

REFERENCES


