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CIGI QUALITA MOSIM 2023

Team maturity characterization to sustain Continuous Improvement's programs

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Résumé – Les programmes d'amélioration continue sont un atout avéré pour les entreprises qui sont sur la voie de la croissance et de la mondialisation. L'aboutissement de ces programmes dépend fortement des équipes qui sont l'une des ressources les plus importantes, à l'origine du travail quotidien et de la conduite du développement des processus. La plupart des obstacles qui empêchent la mise en place d'une culture d'amélioration sont liés aux ressources humaines. Dans ce contexte, cette recherche a pour objectif d'étudier la maturité des équipes mises en place pour soutenir la pérennisation des Démarches de Progrès grâce à une approche qualitative. A la suite d'une étude bibliographique importante sur le développement des groupes, et des équipes d'amélioration continue ainsi que des entretiens semi-directifs avec des experts de terrain, une caractérisation de la maturité des équipes d'amélioration continue est proposée. Elle est composée de 5 dimensions et de 16 éléments. Cette proposition consolide tous les aspects de maturité au sein de ces équipes qui devraient être renforcées. De plus, cette nouvelle caractérisation des équipes peut aider les parties prenantes à minimiser la résistance au changement, à améliorer la satisfaction au travail et à maintenir les résultats à long terme.

Abstract – Continuous Improvement's (CI) programs are a crucial asset for companies on the path to growth and globalization. The success of these programs strongly depends on the teams which are one of the most important resources, in charge of the daily work routine and driving process development. Most of the obstacles that prevent the establishment of a culture of improvement are related to human resources. In this context, this research examines team maturity to support CI's programs sustainability, through a qualitative approach. From an important bibliographic study on group development and CI teams, as well as semi-structured interviews with field experts, a characterization of the maturity of CI teams is proposed, composed of 5 dimensions and 16 elements. This proposal consolidates all maturity aspects that take place within these teams and should be reinforced. Additionally, this new perspective of these teams can help stakeholders minimize resistance to change, enhance job satisfaction, and sustain long-term results.

Mots clés - amélioration continue, maturité d'équipe, efficacité d'équipe.

Keywords – continuous improvement, team maturity, team effectiveness.

1 INTRODUCTION

The emergence of Industry 4.0 as a technology-driven revolution triggered a concern related to guiding people's actions in highly complex and dynamic systems. Furthermore, with the arrival of Industry 5.0 and a human-centric approach that places workers at the center of manufacturing processes, more attention is to be addressed to individuals and ways to favor wellbeing and productivity in these settings at once ([Lu *et al.*, 2022], [Xu *et al.*, 2021]).

Work teams and improvement projects are at the core of organizations as the instruments to achieve process development and waste minimization. In this context, Lean Manufacturing (LM) has been acknowledged as one of the most accepted strategic management systems to improve business performance and competitiveness over the last decades ([Antony *et al.*, 2021; Tortorella *et al.*, 2021b]).

Still, when it comes to its implementation, a lot of studies point to human related barriers as the most critical, like insufficient management time, workers attitude or resistance and incompetent teams ([Chaple *et al.*, 2021; Antony *et al.*, 2019; Jadhav *et al.*, 2014]). According to [Wackerbarth *et al.*, 2015], the greatest barrier to Lean is often the development of the team aspect of the approach, while the application of its technicalities is the easiest one. To sustain a productive Lean team is becoming a major challenge.

These teams are different from other work teams as they follow Continuous Improvement (CI) principles that establish dynamics and require specific behaviors, like coordination, self-direction, participation in decision-making and in cross-functionally tasks ([Grant et Hallam, 2016; Van Dun et Wilderom, 2017]). [Mostafa *et al.*, 2013] claim that the human element is an intrinsic part of LM, but research evidence that examines the influence of team characteristics in a successful

Lean transformation is scarce ([Grant et Hallam, 2016; Tortorella *et al.*, 2021a]). In complement, according to [De Vries et Van der Poll, 2018], the non-technical circumstances of how and why these teams reached success are lacking. Individuals impact the development of the team, but the team influences the development of its members as well. Based on [Al-Sabbagh et Gren, 2018], groups, rather than individuals, should be the key element of any change efforts. When the potential of the team members expands, combined with the reinforcement of the relations between them and the synergistic effect, the results of the organization will escalate ([Giedraitis *et al.*, 2017]).

Thus, to consider employees separately despite their relations with each other within the group seems inadequate for a long-term CI strategy. It's not the sum of people's competencies that makes them ready to be a productive team in the long term. [Easton et Rosenzweig, 2012] found no relation between individual experience and project success.

Actually, for [Ramirez-Mora *et al.*, 2020], in order to become a team, a group of people need to go through a development process. This condition of maturity is not achieved easily, but it's essential for sustained performance. In fact, team maturity encompasses the team's capacity to continually evolve in a dynamic setting and acquire new competencies accordingly. The ability of a given work group to reinvent itself to maintain a level of process improvement over time, is a crucial competitive advantage and can only be a result of maturity. Unlike competencies, that are related to specific situations or objectives ([Pouydebat, 2022]), we consider team maturity as a systemic approach in which a group of people is ready to handle any given circumstances and continue to optimize performance through time.

In this sense, this research aims to identify and characterize CI teams' maturity through a qualitative research method. The purpose is to determine the elements that define team development in the discussed context and to enable team's maturity level assessment and team management to improve it. Systematic literature reviews were performed on the subjects of group development theory and CI teams, following the methodology proposed by [Lacerda *et al.*, 2014]. Web of Science was the selected database to search the articles and a temporal universe of the last 10 years (2011-2021) was chosen for current and realistic results. Google Scholar was subsequently used to complement the bibliography without year constraints. Finally, exploratory semi-structured interviews were carried out with 2 experts in the field of continuous improvement's initiatives to refine the proposal.

This article is structured as follows: section 2 addresses group development theory, which serves as the foundation to examine maturity of CI teams. Then, maturity dimensions are proposed, based on the analysis of the selected group development model. Section 3 exhibits how CI and Lean teams are inserted in a dynamic and challenging setting that requires team maturity: the 14 aggregated maturity elements proposed to characterize team maturity were identified from 12 empirical researches on CI teams with very different backgrounds. Section 4 presents the combination of the maturity dimensions and the maturity elements gathered from the two precedent sections to propose a CI team maturity characterization. Finally, section 5 stresses the contributions of the proposal and establishes guidelines for future research.

2 GROUP DEVELOPMENT

There are a lot of distinct theories and models in group research to explain a group's process to mature with time.

These group development studies seek to demonstrate how groups function and progress to become effective. However, even if teams are an essential part of any production system, there are not a lot of published works in the Industrial Engineering domain with this purpose. These works are concentrated mostly in the social psychology and education areas.

However, [Guttenberg, 2020] studied Lean Six Sigma's teams in the service sector. He found that groups which progressed through Tuckman's model ([Tuckman, 1965]) completed more projects in total, on time, in less time and with greater cost reduction in comparison to others. Apart from this article, studies connecting group development theory and CI are rather rare. Thus, relying on group development literature to study CI improvement team's maturity is relevant.

As demonstrated by [Maynard et Jacobson, 2019], the use of a group development model helps to identify factors that influence a group's maturity and the analysis of activities to find improvement opportunities. Besides, the maturity of teams has been found to be positively associated with effectiveness ([Ramirez-Mora *et al.*, 2020; Murphy *et al.*, 2016; Leuteritz *et al.*, 2017; Lévassieur, 2011]), efficiency ([Ramirez-Mora *et al.*, 2020]) and performance ([Gren *et al.*, 2017; Navarro *et al.*, 2016]).

In this context, [Chang *et al.*, 2006] provided a framework to select an appropriate model of group development based on three criteria: (i) population - if it's meant for a certain type or all types of groups, (ii) content - related to the level of specificity, or if it is about a more comprehensive picture of groups and (iii) path dependency - which stands that groups evolve over time and through phases, implying that later stages are considered more developed than earlier ones.

In view of the above classification, the Integrative Model of Group Development (IMGD) proposed by [Wheelan et Hochberger, 1996] is defined as a comprehensive, path dependent model indicated to all types of groups. [Gren *et al.*, 2020] point out that the mentioned model considerably overlaps the stages of group development proposed by [Tuckman, 1965], which is also well acknowledged and has similar characteristics, but is based on literature review only.

Wheelan's work is the single evidence-based model known to date ([Gren *et al.*, 2017]) and it provides the Group Development Questionnaire (GDQ), a validated interview guide that allows to diagnose the development stage groups are in, and, consequently, the means to raise it by placing attention where it is needed.

Applications of the GDQ in the agile software development context, [Gren *et al.*, 2017; Gren *et al.*, 2020] found a positive correlation between team maturity and agility, meaning that a more mature group can be more responsive to change, which is not specified in group development theory. Yet, they propose that adding these concepts to the definition of the "agile team" could extend its understanding. Corroborating with these results, [Al-Sabbagh et Gren, 2018] discovered that teams with a higher score of maturity are more effective and that there is an overlap between Wheelan's measurement on what it takes to be a developed team and Software engineering's on what it means to be an agile work group.

Regarding how groups should be examined, [Wekselberg *et al.*, 1997] defend the construction of clear group-level variables to describe them, instead of individual-level ones. The authors posit that the maturity stage of a team can only be usable if it explicit which aspects contributed to it.

In this sense, acknowledging group development literature and the arguments presented above, it was decided that the IMGD

Stages	1	2	3	4	5
Dimensions	Dependency and Inclusion	Counterdependency and fight	Trust and structure	Work	Termination
Group behaviour	Dependence on the leader	Coalitions	Commitment and cooperation	Focus in task accomplishment	Impending termination and regression to earlier stages
Communication	Politeness and hesitation	Greater freedom of expression	Open and task oriented	Free and clear	
Members relationship	Conflict avoidance	Inevitable conflicts	Positif relations intensifies	Problems solved	
Work level	Work avoidance	Procedural decisions	Focus on objectives	Intense productivity	




Figure 1. Proposed dimensions and characteristics of group development based on [Wheelan et Hochberger, 1996]

would be an adequate base model to explain CI teams' maturity. Founded on the analysis of the 5 stages of group development introduced by the IMGD, we identified 4 main dimensions to synthesize the group's characteristics for each stage: Group Behavior, Communication, Members' Relationship and Work Level. The proposed dimensions can be considered as the main variables to investigate a group's development stage. Figure 1 presents our proposal.

For each dimension the group will act accordingly to the stage of development they're in. For instance, taking the Work Level dimension, a group in the first stage will tend to avoid work at all costs, afterwards it will progress to making procedural decisions on the group structure and roles, before focusing on objectives and increasing the group's capacity to work effectively, until it finally reaches a state of intense productivity. It's interesting to notice that development will occur in a more or less conjoint way between the dimensions, as they have an impact on each other.

We consider that this IMGD model completed by the 4 proposed dimensions is suitable to assess CI team maturity. Indeed, the path-dependency perspective, with the characteristics of group development, are considered relevant for the CI team context. The idea of progression in time, presumed as a crucial factor for achieving team maturity in any setting, is integrated and the 4 identified dimensions enable a better structure of group maturity.

3 CONTINUOUS IMPROVEMENT TEAMS

CI teams are a particular type of group. In this sense, [Van Dun et Wilderom, 2017] define a Lean team as a work floor unit within an organization, that follows Lean's philosophy and tools and implements workers ideas to improve its own processes.

Lean production systems rely on the elimination of non-value-added activities through standardization of work and continuous operational improvement through individuals and teams that are proactive and go beyond stipulated work. However, Lean's structure may limit autonomy and reduce work motivation ([Lantz et al., 2015]).

Although there are positive cognitive sides of Lean in the workforce, like job rotation that increases employee involvement and satisfaction ([Neirrotti, 2020]), the staff may be affected by a coercive side of stress, loss of independence regarding the time pace and work methods, fatigue and pressure to meet the daily quality and cost standards, resulting in work intensification ([Adler, 2012]).

Literature on CI systems is still more focused in production activities (the technical side) than, for example, in methodologies to engage employees and teams in the improvement philosophy. Nevertheless, Lean and CI program's sustainability requires worker involvement, a CI culture, an enabling organization and team environment, committed management and proper training ([Jaca et al., 2012]). In accordance, the findings of [Neirrotti, 2020] shows that the team and workplace environment have a positive effect on work performance, personal efficacy and job satisfaction.

In these circumstances, in order to upgrade overall performance, direct action to group activity is needed. With all these particular traits and additional challenges, CI teams differentiate themselves from other work groups and the continuous cycle of process improvement demands even more of team maturity.

Assuming the pivotal role of teams for the success and sustainability of CI programs, we analyzed and identified elements as representatives of team maturity from 12 empirical researches with CI and Lean teams in the literature. These studies (extensive list in table 1) were diversified in their purposes, making it possible to obtain a comprehensive picture of a team in the discussed context and identifying what makes it mature or not. Furthermore, these articles have different backgrounds (e.g. teams in the manufacturing or service sector, with distinct sample sizes and types of groups).

Thanks to the extensive list of elements identified from these studies that characterize CI team maturity, and considering the similarities between some of them, we ended up with 14 maturity elements (the literature references for each element are presented in table 1):

- Collaboration

- Communication openness
- Trust
- Shared goals
- Shared meaning
- Shared values
- Participatory problem solving
- Roles organization in the team
- Performance monitoring between members
- Autonomy level
- Performance level
- Communication with other teams and departments
- Collaboration with other teams and departments
- Communication openness with the program manager

These 14 elements provide a guideline for a CI team to achieve maturity, therefore a constructive team environment, work satisfaction and productivity in a strong and sustainable way. All the elements are related to dynamics inside the group and between the members, except for Communication and Collaboration with other departments and with the program manager, that concerns the relation of the group with external people. Still, the lack of any of the proposed elements can be seen as a barrier to team maturity, and on the other, a good level of development in one of them is a step in the right direction.

These 14 identified elements will serve as basis for assessing team maturity and are general for different CI programs.

4 RESULTS AND DISCUSSION

The comparison of the characteristics of a developed group in the last stage of the IMGD and the 14 maturity elements identified in the CI team's literature reveals more similarities than differences. In a coherent way, both constructs are mainly made of equivalent aspects in regards to what it takes to be a mature team.

The idea of progression in time or the idea of team's maturity itself is not explicitly present in the CI bibliography, and neither is the comprehensive examination of what makes a developed CI team. In this sense, the combination of group development's concepts and identified dimensions from the IMGD (figure 1) with the maturity elements identified in the CI team's context resulted in the characterization of CI team's maturity, which is composed of 5 dimensions and 16 elements (table 1).

The proposed maturity elements were classified in the 4 proposed dimensions identified in the IMGD. A 5th dimension "External relationships" was added to incorporate the aspects related to the contact between the group and its external environment, not present in the IMGD theory, but important in the context of CI teams. Then, 2 other elements were added - Conformity and Conflict management - as they were not found in the CI literature, but are important traits of group development for [Wheelan et Hochberger, 1996], particularly, working on conflicts is a key step for building trust among members.

Furthermore, the 3 elements "Shared meaning", "Shared values" and "Performance monitoring between members" are not a part of the IMGD, but are found in the CI literature as factors for improvement sustainability and high Lean team performance. About the other elements, even if there is some

variety in vocabulary, they address the same notions and are present in both literatures.

The combination of the group development's and CI's literature resulted in an original characterization of CI team's maturity and evidences the value of a construct adapted to the CI context. Using only group development's theory would be insufficient for assessing CI team's maturity.

Moreover, all of the proposed elements were presented to 2 experts in CI program's management for confrontation through semi-structured interviews which confirmed the pertinence of the research. Particularly, they endorsed the idea of progression over time for each element as in group development's research, mentioning time as a crucial condition to CI team development.

It is also relevant to notice that some of the proposed maturity elements had a lot more references than others in the CI literature. However, this only, cannot be an indication of greater importance of an element over another. For example, even though it had one single reference, Trust was also evidenced by the experts and it's a crucial aspect in Wheelan's theory.

The proposal of dimensions and elements to characterize team maturity in the CI context based on group development's theory and CI team's studies is a useful asset to evaluate CI teams and, consequently, improve its maturity. The identified elements need to be supported and reinforced by managerial practices, ascertained that increasing team maturity is the route to sustaining results in the long term.

5 CONCLUSION AND FUTURE RESEARCH

In this research, we examined team maturity as an important feature for CI processes in organizations. Through a qualitative method, we analyzed group development's and CI team's literature to come up with 5 dimensions and 16 elements to characterize team maturity in the CI context. The choice to first explore group development's literature allowed a step back from CI works and a thorough view in group studies from various domains. Even if there are differences in background, some maturity aspects are common for all types of groups.

The characterization of team maturity is a valuable instrument to support CI program's results and sustainability, as it enables stakeholders to find opportunities for development through the identification of group elements that need action. Maturity makes teams effective in the long term and mature teams have the ability to adapt to different situations and keep improving. In dynamic contexts, such as CI, this is a crucial competitive advantage that cannot be neglected.

From a practical perspective, this work provides managers a roadmap to guide their actions towards teams, as they should aim at reinforcing the maturity elements identified. Still, the emphasis on team's maturity will contribute not only to industrial advancement, but also to individual development and worker's satisfaction and well-being, which is a growing concern in the Industry 5.0 era.

To provide more evidence to our findings, further studies could be conducted, using surveys or focus groups, for example. Future research agenda includes the investigation of the links between team maturity and individual maturity, the investigation and proposal of enablers to act on each of the maturity elements to improve team maturity and a field validation of the whole construct.

Table 1. CI team's maturity characterization

Dimensions	Maturity Elements	References
Group Behaviour	Collaboration	Cooperation and respect within team [1]; Cultivation of teamwork [2]; Teamwork [3, 4]; Inclination to collaborate [5]; Reinforcement of interpersonal relationship and cohesiveness [1]; Peer support [6]
	Conformity	Voluntary conformity is high [7]
Communication	Communication openness	Communication [8]; Regular recognition of achievements among team members [1]; Information collection and feedback of quality [2]; Degree of team member's information sharing [9]; Communication among workers of a team [10]; Information sharing [6, 11]; High level of open communication [1]
Members' relationship	Trust	Trust reinforcement [11]
	Shared goals	Shared understanding of team goals and strategies [12]; Clear and shared goals [1]; Goals management [2]; Common understanding of team priorities [5]
	Shared meaning	Construction of a shared meaning of work [12]; Greater value to performance improvements [1]; Cultivation of quality consciousness [2]; Greater sense of ownership and belonging [1]
	Shared values	Self-transcendence work values [6]; Openness to change work values [6]
	Conflict management	Periods of conflict are frequent but brief [7]; The group has effective conflict management strategies [7]
Work level	Participatory problem solving	Participation in decision-making and problem solving [1]; Improvement of group staff's abilities to analyze problems [2]; Participative decision making [12]
	Roles organization in the team	Clear responsibilities among team members [1]
	Performance monitoring between members	Performance monitoring [6]
	Autonomy level	High level of autonomy (participation and empowerment) [13]; Proactivity [12]; Job autonomy and empowerment [1]; Self-directed team activity [3]
	Performance level	Process improvement [6]; Multi skills [2]; Skill level improvement of the workers on the team (flexible workers) [5]; Skill utilisation (multifunctional) [1]; Ratio of defects outflow [2]; Labor productivity [2]
External relationships	Communication with other teams and departments	Communication among different teams [10]
	Collaboration with other teams and departments	Cooperation and respect with other teams [1]; Horizontal integration and cross-functional teamwork [3]; Collaboration with other teams and departments [12]
	Communication openness with the program manager	Communication between teams and management [10]

[1] : [Tortorella *et al.*, 2021a] ; [2] : [Wang *et al.*, 2016] ; [3] : [De Vries et Van der Poll, 2018] ; [4] : [Jaca *et al.*, 2012] ; [5] : [Grant et Hallam, 2016] ; [6] : [van Dun et Wilderom, 2021] ; [7] : [Wheelan et Hochberger, 1996] ; [8] : [Berlec *et al.*, 2017] ; [9] : [van Dun et Wilderom, 2016] ; [10] : [Colazo, 2016] ; [11] : [Hansen *et al.*, 2020] ; [12] : [Lantz *et al.*, 2015] ; [13] : [Rolfen et Langeland, 2012].

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