Joy to the Work: How Does Software Team Formation Strategy Influence Job Satisfaction?

Sergio Cavalcante
Institute of Computing
Universidade Federal do Amazonas (UFAM)
Manaus, AM, Brazil
sergio.cavalcante@icomp.ufam.edu.br

Bruno Gadelha
Institute of Computing
Universidade Federal do Amazonas (UFAM)
Manaus, AM, Brazil
bruno@icomp.ufam.edu.br

Edson Oliveira
Secretaria de Estado da Fazenda (SEFAZ),
Manaus, AM, Brazil
edson.cesar@icomp.ufam.edu.br

Igor Steinmacher
School of Informatics, Computing and Cyber Systems
Northern Arizona University (NAU)
Flagstaff - USA
igor.steinmacher@nau.edu

Walter T. Nakamura
Academic Department of Computing
Universidade Tecnológica Federal do Paraná (UTFPR)
Campo Mourão, PR, Brazil
waltertakashi@utfpr.edu.br

Tayana Conte
Institute of Computing
Universidade Federal do Amazonas (UFAM)
Manaus, AM, Brazil
tayana@icomp.ufam.edu.br

ABSTRACT

Background - The main assets of software organizations are their development teams. Several factors impact job satisfaction, such as salary, workload, and autonomy; still, the software team relationship could impact one's job satisfaction. **Objective** - We aim to understand how software team formation strategy impacts job satisfaction. **Method** - We analyzed two software team formation strategies: (i) team members selected by a leader, and (ii) team members self-selection. We administered a survey to 66 employees of an R&D organization, comparing the team formation strategies. **Results** - Our results indicated that, in this context, the self-selection team formation strategy positively impacted job satisfaction and influenced good team cohesion and performance. Qualitative results showed that this formation strategy assembled teams with a good relationship among their members in which conflicts arose but were harmonically solved. **Conclusion** - This suggests that autonomy in the team formation stage would be good practice and could be more tested in the industry. These results may bring new evidence to practitioners about the benefits and drawbacks that self-selected teams may offer to the organization.

KEYWORDS

Software Development Teams, Team Staffing, Allocation, Job Satisfaction, Self-Selected Teams, Leader-Selected Teams

ACM Reference format:

FirstName Surname, FirstName Surname and FirstName Surname. 2018. Joy to the Work: How Does Software Team Formation Strategy Influence Job Satisfaction? In *Proceedings of ACM Woodstock conference (WOODSTOCK'18). ACM, New York, NY, USA, 10 pages.* https://doi.org/10.1145/1234567890

1 Introduction

The most important pieces of software development companies are the people who collaboratively build software systems: the software development teams. These teams need to understand the job to be done, communicate to the customers, understand the user needs, build the software, keep customer satisfaction high, and maintain a positive relationship between the customer and the organization[1] [2]. Graziotin et al.[4] showed that having happy people as part of the development team is associated with better software quality and team productivity, resulting in better customer outcomes. Kuutila et al. [5] also connected emotion with productivity showing that an affective state may impact productivity; therefore, it is important to the organization to maintain its collaborators happy with their work, increasing their job satisfaction.

Jahanbakhsh et al. [6] point out that one aspect that impacts job satisfaction is who works with whom. A dysfunctional team could lead the organization to lose people due to job dissatisfaction [6], [7]. Due to this, a significant moment in a project set-up process is to staff the software development team. Therefore, organizations should make some effort to improve the software team formation practice, for example, finding an adequate team formation strategy to achieve project success from the customer perspective [2].

In this paper, we investigate how the selection strategy influences team members' job satisfaction. We defined the following research question: **RQ - How does software**

development team formation strategy influence job satisfaction?

We investigated the relationship between two strategies applied to form software teams with job satisfaction: Self-Selected teams (SS) — team members selected by themselves; and Leader-Selected teams (LS) — team members selected by a leader. We conducted a survey, collecting and analyzing quantitative and qualitative data. We invited 95 employees that worked on 44 projects in an R&D (Research and Development) organization from 2016 to 2019 to answer the survey and got responses from 66 of them. While we have found papers indicating the industry widely using (and improving) the optimization approach of LS teams, we found the SS teams approach used mostly in education or sports contexts. Our findings suggest that the industry would benefit from assembling SS teams, focusing on people's autonomy in self-selection.

2 Related Work

In this section, we discuss other studies related to job satisfaction. We also briefly discuss the literature that relates to team formation and satisfaction.

Locke [8] defines job satisfaction as used by psychologists: "present-oriented evaluation of the job involving a comparison of an employee's multiple values and what the employee perceives the job as providing". Job satisfaction has been widely discussed in the literature to understand what could (positively and negatively) impact it. For example, Kropp et al. [9] found an association with agility and agile practices as collaboration, continuous delivery, and self-organized teams with higher job satisfaction. Pedrycz et al. [10] conducted a survey in which they found good communication and work sustainability as major causes of job satisfaction; they suggest pair programming would help raise these factors.

Few studies explored the self-selection approach regarding team formation strategies, and those that did were conducted at universities [6]. In this paper, we aim to understand how applying autonomy —a significant agile value [11] — in the team formation stage, where people could self-select their members by choosing their peers by technical/personal affinity and trust, could impact job satisfaction.

3 Forming Teams Strategies

An important activity in development initiatives is forming the project team [12]. In this section, we highlight two strategies for team formation: leader selection and self-selection.

3.1 Leader-Selected team (LS)

There are studies in the literature about organizations that use a pool of employees trained on specific technologies that the organizations aim to stand out at, available to upcoming initiatives [13]. A leader – usually a project manager – selects people from this pool in a top-down way, depending on the technologies that would be challenging for the project. The project plan's technical information must be available, and the employees' technical competencies mapped. The leader must then find the optimal match between project technology needs and people skills to assemble a team with a size that would fit the project budget, which would support the best case of task allocation over time [3], [14].

This practice of selecting people from a pool shows that the organization temporarily forms its teams. So, when a project ends, candidates return to the pool and may be selected for other initiatives. In this paper, we will call this kind of team, formed using this strategy, **Leader-Selected teams (LS).**

There is a rationale behind this. Firstly, the main goal is to guarantee that the team will have all the technical knowledge the project needs. A team technically prepared to deal with the project would reduce project risks of failure and delays, achieving a positive result [14]. Secondly, team members would be more motivated because of job rotation on new projects [15]. However, requirements may change during project execution, technical challenges not present on the team knowledge base may arise, and other technologies may not be necessary anymore. These requirement changes may induce the leader to change the team composition to keep matching the project's technological needs and people skills, but it depends on the availability of appropriate candidates in the pool.

Several tools based on computer science techniques were developed to support leader selection in this optimization problem like SBSE (Search-Based Software Engineering) and fuzzy logic [16], particle swarm algorithms [17], or solutions based on genetic algorithms and linear programming [16, 21, 22]. Still, this selection often depends on the manager's intuition and experience, leading to wrong choices and not selecting candidates who best fit the project team [12].

3.2 Self-Selected teams (SS)

Opposing the Leader Selection strategy, we can observe alternatives, e.g., a forming team strategy called **Self-Selected team (SS)**. It is a non-predictive way of staffing a group through self-allocation [20]. Rather than a manager choosing the candidates to staff a group, the individuals have the autonomy to arrange themselves by individual or technical affinity [21].

The organization in which this study took place expected a few benefits with this methodology: (1) This grouping bets on collaboration as opposed to individual work, with a duty to help other members and fast learning; (2) Agility concerning changes in the requirements; (3) Autonomy when allocating themselves to tasks. With good affinity between team members, the frequency of conflicts is expected to be low [22] and even solved in a valuable way, collaborating to increase team cohesion and propelling its development stage.

Differently from the Leader-Selected team of specialists, the Self-Selected team might not have some specific technical skills expected to deal with some specialized challenges required by the project they will face. Furthermore, a new SS team would likewise have initially low cooperative energy and still need to find how to function effectively together [22].

In the literature, we found few papers that refer to self-selection, most of them citing a synonym of self-selection called student's

choice to shape groups for schoolwork [23, 26, 27]. Mamoli and Mole [25] shared examples of this strategy's application in the industry (with good results in employees' happiness) and described a method of applying it.

4 Empirical Study

To answer our research question, we conducted a cross-sectional survey [26], a self-administered questionnaire. We sampled our participants using a cluster-based sample (individuals that belong to defined groups) [26].

This research took place in an R&D organization where the software development teams are formed by full-time employees with a holistic view. In the following sections, we present the organization's context where the research was conducted, explaining when the organization adopted both strategies and their impact on teams. We also discuss how we designed and conducted a personal opinion survey with 95 employees. After that, we performed both quantitative and qualitative analyses of the results.

4.1 Organization Context

The studied organization develops software on-demand in a service delivery model. The organization had 95 employees and former employees that worked on 44 different projects for several customers from 2016 to 2019. To conduct this research, we gathered all employees and projects execution data from the organization's portfolio management tool database.

The candidate projects were developed in 2016, 2017, 2018/2019 (started in 2018 but ended in 2019), when the organization changed its structure. In 2016, the main partner, who funded most organization projects, left the business partnership. The teams used to be formed according to the partner's business model and technical challenges, following the LS Teams approach. Thus, the organization needed to find a way to be competitive and retain its talents. There were many issues to reorganize, including the strategy used to form the development teams. This research analyzed this dataset from 2016 to 2019, including Self-Selected teams (9 Projects) and Leader-Selected teams (35 Projects).

4.2 Planning the Survey

To plan our survey, we have followed the steps described by Kitchenham and Pfleeger [26], which are: set survey objectives, design and develop the survey instrument, and evaluate it through a pilot test.

4.2.1 Population/Representative Sample: Our population was composed of 95 employees and former employees of the R&D organization that worked on 44 different projects from 2016 to 2019. The respondents were product owners, developers, designers, and test developers who actively participated in the development teams on these projects.

4.2.2 Setting the Objectives: Before administering the questionnaire, we refined the research question for this survey to provide more support for job satisfaction evaluation. In addition to the job satisfaction question, we have created other questions to learn about other team collaboration aspects and analyze if they would correlate as follows:

- **Q1 - Job Satisfaction:** Does the team formation selection strategy influence the team members' satisfaction?
- **Q2 - Conflicts Frequency:** Does the team formation selection strategy correlate with conflict frequency on the team?
- **Q3 – Perceived Team Productivity:** Does the team productivity perceived by members correlate with team formation selection strategy?
- **Q4 – Perceived Individual Productivity:** Does the perceived individual productivity correlate with team formation selection strategy?
- **Q5 - Team Performance:** Can the team formation selection strategy improve the team's perceived performance?
- **Q6 - Team Cohesion:** Can team formation selection strategy stimulate team cohesion?

While productivity and performance seem to refer to the same concept, we call performance the capacity to adapt to contexts and difficulties [27]. In contrast, productivity is related to producing something, i.e., making things real [28].

4.2.3 Developing the survey instrument: With these goals, the next step was to prepare the questionnaire, composed of six questions in total.

The first four questions (Q1 to Q4) were close-ended, asking about 1 – Job Satisfaction, 2 – Conflicts Frequency, 3 – Team Perceived Productivity, and 4 – Individual Perceived Productivity, using a 5-point Likert-scale from 1 (Very Low) to 5 (Very High). They were questions following this format: "On a scale from 1 to 5, how do you evaluate this item in your project team?". For the Job Satisfaction question specifically, being the main objective of this study, we asked the participants to explain the rating provided using an open-ended question. This question (Q1) was designed and revised by all authors to avoid ambiguities. The other questions (Q2, Q3, and Q4) were designed to collect participants' perceptions factors that are mentioned in the Tuckman stages of teams [22].

Q5 (Performance) and Q6 (Cohesion) were composed of 6 subitems each, using another Likert scale from 1 (completely disagree) to 7 (completely agree) for each subitem. For these two Qs, we have searched the literature to select already validated questionnaires. We have chosen two constructs to adapt, one about team performance [33] and the other to measure team cohesion [29]. The construct's adaptation was on the language and the scale, where we used a 7-point Likert scale, while the original construct used a 9-point Likert scale. Thus, we assessed its internal consistency by calculating Cronbach's alpha [30]. The final instrument is available as supplementary material[1].

We asked six questions to each respondent about each project team they worked on. Some respondents worked on just one project, while others worked on more, like 5 or 6 projects. Initially, we designed the questionnaire for the participants to answer about

[1] https://figshare.com/s/2e6b10ce3e5a1b1e53cc

three projects they were part of. However, we noticed in our pilot test with two former employees to assess the questionnaire format that it was too time-consuming. Thus, to reduce the time required to answer it, we limited the number of projects to 2 per respondent. Since we have fewer SS Teams formed than LS Teams, we first verified if the participant was part of a SS team to collect as many responses for this strategy as possible. Otherwise, we selected projects with teams formed using the LS strategy.

Finally, to increase the response rate, we chose a questionnaire tool in which people could answer comfortably using their phones. To achieve this, we selected Typeform[2].

4.3 Quantitative Analysis

We performed a quantitative analysis of project data to assess whether there is a significant difference between team formation strategies. We statistically compared Self Selected teams (SS), and Leader Selected teams (LS) using six dependent variables (Job Satisfaction, Conflicts Frequency, Perceived Team Productivity, Perceived Individual Productivity, Team Performance, and Team Cohesion). We aimed to demonstrate if the autonomy given to the teams to form themselves would impact the team's characteristics.

We performed a normality test for each comparison to support the choice of the statistical analysis method. We applied the non-parametric Mann-Whitney test to compare samples when we found non-normal distribution [31]. We conducted all statistical tests, normality, and auxiliary graph plotting using the statistical tool JASP[3].

4.4 Qualitative Analysis

To analyze the open-ended question where the respondents justified their ratings for job satisfaction, we focused more on the non-positive (1 to 3) and the high positive (5) ratings to identify the issues and the main positive aspects of each approach. We performed the qualitative analysis mainly using open coding and axial coding [32]. Open coding involves the data's breakdown, analysis, comparison, conceptualization, and categorization. Axial coding examines the relations between the identified categories. The first author did the open coding, associating codes with quotations of transcripts, and axial coding, where the codes were merged and grouped into more abstract categories. Once prepared, the codes were reviewed, analyzed, and changed upon agreement with the other 5 researchers.

Using the Atlas.ti[4] tool, we created annotated diagrams showing the relationship among these codes and the good and bad ratings to understand their relation.

5 Results

In this section, we show the quantitative results based on the respondents' ratings. We reached a 69% response rate, with 66 respondents from a total of 95, generating a sample of 111 answers (some respondents answered questions about two projects). We can observe the respondents' main characteristics in Table 1.

Table 1 - Respondents Data

Respondents	66
Answers	111

Gender	
Men	54
Women	12

Roles	
Designer	8
Developer	44
Product Validator.	10
Product Owner	4

Age	
20 to 30 years	28
31 to 40 years	29
41 to 50 years	9

Experience	
From 1 to 5 years	18
From 5 to 10 years	18
More than 10 years	30

2016-2019 Projects	
1 project	21
2 projects	10
More than 2 projects	35

First, we evaluated the validity of the constructs used and the team performance and team cohesion's internal consistency. After that, we analyzed the test results to answer the Q's. In each subsection, we present some context information about the variable, a Likert barplot analysis to visualize better the data distribution and possible differences between groups and variables, and the statistical test result. Finally, at the end of this section, we show the qualitative results based on the respondents' open answers justifying their job satisfaction ratings.

Since Team Performance (Q5) and Team Cohesion (Q6) were composed of sub-questions, we had to reach a unified rating to represent each of these two questions' results. To do so, we calculated the median to obtain the respondents' perceptions of these questions.

To establish the validity of the measures used in this study, we examined the correlation matrix for the questionnaire items. Given that we are comparing ordinal variables to our dependent variables, we calculated Kendall's Tau [33] correlation (see Table 2). In general, the correlations were not high, demonstrating that each construct adds something new to our research.

Table 2 - Correlations Between Dependent Variables

	JS	**IP**	**TP**	**P**	**C**	**CF**
JS	1					
IP	0.380	1				
TP	0.532	0.476	1			
P	0.610	0.338	0.532	1		
C	0.607	0.361	0.508	0.702	1	
CF	-0.360	-0.070	-0.265	-0.428	-0.301	1

[a] JS – Job Satisfaction, IP – Individual Productivity, TP – Team Productivity, P – Performance, C – Cohesion and CF – Conflicts Frequency.

One exception was that the correlation between Cohesion and Performance was high (0.702) [34], but we can argue that these items are not the same constructs because they have their specific purposes. On the one hand, performance items ask questions about adaptation, teamwork, and continuous technical improvement. On the other hand, cohesion was mapped by questions about members

[2] https://www.typeform.com/product/
[3] https://jasp-stats.org/
[4] https://atlasti.com/product/what-is-atlas-ti/

enjoying getting together, meeting after work like friends do, and getting concerned about the other members reaching their goals.

We also calculated Cronbach's alpha [30] to assess the internal consistency of two constructs from the questionnaire: team Performance and team Cohesion. The results indicated a high internal consistency for both scales since their alpha factors were greater than 0.8 [34], with $\alpha = 0.905$ and $\alpha = 0.850$ for team Performance and team Cohesion, respectively. Therefore, our adaptation (language and Likert scale) did not negatively affect the use of these constructs, allowing us to proceed with the analysis of these data.

After that, we compared the team formation strategies to assess their impact on the dependent variables to answer our Qs. We applied the Shapiro-Wilk[35] test in all comparisons to analyze the data distribution. We observed that the p-value for all cases was smaller than 0.05, suggesting that the sample distribution does not follow a normal distribution. Therefore, we applied the non-parametric Mann-Whitney U statistical test [31] to perform all comparisons.

5.1 Self-Selected teams (SS) versus Leader-Selected teams (LS) testing Job Satisfaction

In the first comparison, we tested if there is a difference between Self-Selected teams and Leader Selected teams regarding members' job satisfaction ratings, which is the primary question of this paper. This question aimed to verify if team members would be more satisfied at work, depending on how the team is formed. The null hypothesis for this comparison is:

HA0 - Job Satisfaction ratings of Self-Selected team members versus Leader Selected team members are not different.

Figure 1 shows that most Self-Selected team members' ratings for job satisfaction are in the range of High and Very High. In turn, the Leader Selected team members' ratings are more spread, with around 1/3 non-positive answers. We notice that 5% of LS team members reported low, and 1% reported very low job satisfaction ratings.

Figure 1 - Job Satisfaction

The Mann-Whitney test showed that the SS teams' Job Satisfaction ratings are significantly higher than the LS teams, with a moderated effect size (Rank-biserial correlation rB=-0.387), rejecting HA0 (U=513, p-value=0.006). This result shows that self-selected teams are considerably more satisfied with their jobs than teams selected by a leader strategy in the studied context.

5.2 Self-Selected teams (SS) versus Leader-Selected teams (LS) testing Conflicts Frequency

In our second comparison, we tested if there is a difference between Self-Selected teams and Leader Selected teams regarding members' conflicts frequency ratings. This question goal was to verify if the strategy used to form the teams may be related to the number of conflicts in the team:

HB0 – Conflict Frequency of Self-Selected teams and Leader Selected teams are not different.

We can observe in Figure 2 that most Conflicts Frequency ratings were distributed similarly on both types of team formation strategies. Still, LS teams were the only strategy with "Always" ratings. We can also notice half of the SS teams had ratings on the "Seldom frequency" category, meaning low frequency, but the conflicts are still there.

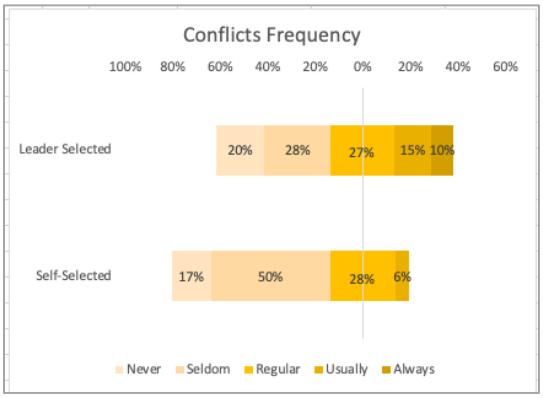

Figure 2 - Conflicts Frequency

When comparing the two groups of the Conflicts Frequency obtained by the experimental study using the Mann-Whitney statistical test, we found no statistical difference between them (p-value=0.199). Therefore, we cannot reject HB0.

5.3 Self-Selected teams (SS) versus Leader-Selected teams (LS) testing Perceived Team Productivity

Our third question intent was to evaluate how the members perceived team productivity and compared it to the formation strategy. We statistically tested the difference between Self-Selected teams and Leader-Selected regarding team Productivity perceived by team members.

HC0 – Members' Perceived Team Productivity of Self-Selected teams and Leader Selected teams are not different.

Figure 3 shows that the Perceived Team Productivity of SS teams was mostly positive, with some regular ratings. Nevertheless, the LS teams also had a similar distribution, with most ratings between regular and positive. Again, only LS teams had negative ratings. We found no statistical difference between the groups (p-value=0.204), and HC0 could not be rejected.

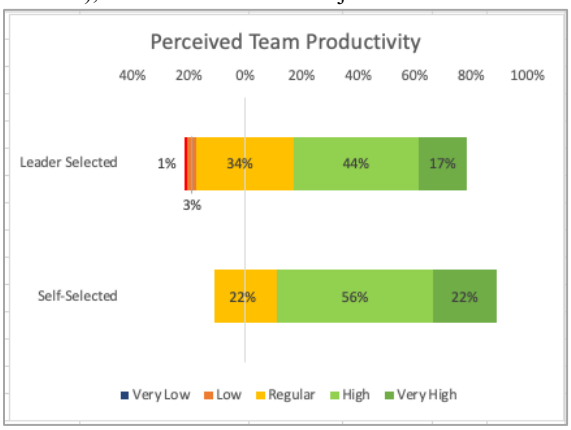

Figure 3 - Perceived Team Productivity

5.4 Self-Selected teams (SS) versus Leader-Selected teams (LS) testing Perceived Individual Productivity

The fourth question's goal was to analyze the differences on Individual Perceived Productivity among the two team formation strategies. Our null hypothesis was the following:

HD0 - The Perceived Individual Productivity of Self-Selected teams and Leader-Selected teams are not different.

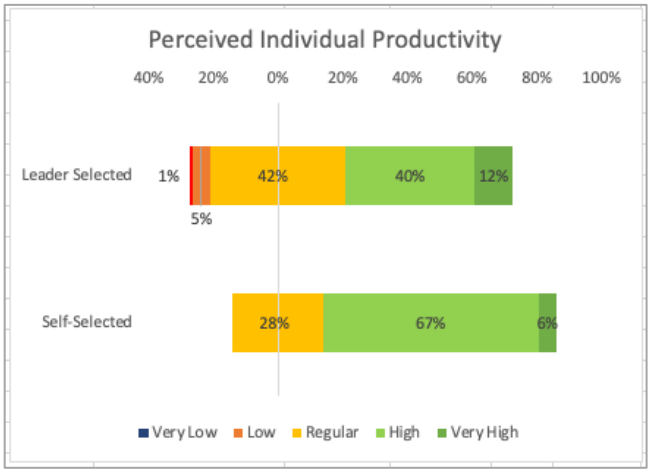

Figure 4 - Perceived Individual Productivity

Figure 4 shows that most Perceived Individual Productivity responses are similarly distributed to the Perceived Team Productivity responses. There are overall regular to positive ratings on both strategies. LS teams were the only ones with negative ratings. However, they also had many "very high" answers.

When comparing the two groups' results related to the Perceived Individual Productivity obtained by the experimental study using the "Mann-Whitney" statistical test, we found no statistical difference between the groups (p-value=0.226). Thus, we could not reject HD0.

5.5 Self-Selected teams (SS) versus Leader-Selected teams (LS) testing Team Performance

The fifth question aimed to assess the participants' agreement on the team performance. The null hypothesis was as follows:

HE0 - Team Performance of Self-Selected teams and Leader Selected teams are not different.

Looking at Figure 5, we can see SS and LS response distribution regarding team performance. SS team members had a high agreement about their self-perceived performance. They unanimously agreed that the SS approach improves the team's performance. It makes sense since most performance questions require some teamwork level since we measure the team's performance, not the individuals. Regarding LS teams, most of them (73%) also agreed that the LS approach improves the team's performance. In turn, more than one-quarter of the ratings (27%) were neutral or did not agree with the affirmatives.

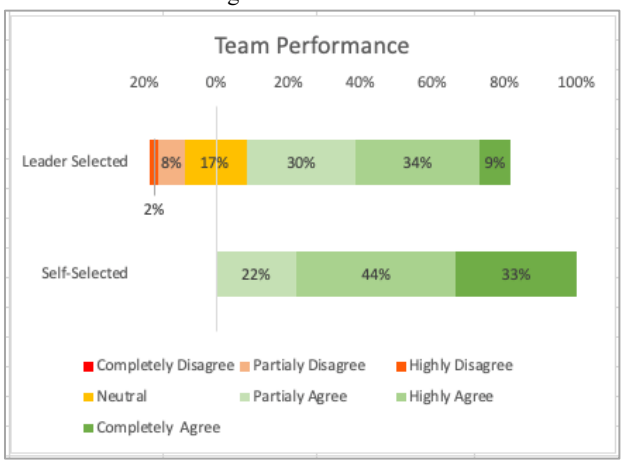

Figure 5 - Team Performance

The statistical test showed that the SS teams' performance ratings are significantly higher than the LS teams, with a moderate effect size (Rank-biserial correlation rB= –0.484), rejecting HE0 (U=432, p-value<0.001). It shows that self-selected teams result in better Team Performance than teams selected by a leader's strategy in the studied context.

5.6 Self-Selected teams (SS) versus Leader-Selected teams (LS) testing Team Cohesion

The last question assessed the team members' agreement regarding team cohesion. The null hypothesis was the following:

HF0 - Team Cohesion of Self-Selected teams and Leader Selected teams are not different.

Figure 6 shows SS and LS response distribution regarding team cohesion ratings. SS teams were very positive regarding their

agreement on team cohesion, with 78% of the ratings associated with "highly agree" and "completely agree". LS teams also had a fair number of positive agreement ratings; however, we can also see that almost one-quarter of the agreement ratings were neutral to negative, similar to Team Performance.

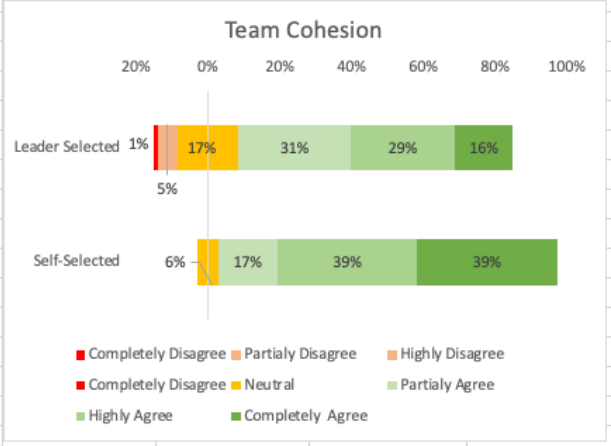

Figure 6 - Team Cohesion

The non-parametric Mann-Whitney test results also showed statistical significance (U=500.5, p-value=0.005), with a moderated effect size (Rank-biserial correlation rB=-0.402), rejecting HF0. Thus, the statistical test shows that the Self-Selection strategy results in better Team Cohesion than the Leader-Selected strategy.

5.7 Qualitative results

In this subsection, we present the results of the qualitative analysis of the open-ended questions related to job satisfaction from the perspective of both team organization strategies.

We organized this subsection into two types of results. We aimed to differentiate comments from negative and positive ratings. First, we discuss the responses from negative to regular/neutral ratings (ratings 1-3 - we call them non-positive). Then we discuss responses given to high positive ones (ratings 5 - we will call them positive). We analyzed 33 answers related to non-positive ratings and 36 related to positive ratings in a total of 69 responses.

It is important to notice that almost all the non-positive answers came from LS teams, and only one negative answer came from the SS teams' participants. We further classified these quotes into different categories, presented in the following.

Codes related to non-positive ratings:

Harmful Conflicts. According to the respondents, conflict is an important factor that may impact job satisfaction. For example, P45 and P35 emphasized the frequency of the conflicts.

> *"There were many conflicts, and the team always disagreed on several aspects" – P45*
> *"Many conflicts and the client did not embrace the project" – P35*

P90 mentioned that these conflicts had even personal motives:

> *"The team was unmotivated, and some members fought over personal issues unrelated to the project" – P90*

This factor appeared on the lowest job satisfaction ratings, suggesting its severity. All the non-positive responses came from LS teams, indicating low affinity between the selected members. Our quantitative study showed that conflicts occurred in both kinds of teams. However, the qualitative analysis revealed their harmful side in LS teams.

Technical Issues. Respondents reported technical knowledge issues. In their answers, they talked about people not prepared to deal with the technical challenge— mentioned by P39 and P14:

> *"To learn new technologies, productivity is penalized at the beginning of the project" – P39*
> *"We had problems with the technology, it was not something already dominated by the team, and we had a lot of difficulty in delivering the project" – P14*

Others reported the different knowledge levels among the people – as mentioned by P77 and P85:

> *"team members were extremely skilled, others needed to develop" – P77*
> *"In addition to technical unpreparedness of some parts of the scrum team. The evaluation was because it was a team of newbies, in the beginning, there was no one really prepared to handle the project" – P85*

All these responses also came from LS teams, which may show how difficult it is for the leader to match the project's technical requirements with the pool of technical knowledge.

Customer Issues. In addition to team formation issues, we also found the influence of external factors on job satisfaction, such as customer issues. For example, P36 and P31 reported the customer's low involvement and how it negatively impacts the team:

> *"client did not embrace the project" – P36*
> *"There was a lot of confusion in the team due to the low involvement of the client" – P31*

P18 and P45 answers were about the same project, also related to customer involvement. P18 complaints were about the lack of technical info expected to be provided by the customer. P45 also mentioned a lack of support from the customer and evidenced a bad relationship:

> *"There were several uncertainties the development team faced that could be cleared up by the customer. We hardly had accurate information and technical material provided by the customer" – P18*
> *"The client also does not help and questioned many past mistakes" – P45*

Still, this kind of problem seems independent of team formation.

Regarding the SS teams, we had only one complaint from P55 related to a PO issue.

> *"Despite the good performance of the team, there were many conflicts with the PO for not respecting processes, and this caused stress in the team" – P55*

Codes related to Positive ratings:

We have had 37 High Positive (rating 5) quotes from 36 respondents. These quotes were from participants from both LS and SS teams. The most mentioned were **technical knowledge** and a team with a **good relationship**.

We can notice in the following **positive responses that LS teams,** formed with tech skills in mind, met the strategy goal according to the respondents.

P38 highlights the team's great technical knowledge:

> *"notorious knowledge regarding the project and other areas of knowledge." – P38*

P24 emphasized the multi-disciplinarity:

> *"we worked at the time with a well-matched team, with varied skills of dev, QA, and DevOps on the same team." – P26*

And P91 mentions that it was good to work on this team and learn from them:

> *"I really enjoyed working with colleagues on this team. They had a lot of knowledge to be passed on" – P91*

Talking **uniquely about SS Teams**, also, we can visualize these positive responses:

Technically skilled team. Even SS teams being formed by affinity, we could find some responses emphasizing the team's technical skills. P72, P29, and P15 highlight the good technical skills of these teams.

> *"Because of the brilliant people" – P72*
> *"Mature and technically good team" – P29*
> *"Technically mature and good team. Good communication and interpersonal relationship between team members." – P15*

These responses could indicate that the match between project requirements and the team's overall technical knowledge worked as well.

Conflicts Solving. SS teams also mentioned conflicts, but not in a harmful way. Here, the respondents showcased how people on their teams dealt with the conflicts and how they acted to solve them harmoniously. P16 mentioned that the team members felt free to express their disagreements and highlighted the healthy way to solve team conflicts. These answers indicate that team members' affinity would stimulate the team to find a friendly way of solving the conflicts.

> *"conflicts and team discussions always arose, but in a healthy way […] due to the complicity of the members we were free to express disagreement whenever necessary." – P16*
> *"As the team was already working together on the latest projects, interpersonal issues were resolved in such a natural way that they did not generate any impact" – P16 about the other project.*

Good Team Relationship. Respondents' quotes mentioned good relationships and harmony inside the team. P15 highlighted the good interpersonal relationship between team members:

> *"Technically mature and good team. Good communication and interpersonal relationship between team members." – P15*

While P79 mentioned how the team avoided stressful situations:

> *"team tuning avoided stressful situations" – P79*

P51 reported that the team was excellent to work with:
> *"The team was excellent to work with. It was the best team to work with" – P51*

P13 complements talking about harmony and highlighting that the team was also stable, suggesting that maybe this could also contribute to the team harmony:

> *"We had been working together for a long time, and that guaranteed us a lot of harmony throughout the project" – P13*

These responses suggest a confirmation of the rationale for thinking that autonomy in the team formation moment, where members can self-select, could contribute to a better team relationship. A good team relationship was expected since it was a rationale for choosing this team formation strategy.

6 Discussion

Regarding our research question ("*How does software development team formation strategy influence job satisfaction?*"), our results suggest that using a selection strategy that provides autonomy to the team to choose whom to work with based on their affinity may positively impact team members' job satisfaction and build a team with cohesion and superior performance. One of the most relevant characteristics in high-performance teams is autonomy at work [36], suggesting that it is likely a factor that could generate this performance.

Still, although quantitative results showed that conflicts occurred in both team formation strategies, qualitative results revealed that SS teams dealt better and naturally with them, differently from LS teams, where these disagreements caused dissatisfaction and were harmful.

Quantitative results showed no statistical difference between the two team formation strategies regarding productivity. Even qualitative results mentioned nothing about productivity; instead, there were mentions about technical aspects impacting their job satisfaction. We found technical aspects impact in both ways: if there is a lack of technical skills or imbalance on the team, the result was negative. Curiously, the lack of technical skills was cited only by participants from LS teams selected with the rationale to fulfill project technical challenges. Good technical knowledge was mentioned as positive by the respondents, and it was pointed out by LS and SS teams. It was interesting to observe that even teams formed by affinity also had positive technical mentions.

Also, we consider [WN1][SC2]that there is a probability that the quality of the software produced will be affected by the job satisfaction resulting from the choice of the team formation strategy. A more cohesive team with good teamwork that resolves conflicts harmoniously is likely to communicate better. They can

be more committed to each other and the result of the team's work, resulting in better-quality products. Lindsjørn et al.[37], for instance, found that "the effect of teamwork quality on team performance was greater for product quality than for project quality", and that "if quality of the product in a project is more important, the quality of teamwork must be emphasized". Thus, we consider that [WN3]the greater the job satisfaction, the better the product quality.

Furthermore, it would be relevant to verify on quantitative results the mentions of the SS team formation strategy's rationale regarding good team relationships, reflecting on the respondent answers. A good team relationship would bring harmony and could support the quantitative results about team performance and cohesion.

While the industry is still widely using (and improving) the optimization approach of LS teams [19], some teamwork problems keep occurring and affecting people's job satisfaction. We have found papers showing good results in using the SS teams approach in education or sports contexts [23], [26], [27], and our findings suggest that the industry would benefit from assembling SS teams, focusing on people's autonomy in selecting their team members. There are clear benefits to thinking about creating affinity teams than groups of specialists. These affinity teams are supposed to have higher job satisfaction and still have good technical skills to solve the project challenges and may potentially deal well with conflicts.

7 Threats to Validity/Limitations

The main limitation of this study is related to its nature as a case study; therefore, we cannot generalize our results to all organizations. We collected the data from a single R&D organization in a single city that develops software on demand. All study is largely based on self-reported data collected from this organization. Even so, the results may be representative and may apply to similar organizations.

Another possible threat could be the small size of the dataset and its unequal size (22 SS responses of 111 total responses). However, according to the literature, we can use it since we still have statistical power using the Mann-Whitney test [38].

A threat to the validity is the measure used for the job satisfaction rating score. However, when analyzing the responses to the open-ended question about job satisfaction, it was possible to observe that the ratings were consistent with the justifications.

Given that we conducted the study at the end of 2020 and the questions were about projects from a few years ago, there was a concern if the participants would have a clear memory of their teams to answer the Survey effectively. To verify that, the two chosen former employees of the pilot test were asked about the projects from 2014-2015 that they were part of, and we noticed that they still had a strong memory since they gave some details while answering the open-ended question.

We did not test other team formation strategies, such as personality and random, because the organization did not adopt them. These different strategies could be explored in future studies.

8 Conclusion

This study compared how employees' job satisfaction relates to team formation selection strategy in an R&D organization. After examining 111 responses, we found quantitative results suggesting that Self-Selected teams tend to potentially provide higher job satisfaction ratings than the Leader-Selected teams. It was also true for cohesion and performance. Our qualitative results based on the rating justification support these conclusions. Nevertheless, we could not find differences between the perception regarding team conflict frequency, team perceived productivity, or individual perceived productivity.

In the paper, we have brought evidence about a non-conventional way of forming teams. Focusing on forming teams based on autonomy sounded interesting since it could motivate people and raise their job satisfaction feelings, avoiding software organizations from losing their employees, their main assets. People build things, collaborate, communicate, and maintain these organizations alive. We hope we can inspire organizations managers to think even more about people and their interactions, as mentioned in the agile manifesto [11]. Giving people autonomy even to choose with whom to work could raise job satisfaction and lead to good outcomes for motivated individuals. Future studies could evaluate other types of organizations. Conducting the same experience in other organizations and contexts would also help better understand the effect of team formation strategies.

ACKNOWLEDGMENTS

We would like to thank the case organization, which kindly allowed the study. We thank all the participants in the empirical study and USES Research Group members for their support. This work is supported by CAPES - Financing Code 001, CNPq (314174/2020-6), FAPEAM (062.00150/2020), and grant #2020/05191- 2 São Paulo Research Foundation (FAPESP). The present work also is the result of the Research and Development (R&D) project 001/2020, signed with Federal University of Amazonas and FAEPI, Brazil, which has funding from Samsung, using resources from the Informatics Law for the Western Amazon (Federal Law no 8.387/1991), and its disclosure is in accordance with article 39 of Decree No. 10.521/2020.

REFERENCES

[1] N. Helander and P. Ulkuniemi, "Customer perceived value in the software business," *Journal of High Technology Management Research*, vol. 23, no. 1, pp. 26–35, 2012, doi: 10.1016/j.hitech.2012.03.003.

[2] G. Evans, "Measuring and managing customer value," *Work Study*, vol. 51, no. 3, pp. 134–139, 2002, doi: 10.1108/00438020210424262.

[3] PMI, *PMBOK Guide | Project Management Institute*. 2017.

[4] D. Graziotin, X. Wang, and P. Abrahamsson, "Happy software developers solve problems better: Psychological measurements in empirical software engineering," *PeerJ*, vol. 2014, no. 1, p. e289, Mar. 2014, doi: 10.7717/peerj.289.

[5] M. Kuutila, M. v. Mäntylä, M. Claes, M. Elovainio, and B. Adams, "Using experience sampling to link software repositories with emotions and work well-being," Aug. 2018. doi: 10.1145/3239235.3239245.

[6] F. Jahanbakhsh, W. T. Fu, K. Karahalios, D. Marinov, and B. Bailey, "You want me to work with who? Stakeholder perceptions of automated team formation in project-based courses," in *Conference on Human Factors in*

Computing Systems - Proceedings, May 2017, vol. 2017-May, pp. 3201–3212. doi: 10.1145/3025453.3026011.

[7] S. Yu, C.-E. Liu, H. Yang, X. Yuan, and J. Ren, "Work-Related Identity Discrepancy and Employee Turnover Intention: The Mediation Effect of Job Satisfaction 1," *International Journal of Business and Social Science*, vol. 10, no. 11, 2019, doi: 10.30845/ijbss.v10n11p5.

[8] E. A. Locke, "Job Satisfaction," in *Social Psychology and Organizational Behaviour*, M. G. and T. WALL, Ed. John Wiley & Sons, Ltd, 1984, pp. 93–118.

[9] M. Kropp, C. Anslow, A. Meier, and R. Biddle, "Satisfaction, practices, and influences in agile software development," in *ACM International Conference Proceeding Series*, Jun. 2018, vol. Part F1377. doi: 10.1145/3210459.3210470.

[10] W. Pedrycz, B. Russo, and G. Succi, "A model of job satisfaction for collaborative development processes," *Journal of Systems and Software*, vol. 84, no. 5, pp. 739–752, May 2011, doi: 10.1016/j.jss.2010.12.018.

[11] W. Beck, K., Beedle, M., Bennekum, A. van., Cockburn, A., Cunningham and D. Fowler, M., Grenning, J., Highsmith, Hunt, A., Jeffries, R., Kern, B., Marick, J., Martin, R.C., Mellor, S., Schwaber, K., Sutherland, J., Thomas, "Manifesto for Agile Software Development," 2001. https://agilemanifesto.org/ (accessed Jun. 03, 2019).

[12] A. Barreto, M. de O. Barros, and C. M. L. Werner, "Staffing a software project: A constraint satisfaction and optimization-based approach," *Comput Oper Res*, vol. 35, no. 10, pp. 3073–3089, 2008, doi: 10.1016/j.cor.2007.01.010.

[13] A. Ngo-The and G. Ruhe, "Optimized resource allocation for software release planning," *IEEE Transactions on Software Engineering*, vol. 35, no. 1, pp. 109–123, 2009, doi: 10.1109/TSE.2008.80.

[14] P. Eskerod, "The Human Resource Allocation Process when Organising by Projects," in *Projects as Arenas for Renewal and Learning Processes*, Boston, MA: Springer US, 1998, pp. 125–131. doi: 10.1007/978-1-4615-5691-6_12.

[15] R. E. S. Santos, F. Q. B. da Silva, C. V. C. de Magalhães, and C. V. F. Monteiro, "Building a theory of job rotation in software engineering from an instrumental case study," in *Proceedings of the 38th International Conference on Software Engineering - ICSE '16*, 2016, pp. 971–981. doi: 10.1145/2884781.2884837.

[16] R. Britto, P. S. Neto, R. Rabelo, W. Ayala, and T. Soares, "A hybrid approach to solve the agile team allocation problem," *2012 IEEE Congress on Evolutionary Computation, CEC 2012*, 2012, doi: 10.1109/CEC.2012.6252999.

[17] S. Gerasimou, C. Stylianou, and A. S. Andreou, "An investigation of optimal project scheduling and team staffing in software development using particle swarm optimization," *ICEIS 2012 - Proceedings of the 14th International Conference on Enterprise Information Systems*, vol. 2 ISAS, no. SAIC/-, pp. 168–171, 2012, doi: 10.5220/0004001001680171.

[18] J. Park, D. Seo, G. Hong, D. Shin, J. Hwa, and D.-H. Bae, "Human Resource Allocation in Software Project with Practical Considerations," *International Journal of Software Engineering and Knowledge Engineering*, vol. 25, no. 01, pp. 5–26, 2015, doi: 10.1142/S021819401540001X.

[19] X. Shan, G. Jiang, and T. Huang, "The optimization research on the human resource allocation planning in software projects," *2010 International Conference on Management and Service Science, MASS 2010*, pp. 0–3, 2010, doi: 10.1109/ICMSS.2010.5577166.

[20] D. Potosky and J. Duck, "Forming Teams for Classroom Projects," *Developments in Business Simulation and Experiential Learning*, vol. 34, pp. 144–148, 2007.

[21] E. Scott and M. Pollock, "Effectiveness of Self-selected Teams: A Systems Development Project Experience," *Issues in Informing Science and Information Technology*, vol. 3, pp. 601–617, 2017, doi: 10.28945/918.

[22] B. W. Tuckman and M. A. C. Jensen, "Stages of Small-Group Development Revisited," *Group & Organization Studies*, vol. 2, no. 4, pp. 419–427, Dec. 1977, doi: 10.1177/105960117700200404.

[23] D. R. Bacon, K. A. Stewart, and E. S. Anderson, "Methods of assigning players to teams: A review and novel approach," *Simul Gaming*, vol. 32, no. 1, pp. 6–17, 2001, doi: 10.1177/104687810103200102.

[24] B. Caglayan, A. B. Bener, and A. Miranskyy, "Emergence of developer teams in the collaboration network," *2013 6th International Workshop on Cooperative and Human Aspects of Software Engineering, CHASE 2013 - Proceedings*, pp. 33–40, 2013, doi: 10.1109/CHASE.2013.6614729.

[25] S. Mamoli and D. Mole, *Creating Great Teams*, 1st ed. Dallas, TX? Pragmatic Bookshelf, 2015.

[26] B. A. Kitchenham and S. L. Pfleeger, "Personal Opinion Surveys," in *Guide to Advanced Empirical Software Engineering*, London: Springer London, 2008, pp. 63–92. doi: 10.1007/978-1-84800-044-5_3.

[27] D. L. Largent, "Getting and staying agile," *XRDS: Crossroads, The ACM Magazine for Students*, vol. 17, no. 1, p. 38, 2012, doi: 10.1145/1836543.1836555.

[28] A. Mockus, Ping Zhang, and P. L. Li, "Predictors of customer perceived software quality," in *Proceedings. 27th International Conference on Software Engineering, 2005. ICSE 2005.*, pp. 225–233. doi: 10.1109/ICSE.2005.1553565.

[29] A. K. S. Kakar, "Engendering cohesive software development teams: Should we focus on interdependence or autonomy?," *International Journal of Human Computer Studies*, vol. 111, pp. 1–11, Mar. 2018, doi: 10.1016/j.ijhcs.2017.11.001.

[30] L. J. Cronbach, "On estimates of test reliability," *J Educ Psychol*, vol. 34, no. 8, pp. 485–494, Nov. 1943, doi: 10.1037/H0058608.

[31] P. E. McKnight and J. Najab, "Mann-Whitney U Test," *The Corsini Encyclopedia of Psychology*, pp. 1–1, Jan. 2010, doi: 10.1002/9780470479216.CORPSY0524.

[32] J. Corbin and A. Strauss, *Basics of Qualitative Research | SAGE Publications Inc*. 2015.

[33] M. S. Schaeffer and E. E. Levitt, "Concerning Kendall's tau, a nonparametric correlation coefficient," *Psychol Bull*, vol. 53, no. 4, pp. 338–346, Jul. 1956, doi: 10.1037/H0045013.

[34] J. C. Nunnally, "An Overview of Psychological Measurement," in *Clinical Diagnosis of Mental Disorders*, Boston, MA: Springer US, 1978, pp. 97–146. doi: 10.1007/978-1-4684-2490-4_4.

[35] S. S. Shapiro and M. B. Wilk, "An Analysis of Variance Test for Normality (Complete Samples)," *Biometrika*, vol. 52, no. 3/4, p. 591, Dec. 1965, doi: 10.2307/2333709.

[36] A. C. S. Dutra, R. Prikladnicki, and T. Conte, "What Are the Main Characteristics of High Performance Teams for Software Development?," in *Proceedings of the 17th International Conference on Enterprise Information Systems*, 2015, vol. 2, pp. 145–152. doi: 10.5220/0005375601450152.

[37] Y. Lindsjørn, D. I. K. Sjøberg, T. Dingsøyr, G. R. Bergersen, and T. Dybå, "Teamwork quality and project success in software development: A survey of agile development teams," *Journal of Systems and Software*, vol. 122, pp. 274–286, Dec. 2016, doi: 10.1016/J.JSS.2016.09.028.

[38] H. B. Mann and D. R. Whitney, "On a Test of Whether one of Two Random Variables is Stochastically Larger than the Other on JSTOR." https://www.jstor.org/stable/2236101 (accessed Oct. 11, 2021).