Autonomy and Turnover in Distributed Software Development Projects: a Systematic Literature Review

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Abstract. *Distributed teams have become a tendency among software companies. However, companies that apply Distributed Software Development (DSD) suffer from high developer turnover. Research shows that autonomy factors can mitigate or prevent team turnover. In this research, we investigate the role of autonomy on turnover in distributed teams through a Systematic Literature Review (SLR). Our findings revealed a set of autonomy dimensions that influence turnover in DSD projects. Besides, we identified the main factors related to autonomy linked to turnover in DSD projects. These findings provide software companies and organizations with a better understanding of the importance of autonomy factors to battle the DSD projects turnover problem.*

1. Introduction

Turnover originates different changes on the company's human resources departments and software projects [Khan et al. 2010]. Studies point out that there are different factors negatively or positively related to turnover happening [Sulayman et al. 2014]. Since 1979, literature has created models trying to relate determining factors to turnover, for example, Mobley's model [Goldenson and Herbsleb 1995], which developed a motivation action model in an individual level at user behaviour.

Software companies show high levels of turnover and this constant change and turnover generates some problems such as increasing companies costs, the difficulty of managing a team, the decrease in the workplace harmonia, impact on project success and others [Rainer and Hall 2002, Khan et al. 2010]. For example, Ramasubbu [Ramasubbu 2013], pointed out that 90% of projects suffer from turnover .

A high level of turnover becomes a problem because it indicates that professionals do not stay in the company for a long time, making companies and projects show a low retention level. Furthermore, turnover itself causes significant costs whether they are considered as a pecuniary classification or also a work quality level, and individual work [El Emam and Koru 2008]. In DSD projects, turnover levels are reported to be even

higher than in localized projects, which can be related to the specifics of the job related to geographic location, communication, etc [Armstrong et al. 2018].

Models show positive and negative factors to have a turnover occurrence, differing turnover when the professional has already left the project and company, and turnover intentions. It is possible to notice professional intentions in a determined moment where he lived and acted in the project [Khan and Khan 2013]. Some factors are stated in literature because of their turnover impact and turnover intentions [Khan and Khan 2013, Kautz and Nielsen 2000]. Autonomy is an essential factor and a motivator for software engineering in this context. One dissatisfaction among autonomy needs provenience from software engineers, and autonomy degree is that he/she owns might have an impact on performance and motivation [Sulayman et al. 2014]. Therefore, our primary focus in this paper is to present a relationship between autonomy and turnover from Software Engineers that are inserted in Distributed Software Development (DSD) projects.

Thus, to answer the research question, "What is the relationship between autonomy and turnover in distributed software projects?" we elaborated two subquestions:

- RQ1.1 - What are the main dimensions of autonomy that influence turnover in distributed software projects?
- RQ1.2 - What are the main factors related to autonomy linked to turnover in distributed software projects?

This paper is organized as follows: in Section 2, we introduce the background. Section 3 describes the method we apply. Section 4 presents the results, their implications and limitations, respectively. Furthermore, Section 5 presents discussion and limitations. Finally, Section 6 presents conclusion and future research directions.

2. Background

2.1. Autonomy

Autonomy is known as one of the most studied job characteristics, and it plays a central role in motivation's work design [Campion 1988]. In an early stage, autonomy was seen as a synonym of how much freedom and independence in an individual perspective a team member had while executing a project or work task [Hackman and Oldham 1976].

After that, researches [Wall et al. 1992, Bass et al. 2018, Marinho et al. 2021] regarding this theme made explicit that the concept of autonomy in workplaces was mentioned when there were some characteristics such as freedom, independence, decision making, choices of working routine and methods to task execution.

Nevertheless, Morgeson *et al.* [Morgeson and Humphrey 2006] also pointed out three aspects interrelated to autonomy focused on freedom such as working routine, decision making and working methods.

Autonomy is strongly related to Self-Determination theory stated by [Deci and Ryan 2012] which aims to explain the factors that could mediate motivation. In this context, competency, identification with work and autonomy are three psychological necessities innate to a person to feel satisfied in a workplace are expressed

by this theory. Furthermore, Ryan and Deci pointed out that the higher the autonomy one feels, the more motivated one is [Deci and Ryan 2012].

According [Noll et al. 2017] the autonomy at work was recognized as a central factor in work design, leading to many positive outcomes. Even so, [Dysvik and Kuvaas 2013] have rightly questioned its predictive role for several outcomes, including turnover intention, as well as the relationship between them.

In software engineering, the Self-Determination factors may be described as barriers to motivation and satisfaction with work. Professional demotivation is considered a predictive factor for turnover, which is considered a specific and different context when working on distributed projects [Cruzes and Dyba 2011].

Autonomy has been identified as an important motivational factor for software engineers who work in distributed models. Those professionals are also more tolerant of motivational changes because they are naturally exposed to hours of antisocial work and travel necessities [Ivarsson and Gorschek 2011].

In a distributed project context, autonomy itself is not referred to as a factor that might motivate a team member. However, when it is not present, an individual's needs for autonomy might contribute to a higher dissatisfaction with work and result in this team member turnover [Wall et al. 1992].

2.2. Turnover

Team members' turnover negatively impacts software development. Even though many authors consider turnover as a natural part of an organization, high levels usually result in negative impacts on processes efficiency [Bass et al. 2018].

Turnover may be classified as external when team members leave the organization or internal when they remain in the company but change their previous work. This process can happen voluntarily when the employee himself decides to abandon the company and their role or involuntarily, which happens when the organization decides to terminate its relationship with the employee [Chatzipetrou et al. 2018].

Furthermore, turnover rates can be calculated by dividing the number of employees who left the organization in a determined time by the total amount of employees during this same period. However, in daily organizational practice, the data needs to be more detailed to identify the reasons that resulted in a turnover. This understanding is shown as one of the main barriers. Such data are highly relevant for strategies creation that might be applied in an efficient way to deal with turnover and its consequences properly [Chatzipetrou et al. 2018].

Articles show that perceived intention job autonomy was negatively related to turnover reporting only for employees with high levels of perceived support. However, these results must be integrated with new ways of working, such as the Distributed Software Development (DSD) [Dysvik and Kuvaas 2013].

DSD has become a common practice worldwide, intensified by financial, structural and global factors [Bass et al. 2018].

Among the several characteristics related to DSD is the organization's potential to attract qualified professionals, even being in a local context with professionals' scarcity.

This incredible capacity to attract and hire specialized professionals positively impacts productivity and services, and products' quality [Dysvik and Kuvaas 2013].

DSD projects might have turnover levels raised because of physical distance, and on Ebert and Jha study [Ebert et al. 2016], turnover is mentioned as one of the five most significant risks for DSD projects. Previous short research related to the relevance of motivational factors to prevent this phenomenon in distributed projects [Deci and Ryan 2012].

2.3. Distributed Software Development

A distributed project is a group of people among different locations that work united in a single project for an extended period. This kind of software project in which the human resources involved are spread by distance, regionally, nationally or globally, is defined as Distributed Software Development (DSD) [Sulayman et al. 2012, Marinho et al. 2018, Marinho et al. 2019].

Furthermore, DSD can be classified on two factors: the distance among work teams which presents itself as Onshore (teams located in the same country) and Offshore (teams located in different countries). Besides, on the other hand, the control relationship the central organization has over the remote teams presents itself as Outsourcing (hiring of third party company) or Insourcing (creation of a company remote unit) [Richardson et al. 2010].

Research indicates that offshore outsourcing service providers could reduce staff member turnover by improving work-life balance and adopting more family-friendly employment policies, such as increased autonomy. Further, outsourcing service providers could reward innovation more effectively and structure contracts to enable software product ownership to improve staff retention [Bass et al. 2018, Marinho et al. 2018].

3. Research Method

In this paper, we conducted a Systematic Literature Review (SLR), which aimed to answer the research question: *What is the relationship between autonomy and turnover in distributed software projects?* We follow kitchenham and Charters' guidelines [Kitchenham and Charters 2007], and it had its execution based on a research protocol that contains our research questions, inclusion and exclusion criteria for gathered studies, search string, chosen digital libraries and a quality evaluation guideline. They are all presented below.

We used the boolean search string shown as following to ensure that we captured a wide variety of papers.

("global software engineering" OR "global software development" OR "distributed software engineering" OR "distributed software development" OR GSE OR GSD OR "distributed teams" OR "global team" OR "dispersed team" OR "spread team" OR "virtual team" OR offshore OR outsource OR DSD OR DSE) AND (turnover OR "turnover intention" OR departure OR "rate of replacement" OR "employee retention") AND (autonomy OR "self-government" OR independence OR "self-rule" OR freedom OR "self-sufficiency" OR "job control" OR "schedule control" OR "self-management" OR isolation OR "job autonomy")

The following criteria guided the selection of papers that helped us address the research questions. We *included*: (i) complete, peer-reviewed, published papers; (ii) papers directly related to the research questions; and (iii) the study is available via the university library services accessible to the authors during the time of the research. We *excluded*: (i) texts not published in English; (ii) technical content, e.g: editorials, tutorials, key-note speech, white papers, thesis, dissertations, technical reports, books; and (iii) Studies not related to Software Engineering.

Our search string returned 1752 studies from 5 engines as noticed in the Table 1. We identified 95 duplicate papers and no replicates. After excluding duplicate results from the dataset, we identified papers for inclusion in the initial selection (phase 1). Of these papers, 85 were passed on to phase 2, in which 25 were eliminated and 60 (`https://bit.ly/3wWUV0Q`) were finally passed on to the data extraction and data synthesis phase (see Table 1).

Engine	Selection	Phase 1	Phase 2
ACM	759	40	33
Scopus	148	27	20
Wiley	175	5	3
Springer	353	3	2
IEEE	317	10	2
Total	**1752**	**85**	**60**

Table 1. Papers by engine.

A spreadsheet was used to record the extracted data. Two researchers performed the data extraction independently to reduce the bias of the data extraction. Before the formal data extraction process, two researchers discussed the definitions of the data, in pairs, items to be extracted to ensure that both researchers had a common understanding. After we completed the data extraction, a discussion was held to resolve conflicts for reaching a consensus on the data extraction results.

We opted for a mixed approach based on quasi schemes(standard) where the research type of facet was selected as described by [Wieringa et al. 2006]. The rigour and relevance model used was the one proposed by [Ivarsson and Gorschek 2011] in order to establish a qualified point of view regarding SLR's found paper's relevance. To measure the maturity of the themes, a scheme proposed by [Ebert et al. 2016] was carried out, where the results found in research facets and contribution facets over time are crossed.

After that, a thorough reading was done to extract as many quotes that somehow answered our questions as possible. All data were categorized in a digital sheet, using Google Sheets tool, which contained the following fields: study's sequence ID, study's quotes ID, related research questions, quote's field itself with each extracted quote and yet the reason why each one of them was chosen. In the end, it was possible to identify 161 quotes that answered the proposed research questions. They were all exported to MaxQDA 2020 software (version 20.2.1) for proper codification.

In order to codify and to attribute themes for some groups of quotes, we followed Cruzes and Dyba [Cruzes and Dyba 2011]. The initial papers' codification was executed by building a list of codes with 388 categorizations. Then, codes were grouped into themes that resulted in 5 main groups: organizational culture, Autonomy and Global Soft-

ware Development (GSD) relationship, Autonomy and Turnover relationship, Autonomy dimensions in GSD, and Factors related to Autonomy in the event of Turnover.

4. Results

4.1. Overview of primary studies

We executed an overview of all papers found. The first year the theme was found was in 1998, and it reached its apex in 2018 with eight papers found. It was noticed that after 2010, autonomy related to Turnover in GSD projects had a constant recurrence on literature with an average of 4 papers per year as seen in Figure 1.

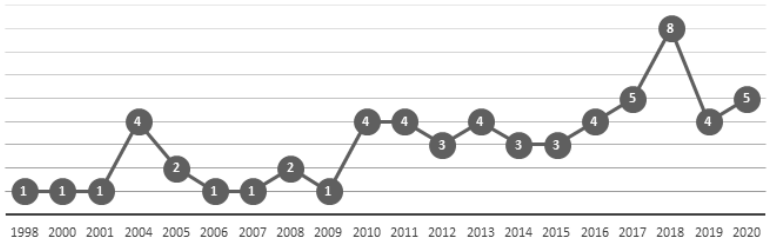

Figure 1. Papers distribution by year.

The researches type facets according to [Wieringa et al. 2006] is presented by year in Figure 2 where most of the analyzed papers were classified as Lessons Learned(32), Theory (12) and Model (8). Also, it was possible to observe that since 2010 there was a theory and Lessons Learned tendency seen. It is also relevant to state the increase of Framework facets types since 2016.

The distribution of contribution type facets of the reviewed studies derived from Petersen *et al.* [Petersen et al. 2008] is presented in Figure 3 by year. Most papers were classified as Evaluation (32) followed by papers of Experience (17) and Solution Proposal (5) in the context of research type facets classification regarding contribution. It was noticeable an increase of Evaluation type tendency over time through found papers contribution analysis.

Based on [Ivarsson and Gorschek 2011] we assessed the rigour and relevance studies. The Rigor consists of combining three concepts: context, study design and discussed validity. They received a score where 0 indicated weakly, 0.5 medium, and 1

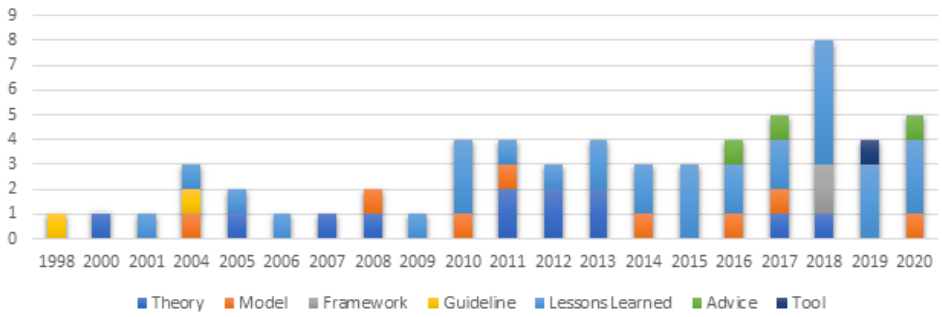

Figure 2. Research type facets over time.

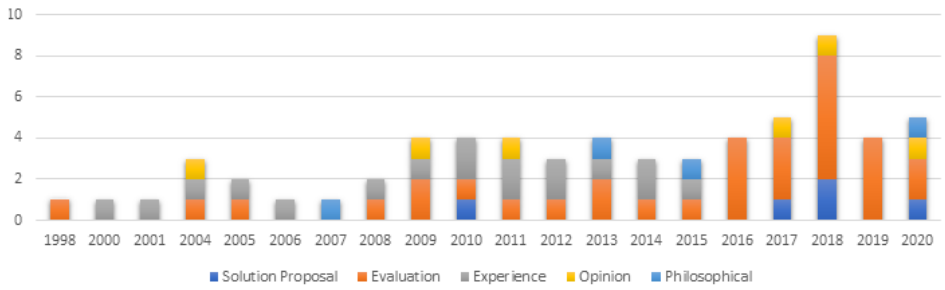

Figure 3
Contribution type facets over time.

strong. The most of the papers were classified as strong on the three concepts mentioned before (25).

Furthermore, we calculated the relevance amount in order to analyze papers relevance which consisted of combining four classifications: Relevance subject, context, scale and method and each one of them were scored with 0 (weak), 0.5 (medium) and 1 (strong). As a result, most papers (38) were classified with a score of 4, which meant strong relevance.

In order to analyze the different contributions' maturity published about autonomy impact on turnover in distributed projects, Figure 4 provides a systematic map to illustrate maturity achieved by the gathered papers. The map shows a focus on collecting lessons learned to guide the knowledge about the theme. Lessons learned (33) represented the most significant part among results and, from them, 19 corresponded to Evaluation papers. This map also shows a kind of maturity in terms of theory based on experiences and evaluation models.

Experience Paper	2	7	0	0	8	0	0
Evaluation Paper	6	3	1	2	19	1	0
Philosophical Paper	0	1	0	0	3	0	0
Solution Proposion	0	1	3	0	1	0	0
Opinion Paper	0	0	0	0	2	0	0
-	Model	Theory	Framework	Guideline	Lessons Learned	Advice	Tool

Figure 4. Systematic Map

4.2. RQ1.1 - What are the main dimensions of autonomy that influence turnover in DSD projects?

Some autonomy dimensions related to concepts that specified and had a relationship with the kind of autonomy given to an employee were identified in the paper extraction phase. There were found eight autonomy dimensions listed on Table 2. Following, we describe the dimensions found.

Table 2. Autonomy Dimensions by references

Dimensions	References	Occurrences
Relatedness	Bass, Beecham, Abdur (2018), Smith, Speight (2006), Lin, Robles,Serebrenik (2017), Gopalakrishnan, Halgin, Borgatti (2013),Moquin,Riemenschneider (2013).	5
Competence	Bass, Beecham, Abdur (2018), Smith, Speight (2006), Meland, Waage, Sein(2005), Moquin, Riemenschneider (2013),Ferratt, Enns, Prasad (2001), Mgaya,Uzoka, Kitindi, Shemi (2009).	6
Context	Mourmant, Niederman, Kalika (2013), Monteiro, Silva, Santos, Farias (2011), Adya, Cotton (2012).	3
Internal	Lundene, Mohagheghi (2018), Monteiro, Silva, Santos, Farias (2011),Uzoka, Mgaya, Shemi, Kitindi (2011),Bao, Xing, Xia, Lo, Li (2017).	4
External	Lundene, Mohagheghi (2018), Monteiro, Silva, Santos, Farias (2011),Uzoka, Mgaya, Shemi, Kitindi (2011),Bao, Xing, Xia, Lo, Li (2017).	4
Individual	Lundene, Mohagheghi (2018), Monteiro, Silva, Santos, Farias (2011),Uzoka, Mgaya, Shemi, Kitindi (2011), Bao, Xing, Xia, Lo, Li (2017).	4
Adaptation	Lundene, Mohagheghi (2018), Mgaya, Uzoka, Kitindi, Shemi (2009), Bao, Xing, Xia, Lo, Li (2017).	3
Variety	Setor, Joseph (2020), Lundene, Mohagheghi (2018), Monteiro, Silva, Santos, Farias (2011)	3

Relatedness and *competence* were connected with the professional need to feel part of the team and identify with the project, and have the opportunity to learn new skills and develop the existent ones. Therefore, autonomy should be balanced between these two dimensions because feelings of stress and demotivation may flourish without competence to execute tasks with higher autonomy. In this sense, it is also stated that professionals who do not feel connected with work might feel isolated when high levels of autonomy are given [Richardson et al. 2010].

The *context* dimension is related to the context in which this autonomy is applicable, whether it is about a product, personal factors, planning or decision making. The context can be summarized in individual, internal and external autonomy [Bass et al. 2018].

Individual autonomy refers to the amount of freedom and discretion an individual has in carrying out assigned tasks. On the other hand, external autonomy is described as the influence applied by managers on other individuals, whether they are involved or not in a team's activities. Internal autonomy refers to how all team members jointly share decision authority. Furthermore, those autonomy dimensions must be balanced to avoid turnover on distributed projects [Bass et al. 2018].

The *adaptation* dimension is related to the work's characteristics that might lead to turnover. Those distributed projects' own characteristics might be related to the team's distribution because the offshore projects show a higher turnover level when compared to onshore ones [Sumner et al. 2005].

Offshore distributed projects have antissocial work hours as a strong characteristic thereby decreasing autonomy related to work routine and also decreasing professional motivation. On the other hand, distributed projects (onshore and offshore) are positively related with work variety and team connection through agile methodologies which is identified as a positive factor for software engineers's motivation [Richardson et al. 2010].

The *variety* is a dimension related to a professional's expertise. So jobs that offer an individual autonomy that might awaken an employee's creativity and provide his learns tend to be a career anchor and are considered a guardian to precursors of turnover intentions [Sumner et al. 2005].

4.3. RQ1.2 - What are the main factors related to autonomy linked to turnover in DSD projects?

We identified the main factors related to autonomy linked to turnover in DSD projects (See Table 3). The literature has widely addressed the importance of considering *employees'*

Table 3. Related Factors by references

Related Factors	References	Occorrences
Employees' wishes	Noll, Razzak, Beecham (2017), Mourmant, Niederman, Kalika (2013), Choi,Tausczik (2017), Hynninen, Piri, Niinimaki (2010).	4
Communication	Lundene, Mohagheghi (2018), Zhou, Gifford, Ratakinda, Westerwick, Engel (2014), Beecham (2014).	3
Contributor's opinion	Lundene, Mohagheghi (2018), Mgaya, Uzoka, Kitindi, Shemi (2009), Bao, Xing, Xia, Lo, Li (2017).	3
Individual factors	Bass, Beecham, Abdur (2018), Noll, Razzak, Beecham (2017), Lundene, Mohagheghi (2018), Robert Jr, Sangseok (2017).	4
Career Satisfaction	Bass, Beecham, Abdur (2018), Smith, Speight (2006), Garrison, Wakefield,Xu, Sang (2010), Uzoka, Mgaya, Shemi, Kitindi (2011).	4
Job opportunities	Uzoka, Mgaya, Shemi, Kitindi (2011), Johri, Teo (2018), Mgaya, Uzoka, Kitindi, Shemi (2009).	3
Work Regime	Bass, Beecham, Abdur (2018), Noll, Razzak, Beecham (2017), Uzoka, Mgaya,Shemi, Kitindi (2011), Foerderer, Kude, Mithas, Heinzl (2016), Johri, Teo(2018).	5
Work Routine	Setor, Joseph (2020), Lundene, Mohagheghi (2018), Monteiro, Silva, Santos, Farias (2011)	3

wishes and aligning them with what the organization can offer. Furthermore, software engineer's opinions about autonomy and its levels in an organizational context need to be investigated, considering the specificities of work [Smith and Speight 2006].

Communication was also pointed as an important factor related to autonomy, mainly in distributed projects. When a company cannot establish an adequate communication flow is common to find inefficient work processes and employees with low levels of commitment to the organization and, thereby, high turnover levels [Noll et al. 2017].

Other factors related to *individuals* are also relevant such as mental overload, conflicts related to roles, social support, organizational noticed support, job demands, engagement and burnout. Individuals factors are directly related to autonomy because they can strongly influence motivation and satisfaction at work and might still contribute to more significant intentions of turnover if they are not balanced [Bellini et al. 2019].

Job opportunities and *career satisfaction* directly influence turnover intentions. Autonomy relates to these factors because it can significantly improve professional satisfaction by allowing the employee to elaborate plan, prioritizations and practices within the work. Autonomy can also improve quality tasks by flourishing feelings of a more specialized work to the ones involved in execution when applied in a motivated team with a high level of satisfaction with their careers [Massoni et al. 2019].

Work regime shows itself as a significant factor related to autonomy because even in a small way, autonomy is commonly perceived as a positive and preventive factor to turnover. However, for that to happen, managers must look for ways to ensure good communication among team members and ensure that team monitoring is not perceived in an authority way because such practice tends to reduce this feeling of individual autonomy [Beecham and Noll 2015].

Furthermore, *work routine* is also an essential factor related to autonomy. A certain level of autonomy is perceived as beneficial to tasks execution because it allows an employee to prioritize the project meant to him and establish practices judged as necessary to its execution. This higher freedom to prioritization gives the employee a feeling of higher control, which becomes a preventive factor for turnover intentions [Remus et al. 2016].

After performing the data extraction and identifying the dimensions of autonomy that influence turnover in DSD and the factors related to autonomy linked to turnover, we analyzed dimensions and factors. Thus, we developed a representative picture of how dimensions can influence factors. We add that the Figure 5 represents the evidence found

in the SLR and that future studies are needed to indicate the correlation of this set of variables.

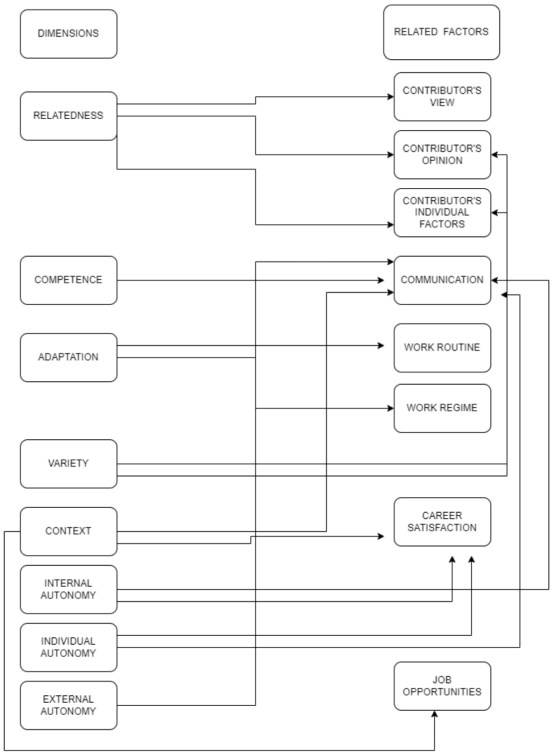

Figure 5. Autonomy Dimensions x Related Factors

5. Discussion

The dimensions of autonomy pointed out that the theme has different divisions, and that they can present themselves differently in the Software Engineer's work routine [Bass et al. 2018, Setor and Joseph 2022]. The factors related to autonomy concern the ways in which autonomy can be modulated by the Software Engineer's perception of his environment and work routine [Smith and Speight 2006, Marinho et al. 2021].

In this sense, some dimensions can be associated with related factors, as they relate to factors to the work environment and their dimensions. For example, the dimension of relatedness [Noll et al. 2017] associates the related factor Contributor's view, opinion and individual factors. In order to feel related to the work, it is important to know the point of view, the opinion and the various individual factors of the employee, analysing this factors for each of them [Smith and Speight 2006, Bellini et al. 2019]. These factors can influence in the motivation factors of the employee as showed in: "A mismatch between an individual's need for autonomy, and the degree of autonomy she or he actually has, may have an impact on motivation levels" [Smith and Speight 2006].

The dimension of competence can also be modulated by the communication factor, since autonomy is considered as a motivating factor when the professional is competent to perform tasks, otherwise his motivation may be reduced, causing stress. Communication is part of this process, as it is important for the employee to be able to communicate with their team and management, even in processes of stress and demotivation.

In distributed projects, communication presents itself as one of the main challenges for management, since many of these employees are on different schedules and activities. As showed in [Lundene and Mohagheghi 2018] “Teams need a shared purpose, the necessary skills, competence and mutual trust among the team members to develop internal autonomy. During the project period the teams gained a complete set of skills to develop, maintain, deploy, monitor and support the applications they have responsibility for. In addition, support was given from legal and communication experts to ensure data protection and clean language applied in the products”. Also, according [Beecham 2014] “Individuals can be undermined if head office is heavy handed, and interferes with communication, or if their work is monitored too stringently. For developers working under the spotlight of the customer, autonomy can be problematic” .

The dimension of adaptation, which relates to the characteristics of the project’s work, is an example of the distribution of teams. In this sense, the factors of work regime and the individual factors of the employee may be related to that dimension. Individual factors will influence how the employee sees the work routine determined for the team, and the work regime will connect with the way the employee is able to adapt to the management of their workload and the specific characteristics of the same. As shown in [Lundene and Mohagheghi 2018] “Autonomy has some pre-conditions to be realized, among them redundancy of skills (since it affects the team’s capability to adapt to changing situations)”.

The dimension of variety is closely connected with the creativity of the employee in a work environment, where autonomy can provide a true career anchor. The related factors of opinion and individual employees are linked to the idea that you should know your employee to be able to determine the professional’s expertise. In this sense, the task quality factor is also related to the work process and a creative and managerial role through the employee.

The dimensions of the context in which internal and individual autonomy are linked may be connected with factors related to communication and career satisfaction, as punctuated in [Lundene and Mohagheghi 2018]: “Internal autonomy refers to the degree to which all team members jointly share decision authority, while individual autonomy refers to the amount of freedom and discretion an individual has in carrying out assigned tasks and their satisfaction”.

External autonomy can also be related to the related factor of communication, as expressed in [Lundene and Mohagheghi 2018]: “Ideally, in high trust organizations, a team should be given a problem to solve, and then the solution should be solely the team’s responsibility” . The context dimension can be related to the job opportunity related factor, as [Johri and Teo 2018] study: “The option to work from home was not only beneficial to the employees but also to the firms – giving workers the opportunity to work from home or from cities of their choice resulted in very low turnover”. Furthermore, it is vital to know the career orientation of employees because based on such knowledge organizations can reduce high turnover rates by providing job opportunities and incentives that match the career orientation of their employees [Mgaya et al. 2009].

5.1. Limitations

Our study has some limitations that will be discussed on this section. In general, there were used known tools to conduct secondary studies following rigorous methods to analysis and data reports. However, the study was only conducted with a pool of found and related themes. We cannot affirm that we presented a full picture because we did not include all themes found on our SLR.

All numbers and classifcations presented on this paper must be treated carefully because our classification may only provide indications. Furthermore, it remains unknown if the present classification properly reflects the real situation in practice.

In short, information and data collection more well structured based on specialists and cases were not applied in this study but they are made necessary in order to confirm the findings in the present paper. Those limitations, however, motivate more researchers to complete a wider board about this matter in the future. As mentioned earlier, the factors and effects are indicators, needing to consider the organisational aspects of the context in which the company is inserted and the individual factors that are customized for each employee.

6. Conclusion

In this paper we performed a systematic literature review where we searched for the relation between autonomy and turnover in distributed projects as well as its dimensions and attached factors. The analysis of the papers revealed that the theme series addresses both conducting high-quality research, but also fostering to explore the DSD context. Among 16 themes that were defined by using the cluster analysis, it was possible to observe that autonomy dimensions and their related factors are directly related to turnover in distributed projects and they can weather be perceived as preventive or precursors of turnover intentions thereby depending on how they are modulated within the context.

This paper pointed out the relevance of studies that address DSD projects, as they are a growing reality in the middle of Software Engineering. As specificities about this project, the relevance of the study of Turnover in this type of project was raised, since the numbers are high when compared to traditional projects.

Motivation was indicated by several authors as a preventive factor for turnover, with autonomy directly associated with this process. Finally, the main implication of the present research is the need for autonomy modulation in a different way in distributed projects, since they have specific dimensions and related factors that can influence employee motivation, reducing the level of organizational turnover.

We concluded that autonomy in distributed projects needs a good organizational preparation before being implemented or increased because factors like communication, work methodologies and an internal factors analysis need to be analyzed and modulated for a software engineer in order to flourish a higher efficiency to work tasks and professional satisfaction not becoming a possible precursor of turnover by stress and feelings of isolation.

Finally, the main implication of the present research is the need for autonomy modulation in a different way in distributed projects, since they have specific dimensions

and related factors that can influence employee motivation, reducing the level of organizational turnover.

References

Armstrong, D. J., Riemenschneider, C. K., and Giddens, L. G. (2018). The advancement and persistence of women in the information technology profession: An extension of ahuja's gendered theory of it career stages. *Information Systems Journal*, 28(6):1082–1124.

Bass, J. M., Sarah, B., Razzak, M. A., and Noll, J. (2018). Employee retention and turnover in global software development: Comparing in-house offshoring and offshore outsourcing. In *2018 IEEE/ACM 13th International Conference on Global Software Engineering (ICGSE)*, pages 77–86. IEEE.

Beecham, S. (2014). Motivating software engineers working in virtual teams across the globe. In *Software project management in a changing world*, pages 247–273. Springer.

Beecham, S. and Noll, J. (2015). What motivates software engineers working in global software development? In *International conference on product-focused software process improvement*, pages 193–209. Springer.

Bellini, C. G. P., Palvia, P., Moreno, V., Jacks, T., and Graeml, A. (2019). Should i stay or should i go? a study of it professionals during a national crisis. *Information Technology & People*.

Campion, M. A. (1988). Interdisciplinary approaches to job design: A constructive replication with extensions. *Journal of applied psychology*, 73(3):467.

Chatzipetrou, P., Šmite, D., and Van Solingen, R. (2018). When and who leaves matters: emerging results from an empirical study of employee turnover. In *Proceedings of the 12th ACM/IEEE International Symposium on Empirical Software Engineering and Measurement*, pages 1–4.

Cruzes, D. S. and Dyba, T. (2011). Recommended steps for thematic synthesis in software engineering. In *2011 international symposium on empirical software engineering and measurement*, pages 275–284. IEEE.

Deci, E. L. and Ryan, R. M. (2012). Self-determination theory.

Dysvik, A. and Kuvaas, B. (2013). Perceived job autonomy and turnover intention: The moderating role of perceived supervisor support. *European Journal of Work and Organizational Psychology*, 22(5):563–573.

Ebert, C., Kuhrmann, M., and Prikladnicki, R. (2016). Global software engineering: Evolution and trends. In *2016 IEEE 11th International Conference on Global Software Engineering (ICGSE)*, pages 144–153. IEEE.

El Emam, K. and Koru, A. G. (2008). A replicated survey of it software project failures. *IEEE software*, 25(5):84–90.

Goldenson, D. R. and Herbsleb, J. D. (1995). After the appraisal: A systematic survey of process improvement, its benefits, and factors that influence success. Technical report, Carnegie Mellon University in Pittsburgh, Pennsylvania.

Hackman, J. R. and Oldham, G. R. (1976). Motivation through the design of work: Test of a theory. *Organizational behavior and human performance*, 16(2):250–279.

Ivarsson, M. and Gorschek, T. (2011). A method for evaluating rigor and industrial relevance of technology evaluations. *Empirical Software Engineering*, 16(3):365–395.

Johri, A. and Teo, H. J. (2018). Achieving equilibrium through coworking: Work-life balance in floss through multiple spaces and media use. In *Proceedings of the 14th international symposium on open collaboration*, pages 1–11.

Kautz, K. and Nielsen, P. A. (2000). Implementing software process improvement: two cases of technology transfer. In *Proceedings of the 33rd Annual Hawaii International Conference on System Sciences*, pages 10–pp. IEEE.

Khan, A. W. and Khan, S. U. (2013). Critical success factors for offshore software outsourcing contract management from vendors' perspective: an exploratory study using a systematic literature review. *IET software*, 7(6):327–338.

Khan, S. U., Niazi, M., and Ahmad, R. (2010). Critical success factors for offshore software development outsourcing vendors: an empirical study. In *International Conference on Product Focused Software Process Improvement*, pages 146–160. Springer.

Kitchenham, B. and Charters, S. (2007). Guidelines for performing systematic literature reviews in software engineering. Technical report, Technical report, EBSE Technical Report EBSE-2007-01.

Lundene, K. and Mohagheghi, P. (2018). How autonomy emerges as agile cross-functional teams mature. In *Proceedings of the 19th International Conference on Agile Software Development: Companion*, pages 1–5.

Marinho, M., Amorim, L., Camara, R., Oliveira, B. R., Sobral, M., and Sampaio, S. (2021). Happier and further by going together: The importance of software team behaviour during the covid-19 pandemic. *Technology in society*, 67:101799.

Marinho, M., Noll, J., and Beecham, S. (2018). Uncertainty management for global software development teams. In *11th International Conference on the Quality of Information and Communications Technology*, pages 238–246, Coimbra, Portugal. IEEE.

Marinho, M., Noll, J., Richardson, I., and Beecham, S. (2019). Plan-driven approaches are alive and kicking in agile global software development. In *International Symposium on Empirical Software Engineering and Measurement (ESEM)*, pages 1–11, Porto de Galinhas, Brazil. IEEE.

Massoni, T., Ginani, N., Silva, W., Barros, Z., and Moura, G. (2019). Relating voluntary turnover with job characteristics, satisfaction and work exhaustion-an initial study with brazilian developers. In *2019 IEEE/ACM 12th International Workshop on Cooperative and Human Aspects of Software Engineering (CHASE)*, pages 85–88. IEEE.

Mgaya, K. V., Uzoka, F.-M. E., Kitindi, E. G., and Shemi, A. P. (2009). Examining career orientations of information systems personnel in an emerging economy context. In *Proceedings of the special interest group on management information system's 47th annual conference on Computer personnel research*, pages 41–56.

Morgeson, F. P. and Humphrey, S. E. (2006). The work design questionnaire (wdq): developing and validating a comprehensive measure for assessing job design and the nature of work. *Journal of applied psychology*, 91(6):1321.

Noll, J., Beecham, S., Razzak, A., Richardson, B., Barcomb, A., and Richardson, I. (2017). Motivation and autonomy in global software development. In *International Workshop on Global Sourcing of Information Technology and Business Processes*, pages 19–38. Springer.

Petersen, K., Feldt, R., Mujtaba, S., and Mattsson, M. (2008). Systematic mapping studies in software engineering. In *12th International Conference on Evaluation and Assessment in Software Engineering (EASE) 12*, pages 1–10.

Rainer, A. and Hall, T. (2002). Key success factors for implementing software process improvement: a maturity-based analysis. *Journal of Systems and Software*, 62(2):71–84.

Ramasubbu, N. (2013). Governing software process improvementsin globally distributed product development. *IEEE Transactions on Software Engineering*, 40(3):235–250.

Remus, U., Wiener, M., Saunders, C., Mähring, M., and Kofler, M. (2016). Control modes versus control styles: Investigating isd project control effects at the individual level.

Richardson, I., Casey, V., Burton, J., and McCaffery, F. (2010). Global software engineering: A software process approach. In *Collaborative software engineering*, pages 35–56. Springer.

Setor, T. K. and Joseph, D. (2022). When agile means staying: A moderated mediated model. *Journal of Computer Information Systems*, 62(1):186–195.

Smith, D. and Speight, H. (2006). Antecedents of turnover intention and actual turnover among information systems personnel in south africa. In *Proceedings of the 2006 ACM SIGMIS CPR conference on computer personnel research: Forty four years of computer personnel research: achievements, challenges & the future*, pages 123–129.

Sulayman, M., Mendes, E., Urquhart, C., Riaz, M., and Tempero, E. (2014). Towards a theoretical framework of spi success factors for small and medium web companies. *Information and Software Technology*, 56(7):807–820.

Sulayman, M., Urquhart, C., Mendes, E., and Seidel, S. (2012). Software process improvement success factors for small and medium web companies: A qualitative study. *Information and Software Technology*, 54(5):479–500.

Sumner, M., Yager, S., and Franke, D. (2005). Career orientation and organizational commitment of it personnel. In *Proceedings of the 2005 ACM SIGMIS CPR conference on Computer personnel research*, pages 75–80.

Wall, T. D., Jackson, P. R., and Davids, K. (1992). Operator work design and robotics system performance: A serendipitous field study. *Journal of applied Psychology*, 77(3):353.

Wieringa, R., Maiden, N., Mead, N., and Rolland, C. (2006). Requirements engineering paper classification and evaluation criteria: a proposal and a discussion. *Requirements engineering*, 11(1):102–107.