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# Human Psychology Factors Influencing Agile Team Autonomy in Post-Pandemic Remote Software Organizations

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# HUMAN PSYCHOLOGY FACTORS INFLUENCING AGILE TEAM AUTONOMY IN POST-PANDEMIC REMOTE SOFTWARE ORGANIZATIONS

by

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## ABSTRACT

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Old Dominion University, 2023
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Agile project management methods are gaining in popularity in the software industry as software development teams are being asked to be adaptive to market needs and resilient to change and uncertainty. With increasing market uncertainty, global competition, and time-to-market pressure, it is becoming a challenge to develop an innovative product and deliver it on-time without the opportunity that comes from team autonomy to experiment and learn from failures in a remote workplace. To resolve this challenge, it is critical to understand the myriad human psychological factors in play that influence Agile team autonomy in a remote work environment.

The role of human psychological factors on Agile project delivery success has been largely neglected or superficially covered in extant literature. The purpose of this research study was to study the influence of key human psychological factors on emergence of Agile team autonomy that leads to Agile project success in software organizations. The findings will help Information Systems researchers and practitioners in proactively identifying and addressing human psychology factors challenges to achieve successful delivery of innovative products using Agile Scrum methodology.

Using an online survey instrument, the study sampled 137 software professionals from US software companies with experience in the Agile Scrum role of Team Member. The quantitative data generated was analyzed using multiple linear regression. The relationship

between the independent variables – the human psychology factors pertaining to Leadership Style, Organization Structure, HR Practices and Stakeholder Engagement and the dependent variable - Agile team autonomy is explained through multiple linear regression. As multiple items are linked to variables, the statistical analysis was performed using the median scores for each variable. One-way ANOVA and Pearson's correlation coefficient were used to demonstrate the existence (or nonexistence) of relationships between variables. Finally, an empirical model relating the human psychology factor variables and the dependent variable of Agile team autonomy was constructed for the population.

This dissertation is dedicated to my wife Sree, and my children Raaghavi and Shreyas. Your support, encouragement, and faith in me were an inspiration during a long, arduous, and rewarding process.

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First and foremost, I am profoundly grateful to my PhD advisor, Dr. Charles Daniels, for his wisdom, guidance, understanding nature and support during this program. He has worked closely with me for past few years and has recently spent time thoroughly reviewing my dissertation and offering keen insight and feedback that enhanced its overall quality. He has always treated me as a colleague and a friend. His genuineness and humility serve as a model for me personally and professionally. I look forward to a long and mutually beneficial academic partnership with Dr. Daniels.

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## NOMENCLATURE

| | |
|---|---|
| ASEM | American Society of Engineering Management |
| CFA | Confirmatory Factor Analysis |
| ANOVA | Analysis of Variance |
| TA | Team Autonomy |
| SM | Scrum Master |
| SE | Software Engineer |
| EM | Engineering Manager |
| LEBQ | Leader Empowering Behavior Questionnaire |
| ARDO | Agile R&D Units' Organization |
| HRM | Human Resource Management |
| HRP | Human Resource Practices |
| JI | Job Insecurity |
| *r* | Pearson's Correlation Coefficient |

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# CHAPTER 1

# INTRODUCTION

There have been several research studies exploring the success factors for Agile project success. Sheffield and Lemétayer (2013), Hoda et al. (2013), Serrador and Pinto (2015), and Hobbs and Petit (2017) found organizational culture and the empowerment of the project teams as enablers of Agile project delivery success.

Surprisingly, the presence of strong executive support and/or sponsor commitment were not significant factors for project success according to Chow and Cao (2008) and Stankovic et al. (2013). This contradicts the results reported by Isaksen and Akkermans (2011) where innovative leadership is shown as a key factor for Agile project delivery success.

According to Malik et al. (2021), Agile team autonomy is a strong antecedent of Agile project success. There is no single research study that has examined the full spectrum of human psychology factors arising from Leadership Style, Organization Structure, Human Resource Practices and Customer Engagement that influence emergence of Agile team autonomy that ultimately leads to Agile project delivery success. Most studies have focused on individual autonomy while team autonomy has been largely neglected (Langfred, 2004; Hodgson and Briand, 2013; Verwijs and Russo, 2023). This research study has attempted to address a significant lacuna in the current body of knowledge on the psychological antecedents of Agile team autonomy.

## 1.1 THEORETICAL FORMULATIONS

Agile project management methods are gaining in popularity in the software industry as software development teams are being asked to be adaptive to market needs, and to react to change and uncertainty (Mishra & Mishra, 2011). Market uncertainty, especially for start-up companies, make it risky to develop a full product without the opportunity to test a concept (Moogk, 2012).

Hislop et al. (2002) explained how software development requires rapid iteration cycles with effective feedback loops which allow for teams to minimize the up-front exhaustive collection of customer requirements. Frequent interaction with project sponsors, face-to-face communication, frequent delivery of useable portions of a product, acceptance to change, and the selection of high caliber teams were also mentioned as common agile techniques (Chow & Cao, 2008; Misra et al., 2009).

In a study to determine what factors and environments aid software development agility in successful projects, Sheffield and Lemétayer (2013) received 106 valid responses from an international survey sent to 452 members from agile communities of practice. They found that organizational culture and the empowerment of the project teams were indicators of project development agility.

Hoda et al. (2013), Gill (2014), and Stettina and Horz (2015) discussed the notion of self-organizing teams, agility of people, processes, tools, and consideration of a revised culture. Stettina and Horz interviewed 30 participants from 14 European software development organizations and found that agile methods empowered team members to take-on tasks that are traditionally performed by project managers, such as coordinating their own work. They noted that teams had increased interaction, were more stable, and they experienced increased

collaboration, transparency, and trust. But no study has been done to understand what this change meant for the role of the project managers and why the project manager role still does not go away.

Serrador and Pinto (2015) collected survey information from 859 people, representing 1,002 projects across multiple industries. They concluded that agile method allows less experienced staff to achieve superior results. They also noted that project complexity was not a significant moderator of agile success. It was not explained why this is the case.

Laanti et al. (2011) administered a questionnaire to more than 1,000 respondents in seven different countries to study the agile transformation of a large-scale project within Nokia. Their results listed the benefits of agile methods to include higher employee satisfaction, a feeling of effectiveness, increased quality and transparency, increased autonomy and happiness, and earlier detection of defects.

Surprisingly, the presence of strong executive support and/or sponsor commitment as well as an agile-style work environment were not significant factors for project success according to survey results from studies conducted by Chow and Cao (2008) and Stankovic et al. (2013). However, this contradicts what other researchers have reported about leadership.

Certainly, a firm's leadership team will have an impact on the work atmosphere. Isaksen and Akkermans (2011) performed a survey of 140 participants who played various roles in managing innovation and creativity from 103 different organizations in 31 industries and 10 countries. The data indicated that organizational leaders influenced innovative productivity as well as the employee perception of creativity and innovation.

According to Stray et al. (2011), the sharing of information and the opportunity to discuss and solve problems are contributors to a positive attitude by the team. Also, the use of an

information radiator to visualize tasks as they were being reported had a positive effect. Factors contributing to a negative attitude were the time taken to provide status reports to the manager, meeting too frequently and extended meeting durations. Other issues with the daily stand-up meeting included an over-reaction to problems by the Scrum master, resulting in team members withholding information about problems, and the reporting of a finished task prior to testing being complete (Moe et al., 2010).

Conforto et al. (2014) provided examples of factors using iterative planning and frequent plan monitoring and process updating, while examples of enablers were the organizational structure and culture, and a collaborative work environment. The framework indicates that the application of an agile management approach is linked to the use of practices, tools, and techniques based on agile project management theory; however, its use will depend on the existing enablers that provide for favorable conditions for the proper application of agile practices.

According to the self-determination theory by Deci and Ryan (2000), the shift from an external to an internal locus of control encourages more proactive behavior in Agile teams towards achieving shared goals while also making them feel more responsible for the project outcomes. Verwijs and Russo (2023) argue that high-autonomy teams are more inclined to engage in continuous improvement than low-autonomy teams. The increased sense of responsibility for their outcomes will lead high-autonomy teams to show greater concern for the needs of stakeholders and more proactive behaviors aimed at understanding those needs. This will make the high-autonomy teams more responsive than low-autonomy teams due to decreased external dependencies. Specifically for Agile teams, Junker et al. (2022) found that teams are more likely to initiate changes and improvements when team autonomy is high. However, team

autonomy is impaired in a remote environment where team members encounter physical separation for long periods of time leading to lower relatedness (Russo et al., 2021). Hodgson and Briand (2013) concluded from an empirical examination of a Canadian video game development studio that total team autonomy may not even be possible in practice. The team may end up adjusting their Agile Scrum practices to satisfy the prevalent power differentials and hierarchy in the organization.

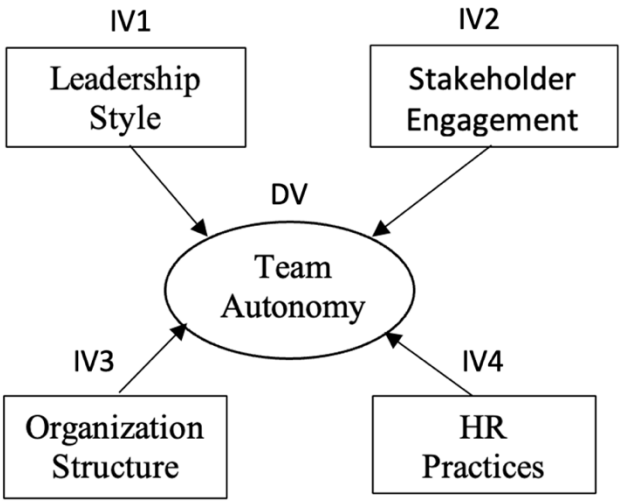


**Figure 1. Human Psychology Factors That Influence Agile Team Autonomy**

**Table 1. Construct Summaries**

| Name | Definition | References |
|---|---|---|
| Human Psychology Factors | Factors concerned primarily with the psychology of leaders, stakeholders, team members, psychological aspects of human resource practices, and the psychological impact of organization structure in a task-oriented environment. | |
| Stakeholder | Limited in this study to the Customer who buys or consumes the product of the Agile project. | |
| Team Autonomy | A self-directed behavior with general limits set by managerial control, which, if granted, ensures required resources' allocation and encourages employees' trial-and-error experimentations. | Feldman (1989)<br>Zhang et al. (2010)<br>Verwijs & Russo (2023) |
| Agile Project Success | Measured by customer satisfaction through predictable delivery of business value. | |
| Remote Workplace | Remote working consists of permanently set places of work outside the in-company office e.g., working from home (tele-/homeworking) or co-working areas (hoteling, telecentres) or working at places solely chosen by the employee (mobile or nomadic working) for 3-5 days every work week. | Kiwert & Walecka (2022) |

Human psychology factors include variables such as Leadership Style, Organization Structure, Human Resource Practices and Stakeholder Engagement that influence emergence of Agile team autonomy as shown in Figure 1. The theoretical constructs are summarized in Table 1. These items are associated with the capability and structure of the employees involved with the project as well as the environment they complete their project work in. The notion of a T-shaped person is understood as someone that has deep knowledge in at least one area and

working knowledge of several other areas thus allowing the team to swarm and help complete tasks efficiently (Demirkan & Spohrer, 2015).

The above studies show that a lot has been written about Agile processes and tools but there is very little research done into the human psychology factors that contribute to the success or failure of Agile projects especially in large systems companies that develop a mix of software and hardware products. The intended area of research is largely unexplored and breaks new ground in the Agile Project Management area. The effectiveness of Agile project management techniques was examined from an organization behavior and human psychology perspective as never done before.

The study results provide insights into the human psychology factors that motivate managerial and team behavior. This can help organizations to design the right incentive programs to promote high work performance and team productivity by Human Resources in large systems companies.

Agile Project Management is based on agile values and principles, expressed for the first time in the Agile Manifesto (2001) as follows.

- *Individuals and interactions over processes and tools*
- *Working software over comprehensive documentation*
- *Customer collaboration over contract negotiation*
- *Responding to change over following a plan.*

Agile management methodologies are based on short time horizons (iterations) for planning and review, more flexibility on planning, and more decision-making autonomy given to members. The most known methodology is Scrum, with the daily standup meeting, called Scrum

(in reference to a rugby team), and a timebox for planning and control, called Sprint (Schwaber, 2009).

Agile methodologies have been developed not only to combat some limits of classical command-and-control management, but also to improve adaptability and responsiveness to change (Nguyen & Mohamed, 2020). However, there are still many challenges in making decisions, notably about availability and reliability of information when making more frequent, short-term decisions (Drury-Grogan et al., 2017).

Takeuchi and Nonaka (1986) applied the rugby term "Scrum" to the practice of moving from the sequential approach for project management to a more holistic one. With this approach, instead of a product development team passing a project from one person to the next until completion, a Scrum team, just as in rugby, works together to pass the ball between team members as they move their way up the field. Cervone (2011) explained that the purpose of a Scrum in rugby is to have a way to restart the game after an interruption has taken place.

According to Takeuchi and Nonaka (1986), Scrum teams are more effective and efficient because they are self-organized with overlapping project phases, they learn together as well as transfer learning to the organization, and they receive limited management direction while maintaining subtle control of the project. This method was discussed by Moe et al. (2010) as a new approach for managing projects by providing decision-making authority to the Scrum team members who will be experiencing problems and uncertainties. They further stated that this transition to self-managing teams requires a reorientation by team members as well as by management.

Project success can also be altered by a number of other situational dynamics. A weak project team structure, unclear goals, a lack of team expertise, and a lack of senior management

involvement are just a few factors that can contribute to a lack of performance (Drury-Grogan, 2014).

As teams continued to develop ways of efficiently working together, the term “agile” became a common way to describe project activity. According to Conforto et al. (2014), agile project management is a method used to simplify project execution by instilling flexibility and enabling iterative cycles as ways to improve project quality, timing, and cost. They describe “agility” as the way a project team reacts quickly to changes in customer and stakeholder needs in order to achieve a better product for the market. The authors made a clear distinction of agility describing the team’s performance, not simply an adjective that describes a method used to manage the project. They explained that internal and external factors such as management practices and techniques contribute to whether a team is agile, rather than the practices and techniques themselves being described as agile.

According to Sheffield and Lemétayer (2013), important factors for project success in an agile environment include both performance management and a social context. Setting up employees for success requires a defined project management protocol, as well as relevant leadership techniques. The social context relates to team dynamics and interactions with stakeholders and other contributors, while the significance of the performance portion relates to the methods in which projects are managed. Moe et al. (2010) suggested that individuals cannot simply be placed in a self-managing situation with the expectation that they will automatically function as an agile team. Project procedures and methodologies can have a big impact on how teams function and manage their daily activities. If associates are not productive in a way that contributes to the success of an organization, process changes may be required.

## 1.2 PURPOSE

Majority of Agile project management research has focused on the Agile Scrum Process and Tools. There is no single research study that has examined the full spectrum of human psychology factors arising from Leadership Style, Organization Structure, HR Practices and Stakeholder Engagement that influence emergence of Agile team autonomy. Additionally, most studies on autonomy in organizations have focused on individual autonomy alone (Verwijs & Russo, 2023). The human psychological factors influencing team autonomy have been largely neglected. This will be the first study that will consider team autonomy as a dependent variable.

The human psychology factors in Agile projects are often neglected in practice. Agile project failures are frequently ascribed to process and product maturity. The hidden human psychology factors are seldom acknowledged by senior management. It was important to bring these factors to light and explore in depth the impact they have on Agile team autonomy, an established antecedent to Agile project success. The study results provide useful insights into human psychological factors that impede management and team effectiveness. This can help organizations to design the right incentive programs to mitigate risks to organization agility in enterprises. It is expected that this study will enable the next phase of growth for Agile project management research and practice alike.

## 1.3 PROBLEM DEFINITION

Thamhain (2013) noted that people are one of the greatest sources of uncertainty and risk in any Agile project undertaking, but also one of the most important resources for reducing risk. The quality of communications, trust, respect, credibility, minimum conflict, job security, and

skill sets, all these factors influence cooperation and the collective ability of identifying, processing, and dealing with risk factors. Many of the conditions that stimulate favorable risk management behavior are enhanced by a professionally stimulating work environment, including strong personal interest in the project, pride, and satisfaction with the work, professional work challenge, accomplishments, and recognition. Other important influences include effective communications among team members and support units across organizational lines, good team spirit, mutual trust, respect, low interpersonal conflict, and opportunities for career development and advancement. All these factors seem to help in building a resilient Agile project team that focuses on cross- functional cooperation and desired results in an ever-changing market.

Further, Senior management has a critical role in conditioning the organizational environment for team autonomy so innovation can happen without fear. Many risk factors have their roots outside the project organization, residing in the domain of the broader enterprise system and its environment. Examples are functional support systems, joint reviews, resource allocations, facility, and skill developments, as well as other organizational components that relate to business strategy, work process, team structure, managerial command and control, technical direction, and overall leadership. All these organizational subsystems have their locus outside the project organization, controlled to a large extent by senior management. In addition, a natural “impedance barrier” seems to exist between the enterprise systems and the project organization, which makes external risks less recognizable and manageable in their early stages. Since early risk detection and mitigation depend to a large degree on the collective multifunctional involvement and collaboration of all stakeholders, it is important for management to foster an organizational environment conducive to effective cross-functional communications and cooperation.

Berger (2007) offers insight into the tension that exists between a mainly bureaucratic management structure of a large Government enterprise and the Agile development approach adoption. It examines key stakeholders' behavior and attitudes borne from a bureaucratic and hierarchical society that were problematic for the Agile approach incurring project delays. It further explored the issues of conflict, trust and a risk adverse blame culture that prevented key stakeholders from building and fostering a collaborative and co-operative collective with the Developers that had significant impact upon project development progress. It is evident that a climate of trust, co-operation, collaborative and flexible working practices coupled with authoritative, rapid decision-making are necessary if iterative development is to succeed. In this case, the bureaucratic culture was contrary to Agile development, and in particular, problematic within a persistent blame culture environment. The study shows how the benefits of Agile development can be negated by a misplaced loyalty to inherent working practices and protocols where the legacy thinking processes are carried forward into the project arena. Stakeholders, in this case the Business Managers, may possess a 'perceived' authority and control that can influence the outcome of the development approach.

Agile benefits are clear, yet it is a mistake to assume that all parties, particularly enterprise leaders, will be onboard with the process from the outset. Before commencing a true agile transformation, one needs to make sure that the top management is in support of it and are prepared to persevere and win battles with the team. The best way to win support is to demonstrate that agile will actually increase the odds of a successful product delivery with short Agile pilots. It's also important to address the concerns of staff and line managers who fear that agile may negatively affect their careers. Customer feedback is essential for ensuring that whatever the agile team is building will be useful. In the absence of customer feedback, it's

exceedingly difficult to prioritize which areas to focus on and teams may end up treating everything as important.

While a lot of people talk about using agile, there are many misconceptions and misunderstandings about Agile concepts. Teams with little Agile experience and inconsistent training lack the baseline knowledge necessary to apply agile techniques and methodologies effectively. Agile teams with poor communication attributes aren't usually successful. Daily activities like stand-ups and sprint retrospectives provide the best ways to course correct and make sure lessons learned are shared across the company.

Organizational values and norms evolve over time, and as they become established, they stubbornly resist change. Senior leadership holds the most leverage in facilitating the transformation of an organization’s culture to one that embraces agile. Tangible, active involvement at the executive level is critical to cultural transformation. Unwillingness of the team to follow Agile has been seen as a cause of failure, and this tends to happen when the members of a team continue to identify themselves by function. Team-level resistance can also happen when there is a team member with a strong personality who insists on retaining his/her position at the top of the order. The theme that underlies these impediments is that they can be traced back to cultural issues in the organization. In order to have significant and lasting agile success, there’s no getting around the need for strong executive leadership, solid training, and capable coaching.

Organizations should be careful when working with team members and vendors especially, those that are geographically dispersed. It is also important to understand that not succeeding at agile adoption the first time doesn’t mean that agile doesn’t work, but that a proper retrospective should be held to assess why it didn’t work and what the lessons learned are so that

it will work next time. Stakeholder involvement and buy-in are critical to Agile project success. This includes customers, sponsors, managers and team members. It is also important to note that there is a big difference between traditional project managers and agile project managers or scrum masters. Traditional command and control approaches of managing are inappropriate, and the correct adaptive management style should be embraced.

It is important to realize that it takes team members up to ten Sprints to begin getting used to Agile processes. Smaller, dedicated, and collocated teams are a big benefit to Agile projects. This along with the mandate to negotiate and self-organize is important. This fosters a culture of ownership and accountability. Teams should be empowered to negotiate and be self-organizing. Knowledge of agile principles is important to project success. Inadequate training and knowledge could result in incorrect application of Agile principles, tools, and techniques.

Competent team members are important for rapid project delivery, but also to avert stress because of team members having to train more junior team members. Regular reflection throughout, to inform and improve the process is important to Agile adoption and successful Agile project delivery. Team members should have a positive attitude, as this enhances project performance and overall energy and well-being of the team. When agile principles are impractical or not conducive to project conditions or an organization's context, it can be adjusted, or omitted if it is possible to continue without it. Team members who are too specialized and don't have general, balanced experience and business acumen, are not a good fit for Agile projects. Team members who lack general business acumen struggle to assist with functions outside of their specific area of competence, and it is important that team members be able to assist others when necessary for Agile projects success.

With the above context of the problem, my Problem Statement is as follows:

*Agile Scrum projects often fail in organizations due to a lack of understanding of the human psychology factors that influence emergence of Agile team autonomy.*

My research questions are as follows for which research hypotheses were developed within the framework of the quantitative/deductive research methodology.

RQ1: What is the relationship between each human psychology factor and team autonomy?

The first research question involves tests for correlation between the human psychology factors versus team autonomy. The purpose of the first research question is to explore the potential relationships of human psychology factors that demonstrate predictability with respect to team autonomy.

RQ2: Does the relationship between each human psychology factor and team autonomy change in a remote workplace?

The second research question involves tests for correlation between the human psychology factors versus team autonomy with a moderating variable in remote workplace. The purpose of the second research question is to explore the moderating effect if any of a remote workplace on the potential relationships of human psychology factors that demonstrate predictability with respect to team autonomy.

My specific Research Hypotheses are as follows:

- *H01: No significant relationship exists between leadership style and team autonomy.*
- *H02: No significant relationship exists between stakeholder engagement and team autonomy.*

- *H03: No significant relationship exists between organization structure and team autonomy.*
- *H04: No significant relationship exists between human resource practices and team autonomy.*
- *H05: The relationship between leadership style and team autonomy if exists is not moderated by a remote workplace.*
- *H06: The relationship between stakeholder collaboration and team autonomy if exists is not moderated by a remote workplace.*
- *H07: The relationship between organization structure and team autonomy if exists is not moderated by a remote workplace.*
- *H08: The relationship between human resource practices and team autonomy if exists is not moderated by a remote workplace.*

My key assumptions for this study are as follows:

- Human psychology factors can be experienced by members of an organization, as well as reportable on an appropriate questionnaire.
- Human psychology factors are not moderated by personal characteristics like age, race, gender and religious beliefs.
- Agile team members already display innovative, entrepreneurial, and self-organizing personality traits. The study will focus on the extrinsic human psychology factors in leadership, organization, human resource practices and stakeholders.
- There are no significant changes in team workspace (office supplies and furniture, internet connectivity, software tools), ease of communication between team members and ability to maintain team identity and cohesiveness in a remote workplace.

- Mental models do not differ significantly in that survey items, which have demonstrated face validity, will generally be perceived in the same context for the individual participants.
- Team autonomy leads to favorable Agile project outcomes. This relationship has already been established by previous studies (Malik et al., 2021; Verwijs & Russo, 2023).

## 1.4 TARGET RESEARCH POPULATION AND CONTEXT OF ENQUIRY

*Engineering firms present themselves as intriguing subjects of study,*

The target population samples for this study came from these sources:

- American Society for Engineering Management (ASEM)
- Scrum.org
- Scrum Alliance
- IEEE Software

## 1.5 METHOD AND PROCEDURE

The study employed a quantitative method approach in determining the influence of human psychology factors on the emergence of Agile team autonomy. Data was collected through a survey questionnaire.

The study sampled 137 software professionals from the US software industry who had any experience as an Agile Scrum team member. The study population was the US software industry. The quantitative data generated was analyzed and interpreted using descriptive statistics and linear regression techniques.

The relationship between the independent variables - Leadership Style, Organization Structure, Human Resource Practices and Stakeholder Engagement and the dependent variable –

Team Autonomy was explained through linear regression. Finally, an empirical model relating human psychology factor variables and team autonomy was proposed.

The study findings have applicability to the US software industry only. The study was cross-sectional but not longitudinal to keep it dissertation size and time boxed. This may cause the study findings to become less relevant after a period of time especially with re-organizations and layoffs. Further, it may not be possible to fully isolate the latent influence of an organization's antecedents.

Future research can test the model in other countries and industries where Agile methods are being used. A country's culture could then be explored as a possible human factor contributing to Agile project delivery success. The role of the customer in Agile project delivery success can be a topic for future research.

The electronic survey was administered to members of professional organizations like *The American Society for Engineering Management (ASEM), Scrum.org and IEEE Software*. The email explained the purpose of the survey and provide a link to the online survey platform - Qualtrics. The survey consisted of 37 questions with the responses rated in a 7-item Likert scale. An IRB review was completed since the study involves human subjects and a waiver was secured since the study poses no harm to the human subjects.

The full survey consisted of:

- Leadership Styles Measure (LEBQ), from Konczak et al. (2000) which consists of 17 items under six proposed dimensions of leader-empowering behaviors in 7-item Likert scale.
- The Agile R&D units' organization (ARDO) questionnaire developed by Meier and Kock (2021) to measure Stakeholder integration (or Customer Integration),

Organization structure (or Flat Hierarchies) as independent variables and Team autonomy as Dependent Variable in 7-item Likert scale.

- The HRM questionnaire developed by Zavyalova et al. (2018) to measure opportunity-enhancing HRM practices with four items in 5-item Likert scale.

All the instruments were presented in separate survey blocks. Meyer and Allen (2004) recommend not mixing commitment-related content with statements of other measures due to possible respondent confusion as well as artificial inflation between measures.

## 1.6 RESEARCH PRODUCTS

The products of this research study are as follows.

- A PhD Dissertation.
- Original contribution to the Engineering Management Body of Knowledge.
    - A journal article with my study findings on the adverse impact of human psychology factors on Agile team autonomy.
- An empirical model based on linear regression relating the human psychology factors and Agile team autonomy.

## 1.7 RESEARCH DELIMITATIONS AND LIMITATIONS

- Delimitations – The study findings have applicability to the US software industry only. Access to data sources outside US was not feasible in the limited time available for a PhD dissertation.
- Limitations – The study was cross-sectional but not longitudinal to keep it dissertation size and time boxed. There is a risk of the data and findings becoming less relevant after

a period of time especially with re-organizations and layoffs. Organization history may be a hidden variable but was not in scope for this research study.

## 1.8 ORGANIZATION OF DOCUMENT

- Chapter 1 contained the introduction and background related to the course of study, supporting reasons for inquiry, and contextual background.
- Chapter 2 reviews the extant literature.
- Chapter 3 covers the research methodology.
- Chapter 4 presents the data and analysis.
- Chapter 5 discusses the results, implications, and limitations.
- Chapter 6 concludes the dissertation with recommendations for future research.
- References and appendices follow at the end.

# CHAPTER 2

# BACKGROUND OF THE STUDY

## 2.1 REVIEW OF THE LITERATURE

The literature review begins by providing an analysis of how the software industry has established agile project management methods as a course to improve their product development process. This has been covered in the previous chapter. The literature review now focuses on a synthesis of existing studies on the influence of Leadership Style, Organization Structure, HR Practices and Stakeholder Engagement on Agile team autonomy.

Articles were grouped under the following topics:

- Leadership
- Teams
- Organization Structure
- Human Resource Practices
- Stakeholders

Emerald Insights, Google Scholar and Engineering Village were used for article search. In my review of 200 published articles on Agile Teams, there was prominent mention of Leadership Style, Organization Structure, HR Practices and Stakeholder Engagement as the key human psychology factors that influence Team Autonomy. These factors are regarded as human psychology factors because they influence team autonomy which is a psychological perception of the team and the individual team members. Any additional potent factors that may surface during data analysis phase will be given consideration. Majority of the articles considered Team

Autonomy to be an enabler for successful Agile projects (which is the dependent variable under study) and hence it is considered as the central human psychological state goal of the study.

**Leadership**

Research on leadership in agile teams mostly differentiates between a leader as peer or coach to the team who provides appropriate boundary conditions (Takeuchi and Nonaka,1986) and an autonomous team that self-organizes its operational work (e.g. Hoda et al., 2013). While some researchers suggest a facilitator who serves as a peer to team members (Takeuchi and Nonaka, 1986) or a leader who empowers the team to lead itself (Manz and Sims, 1987), other researchers do not consider a formal leader of the team but instead emphasize self-organizing roles within the team (Hoda et al., 2013).

The successful implementation of self-organized teams into the industrial sector has been of ongoing interest over the last 70 years. Researchers consider the topic from different angles among which are socio-technical systems (Manz and Sims, 1987; Srivastava and Jain, 2017; Trist and Bamforth, 1951), knowledge management (Takeuchi and Nonaka, 1986), complexity theory (Ba¨cklander, 2019; Schwaber, 1997), role theory (Hoda et al., 2013; Yang, 1996) and agile project management (Sutherland and Schwaber, 2017). One recurring topic across the various streams of research is the role of leadership in a team that is by definition self-organized.

Elloy (2005) examined the impact of superleader (Agile leader) behaviors in self‐managed work teams, on organization commitment, job satisfaction and organization self‐esteem. Data were collected on‐site over a period of three days from employees working in a non‐union paper mill located in a small rural community in the northwestern region of the USA. The survey was completed by 141 employees, representing a 9 per cent response rate. Self‐leadership, organization commitment, job satisfaction and organization self‐esteem were all

measured using different instruments. The results indicated that teams that were led by a supervisor who exhibited the traits of a superleader had higher levels of organization commitment, job satisfaction, and organization self‐esteem.

Carson et al. (2007) highlights the importance of leadership input from multiple team members and suggests that shared leadership is a critical factor that can improve team performance from the viewpoint of customers or end users of a team's work. The study examined antecedent conditions that lead to the development of shared leadership and the influence of shared leadership on team performance in a sample of 59 consulting teams. Both the internal team environment, consisting of shared purpose, social support, and voice, and external coaching were important predictors of shared leadership emergence. The study suggests that teams do well when they rely on leadership provided by the team rather than looking to a single individual to lead them.

Detert and Burris (2007) investigated the relationships between two types of change-oriented leadership (transformational leadership and managerial openness) and subordinate improvement-oriented voice in a two-phase study. Findings from 3,149 employees and 223 managers in a restaurant chain indicate that openness is more consistently related to voice, given controls for numerous individual differences in subordinates' personality, satisfaction, and job demography. This relationship is shown to be mediated by subordinate perceptions of team autonomy, illustrating the importance of leaders in subordinate assessments of the risks of speaking up. Also, leadership behaviors have the strongest impact on the voice behavior of the best-performing employees. Busse and Weidner (2020) conducted a qualitative study at a German firm featuring in-depth interviews that shows that distant leadership,

organization agility, as well as the application of digital collaboration tools can significantly improve team engagement.

Werder (2018) finds management support to be associated with self-organization as it can strengthen the forces of self-organization within the team and prevent external forces from limiting self-organization. The level of support is very important, i.e., not only a verbal commitment but also the corresponding actions and financial support should follow. Higher extent of self-organization and autonomy helps the team to improve its agility.

Turner et al. (2019) proposes a leadership structure that incorporates both shared leadership (bottom-up) and existing hierarchical structures (top-down) for Agile project management success. Combining the shared leadership with an organization's hierarchical structure can become attractive, especially for organizations which are not quite willing to release control of their hierarchical structure just yet.

Lee and Chen (2019) propose a conceptual framework based on the business process management (BPM) perspective that recognizes external and internal environmental stimuli, including institutional isomorphic forces and interior enablers, such as top management championship, the culture type and resource readiness, which affect organizational Agile software development adoption decisions.

Flores et al. (2018) showed the moderating role of emotional self-leadership on the cognitive conflict–affective conflict relationship and their effect on work team decision quality. Key to understanding why cognitive conflict sometimes leads to improved decision quality and sometimes it does not is the role of emotional self-leadership. Through emotional self-leadership, team members can actively anticipate, guide and focus their emotional responses to cognitive conflict and reduce their experience of affective conflict, improving team decision quality. The

study brought attention to the moderating role of emotional self-leadership and called for empirical research on this subject which is yet to be done.

Spiegler et al. (2021) discusses how and when leadership should transfer power to the Agile teams. Managers should provide opportunities for agile teams to be actively part of the needed structural change towards a more agile organization. For example, managers should allow the team to design their own working conditions freely within set boundaries in terms of time or budget. Managers need to provide transparency and opportunities to voice team opinion via regular Backlog Grooming and implementing openly accessible activity boards. Including Development Teams in strategic decisions will lead to motivation and commitment from team to take on leadership roles. At the appropriate time of team maturity, a transfer of power can be executed.

Crowder (2015) emphasizes the need for a new psychology for dealing with agile development teams. While process is important to ensure the team delivers quality software that meets customer requirements, it is important to understand that the Agile Method is geared around more of an informal approach to management, while putting more time, effort, and emphasis on flexibility, communication, and transparency between team members and between the team and management. It promotes an environment of less control by managers and more facilitation by managers. The role of the manager takes on a new psychological role, one of removing roadblocks, encouraging openness and communication, keeping track of the change driven environment to ensure that the overall product meets in goals and requirements, while not putting too much control on the ebb-and-flow of the agile development process.

**Teams**

Fontana et al. (2014) show that practitioners do not see maturity in agile software development as process definition or quantitative management capabilities. Rather, agile maturity means fostering more subjective capabilities, such as collaboration, communication, commitment, care, sharing and self-organization of teams.

Koch and Schermuly (2021) identified an indirect relationship between agile project management and attraction toward the organization via psychological empowerment. Individuals high in sensation seeking are found to be more attracted toward organizations that apply agile project management than individuals low in sensation seeking. These results suggest that agile project management can attract individuals who seek novel, complex and intense sensations. Where applicable, organizations may highlight their practice of agile project management methodologies as part of their employer brand to attract future specialists for agile projects.

Wageman (1997) examined the critical success factors for a superb self-managing team. 43 self-managing teams at Xerox were assessed. Each team participated in a 2-hr interview; their managers provided descriptions of how they were set up; and each team member completed an extensive survey about the team. Teams were identified as superb or ineffective. Results indicate that the quality of a team's design had a larger effect on its level of self-management than coaching: the superb teams showed stronger signs of self-managing than poorly designed teams. Seven features emerged as the ones most likely to be seen in superb teams and not in ineffective teams: clear, engaging direction; a real team task; rewards for team excellence; basic material resources; authority to manage the work; team goals; and team norms that promote strategic thinking.

Lalsing (2012) studied three different sized Agile teams developing products based on the same technologies and using Scrum. Both objective and subjective measures were used and the results are supported by a survey. The results clearly show that for agile methodologies to work well, it is crucial to select the right people for the right team.

Jha (2019) examined the relationships between team autonomy and team performance and tested the mediating effect of learning orientation and moderating effect of psychological empowerment on that relationship. The results show that higher the psychological empowerment, higher is the effect of team autonomy and learning orientation on team performance.

Supportive leadership behaviors at the individual level include leader inclusiveness (Bienefeld and Grote, 2014, Carmeli et al., 2010), support (May et al., 2004), trustworthiness (Madjar & Ortiz-Walters, 2009), openness (Detert & Burris, 2007) and behavioral integrity (Palanski & Vogelgesang, 2011) that strongly influence employee perceptions of team autonomy. At the team level, employees' collective perceptions of support and coaching forwarded by the team leader (Edmondson, 1999; Roberto, 2002), leader inclusiveness (Hirak et al., 2012; Nembhard and Edmondson, 2006), trust in the leader (Li and Tan, 2012; Schaubroeck et al., 2011), and the behavioral integrity of the leader (Leroy et al., 2012) have been found to foster team-level outcomes such as team learning behavior, team performance, engagement in quality improvement work, and reduction in errors among team members.

Other work has found that positive leadership styles such as transformational leadership (Nemanich and Vera, 2009), ethical leadership (Walumbwa and Schaubroeck, 2009), change-oriented leadership (Ortega et al., 2014) and shared leadership (Liu et al., 2014) are

positively and strongly related to such outcomes as employee voice behavior, team learning, and individual learning.

Finally, research has established that leaders who value participation, people, and production use dyadic discovery methods rather than group-based discovery methods (Roussin, 2008; Wong et al., 2010), and an improvement orientation management style (Halbesleben and Rathert, 2008), are able to foster high levels of team autonomy.

At the individual level, there is growing evidence that supportive organizational practices are positively related to employee work outcomes such as organizational commitment and job performance. For example, research has found that employee perceptions of organizational support (Carmeli and Zisu, 2009), access to mentoring (Chen et al., 2014), and diversity practices (Singh et al., 2013) foster positive work outcomes. Drawing on a sample of 191 medical professionals in an Israeli medical clinic, supportive organizational practices were found to foster team autonomy through social learning processes, similar to that of supportive leadership behaviors (Carmeli and Zisu, 2009).

Growing research at the individual, team, and organizational levels has looked at social support and the social capital (resources) inherent in relationship networks as key determinants of team self-reliance. At the individual level, research has established that rewarding co-worker relationships and the extent to which members of the organization interact with one another on an interpersonal basis, influence individual learning and engagement (Carmeli and Gittell, 2009; Carmeli et al., 2009; May et al., 2004). Similarly, at the team level, researchers have found that relationship networks, and the social support and resources inherent in such networks, promote team autonomy and contribute to team learning, performance, and innovation. Finally, at the

organizational level Carmeli (2007) found that the strength of social networks between teams was positively related to their ability to learn from failure when team autonomy is in place.

At the team level, researchers have found that characteristics such as shared team rewards (Chen and Tjosvold, 2012), formal team structures (Bresman and Zellmer-Bruhn, 2013; Bunderson and Boumgarden, 2010), and team engagement in boundary work (buffering, spanning, and reinforcement) (Faraj & Yan, 2009) are positively associated with higher levels of team autonomy. However, Chandrasekaran and Mishra (2012) found that only team autonomy influenced psychological safety when the project goals and processes of the team were aligned with their broader organizational goals and when there were low degrees of relative exploration (i.e., the team focused on refining existing products and processes rather than seeking to develop new products and processes). Contrary to what they expected, Lau and Murnighan (2005) found that the presence of strong faultlines within teams (i.e., the existence of sub-groups with non-overlapping demographic characteristics) led to greater team autonomy among team members. They argued that this may have resulted from generalization of the positive social effects within strong faultline groups to the entire team. Finally, O'Neill (2009) found that when team members were collectively responsible for bad investment decisions, the presence of team autonomy gave them the courage to admit failure, as compared to when they were individually responsible.

The professionally derived status of the team (Nembhard and Edmondson, 2006), leads to outcomes such as the willingness of individuals to speak up and team engagement through enhancing team autonomy. This work suggests that the higher the team autonomy, the safer individuals will feel to experiment and speak up about their innovative ideas.

Job insecurity is a key factor in shaping team behaviors. Borg and Elizur (1992) examined the relations between feelings of job insecurity (JI) and various attitudes and opinions of employees towards their work and the organization. Analyses survey data from 11 European high‐tech organizations with a total of 8,483 respondents. Results show that JI is associated with more negative evaluations of all aspects of the company and the job, including more objective variables such as the quality of products and services. Particularly high correlations were observed between JI and negative judgements on management and the company in general. Trust and Motivation have a strong impact on the well-being and performance of Agile team members (McHugh et al., 2011).

Malik et al. (2021) collected data to find support for the hypothesized relationships between agile practices, psychological empowerment, innovative behavior, and project performance. The statistical results showed that the agile practices of team autonomy and agile communication contributed to psychological empowerment that led to the innovative behavior of agile teams. The resulting innovative behavior had a significant effect on project performance.

Vishnubhotla et al. (2020) investigated the association between the five factor model personality traits (openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism) and the factors related to team climate (team vision, participative safety, support for innovation and task orientation) within the context of agile teams working in a telecom company. A survey was used to gather data on personality characteristics and team climate perceptions of 43 members from eight agile teams. The study showed that a person's ability to easily get along with team members (agreeableness) has a significant positive influence on the perceived level of team climate.

Mariam et al. (2022) have examined the impact of knowledge-oriented leadership on project success via team cohesion and the moderating role of valuing people and project complexity on this relationship. Data was collected from 121 project employees in Pakistan in a two-wave field survey at an interval of 15 days. The results showed a positive association between knowledge-oriented leadership and project success, and team cohesion partially mediated this relationship. Valuing people positively moderated the relationship between knowledge-oriented leadership and team cohesion. Project complexity had a negative but insignificant moderating effect on project success.

The recent Covid-19 pandemic has introduced a new variable in the study. Agile teams have been forced to work from home. Unlike past situations where a few team members were remote, now the entire team is forced to be remote (Waizenegger et al., 2020). Agile teams are still expected to perform at the same level as when they were collocated. The removal of the Agile workspace and physical presence has created team communication and bonding challenges. New teams are taking longer to form. New hires are taking longer to onboard. Managers are finding it hard to lead and motivate virtual teams and build trust with new hires (Paul et al., 2004). A slew of communication technologies has emerged to solve this problem, yet none can match the communication prowess of a physically collocated team. Research has just started on how Agile teams are adapting their activities during the COVID-19 pandemic (Whillans et al., 2021).

After an initial period of adjustment, many employees are beginning to relish the flexibility of remote work and are contemplating remote, or hybrid work forever. Employers are offering hybrid or remote work as a perk to attract potential job candidates.  So, any

psychological success factors for Agile adoption must be considered in the context of remote teams.

A survey study of 2,595 New Zealanders' remote workers (Walton et al., 2020) confirms that software engineers appear to adapt to the lockdown over time, as people's well-being increased, and their social contacts' perceived quality improved. Productivity was similar or higher than pre-lockdown, and 89% of professionals wanted to continue to work from home, at least one day per month. This study also reveals that the most critical challenges were switching off, collaborating with colleagues, and setting up a home office. On the other hand, working from home led to a drastic saving of time otherwise allocated to daily commuting, a higher degree of flexibility, and increased savings.

**Organization Structure**

Teams themselves can influence the internal organization of teams, but team performance depends not only on the competence of the team itself in managing and executing its work; it also depends on the organizational context provided by management (Stray et al., 2011).

Organizational culture can enhance the performance of teams as well as hinder them. Procedures, hierarchical bureaucracy, and traditional mind-set can influence team members not to act according to how their agile method requires. According to Boehm and Turner (2005). managers face several barriers, real and perceived, when they try to bring agile approaches into traditional organizations. They categorized the barriers either as problems only in terms of scope or scale, or as significant general issues needing resolution. From these two categories, they identified three areas - development process conflicts, business process conflicts, and people

conflicts as critical challenges to software managers of large organizations in bringing agile approaches to bear in their projects.

Hobbs and Petit (2017) examined the implementation of agile methods in large organizations through a case study. The study concludes that adoption of agile methods by a large complex organization requires experimentation and adaptation of the methods to the organization's structure, culture, product/service strategy, human resource management policies, customer interfaces, project roles and governance structures, including program and project portfolio management. At the same time, the organizational context is influenced by the implementation of agile methods.

Garcia et al. (2021) argues that organizations with entrepreneurial orientation (EO) have more adherence to agile values, thus, contributing to the success of Agile project management. This EO is characterized by innovativeness, risk taking, proactiveness, autonomy and competitive aggressiveness. The development of an entrepreneurial strategy of the organization focused on innovation, on boldness for risk, on proactiveness in the development of projects and activities, on an aggressive attitude toward the market, and on the autonomy of individuals and teams, favors the incorporation of agile values, which are the foundation of agile project management. These results corroborate signs in the literature about characteristics of the context of agile methods, such as self-managed teams (Conforto et al., 2014), collaboration-oriented culture (Surendra and Nazir, 2018), anticipatory behavior (Li et al., 2011), decentralization and flexibility (Ben-David et al., 2012), willingness to manage risks (Lee and Xia, 2010), deal with uncertainties (Li et al., 2011), freedom to manage and solve problems (Van Marrewijk, 2007) and innovative behavior (Van Marrewijk et al., 2008). Agile development in projects has evolved

toward agility in project management, with a need for a quick, more effective, and integrated learning process with the entrepreneurial spirit in its operations (Stettina & Hörz, 2015).

Cao et al. (2009) draw from adaptive structuration theory (AST) that examines organizational change facilitated by different types of structures provided by advanced technologies, tasks, and organizational environments, as well as structures that emerge in social action. In our context, agile methods provide a structure for software projects and an adapted structure emerges due to social action of the participants in the process. AST provides us a suitable lens to understand the emergent structure that results from using agile methods in different contexts. The authors conducted a multisite case study to examine the adaptation of agile practices and develop a framework guided by AST that describes the emergent structure provided by the adapted agile practices. Digitization is forcing IT organizations to become less hierarchical and more team-based networks. An agile organization has to promote ambidexterity (Lindskog and Magnusson, 2021) practices and support a balanced hybrid structure (Zasa et al., 2020).

According to Mateos-Garcia et al. (2008), established ‘rational’ methodologies in the field of project management emphasize idealized top-down processes that neglect ‘soft’ human dimensions of projects. This has led to negative outcomes such as delays in delivery, low quality products and overshot budgets. The authors argue based on three case studies of companies practicing Agile techniques in the UK Video Games Industry that a shift in attention from processes, documentation and measurement to ‘softer’ variables supports a development system better able to ‘embrace change’, which is understood as the key limitation of formal, rational methods.

Almeida (2017) identifies four dimensions of challenges with large scale adoption of Agile methods by the engineers and managers. The first dimension is the people, with challenges in terms of personal education, experience and commitment, stakeholder involvement, location of teams and stakeholders, available training course and identification of customer needs. A second dimension is the organization and management, in which legal and cultural challenges arise. A third dimension is the process, which involves challenges in changing team practices, identification of functional and non-functional requirements, cross-team dependencies, reporting and tracking of projects, quality management, risk management, and scaling. Finally, the last dimension is related to tools, where challenges are associated with the technical complexity of projects, integration issues, project assessment and issues tracking.

Denning (2017) says the right question doesn't start with the organization or its structure at all. It starts with the customer. What does you customer and your market need? The answer to that determines everything. Generally, the last thing the customer needs is a new structure. To meet customers' needs through enterprise agility, the thinking part of an organization must be run as a network, in which information flows horizontally and upwards, as well as downwards. People may still be located in units for administrative purposes. These units might be seen as their "home base" and these home bases might have names like departments or divisions. But they are not operating like silos or layers, which have priorities separate from the goal of the firm or arguing in secret meetings for their staff and their programs and their status, or against other departments. Work in a network is mostly done in self-organizing teams and groups of teams that are in pursuit of the firm's overall goal and that in substance report to the top of the organization, which also seeks to incorporate the wisdom of the entire staff and set priorities from an organizational perspective.

Agile organizations generally maintain a traditional top-level hierarchical structure, but the remainder of the company is built to be a system of autonomous, dynamic network of teams with a shared purpose and vision. Each team has its own project management and deliverables, and many of the projects may be dependent on others within the company, in other business units. That's why it's important to build the network of teams – to avoid silos and keep everyone apprised of what's going on.

**Human Resource Practices**

Conboy et al. (2011) conducted case studies of 17 organizations that have used agile methods for more than three years. The study uncovered many serious "people" challenges including recruitment, training, motivation, and performance evaluation. This clearly shows that the key challenge in Agile development is people and not process.

Zavyalova et al. (2018) demonstrated that agile firms tend to more strongly rely on HRM practices (especially, motivation- and opportunity-enhancing) in ensuring high organizational performance. Furthermore, successful agile firms had more centralized HRM architectures with less authority diffusion among different levels of management. The study shows that with the elimination of line managers in agile organizations, HR functions are being transferred back to HRM departments. HR is instrumental in establishing the ethics and compliance policies that among other things ensure psychological safety and autonomy for Agile Scrum teams. The strong correlation between the Agile project management approach and HRM architecture may be a crucial reason for why many agile transformations in project-based organizations have failed. The psychological ramifications of Agile transformation in a large enterprise cannot be neglected.

Collins and Smith (2006) developed and tested a theory of how human resource practices affect the organizational social climate conditions that facilitate knowledge exchange and combination and resultant firm performance. A field study of 136 technology companies showed that commitment-based human resource practices were positively related to the organizational social climates of trust, cooperation, and shared codes and language. In turn, these measures of a firm's social climate were related to the firm's capability to exchange and combine knowledge, a relationship that predicted firm revenue from new products and services and firm sales growth.

Grass et al. (2020) conducted 44 semi-structured, in-depth interviews with team members and leaders from various teams at three organizations (i.e., two German and one multinational European firm). The inductive analysis identified empowerment as a focal human factor for adaptability emergence in teams. The findings demonstrate that empowerment is not a static state, but rather emerges through the interactions between various actors. Specifically, the team and its leader engage in both empowerment-enhancing and empowerment-reducing activities. These activities are further influenced by the agile team's immediate context: Two-fold customer influences, that is, supporting and hindering empowerment interactions, the organizational environment, that is, undergoing an agile transformation and supportive top management behaviors.

Owusu (1999) emphasizes the importance of employee involvement and human resource development in agile management systems coupled with good communication. Muduli (2016) conducted an empirical study on the facilitators and mediators of workforce agility. Organizations are to design practices related to organizational learning and training, compensation, involvement, teamwork and IS and implement them efficiently and effectively to enable agility within the workforce, as an agile workforce can only respond proactively to a

volatile, uncertain, complex, and ambiguous business environment. Further, the study also suggests that managers should design the organizational practices capable of enhancing psychological empowerment, as the combination can deliver better workforce agility.

Holbeche (2018) argues that HR can help embed organizational agility by creating holistic scorecards of the right performance metrics that link to the vision. Performance management systems and other people practices should reinforce the Agile principles and become developmental in orientation. For collaboration (with real accountability), promotion criteria should require evidence of collaboration and effective delivery – with job rotations required for moving up the ladder. Similarly, recognition and reward mechanisms should reinforce desirable cultural practices that are central to developing an agile culture. In particular HR can train managers in the new approaches so that they can provide a sense of purpose and progress, help people adapt to change and feel valued. McKenzie and Aitken (2012) provide a framework of 12 leadership agility practices specifically focused on creating conducive conditions for knowledge sharing, learning, engagement, and collaboration.

Appelbaum et al. (2017) show that increased organizational agility increases the ability to respond proactively to unexpected environmental changes so characteristic of today's business environment. The commitment to continuous transformation and agile strategies implies changes at all levels of the organization from its structure, through its leadership and decision-making dynamics, down to the skills and interpersonal relationships of the individuals implementing the agile mission.

Hennel and Rosenkranz (2021) conclude from three case studies conducted in two large insurance companies and one software development company that social agile practices

promoted by leadership positively influence autonomy, transparency, communication, and ultimately productivity in Agile teams.

**Stakeholders**

Stakeholder engagement is critical for Agile teams. Power (2010) categorizes the stakeholders into six primary stakeholder groups - Product Owner Team, Product Delivery Team, Program Sponsor Team, Product Consumers, Product Council and Program Core Team. This study focuses on the interactions between the different stakeholder groups, and how agile processes provide ongoing opportunities for stakeholder engagement. Agile practices such as iteration planning, iteration reviews, daily stand-ups, information radiators, Scrum of Scrums, and retrospectives facilitate early and continuous identification of stakeholders, help to bring stakeholders into the development process, and provide an opportunity to address their needs. Agile practices such as continuous integration, unit testing, test driven development, and frequent releases provide ongoing feedback about the health of the product and whether it is meeting stakeholder goals.

Huck-Fries (2021) investigated the effect of agile practices on stakeholders' job satisfaction. They adopted a mixed methods approach with an exploratory case study to develop the theoretical model, which was evaluated with a survey among stakeholders in agile projects. The study provides empirical evidence of agile practices on stakeholders' job satisfaction and highlights the relevance of interaction and collaboration between Agile team members and stakeholders in agile projects.

Crocitto and Youssef (2003) offer a model of agility based on suppliers, organizational members, and customers united through information technology. It is seen that these connections

rest on a foundation of leadership, organization culture, and employee reward systems that create a relationship between people and technology. These relationships include involving people in decision making, creating process and product quality by offering enriched jobs, training in technology, and providing a reward system which reinforces agility-promoting efforts.

## 2.2 LIMITATIONS OF EXISTING STUDIES

My research focuses on the human psychological factors required in Leadership, Organization Culture, HR Practices and Stakeholders to promote team autonomy and motivate software development teams to deliver successful Agile projects in a dynamic market.

Majority of Agile project management research has focused on the Agile Scrum Process and Tools. The human psychology factors side of Agile projects has been largely neglected or superficially covered. In practice as well, Agile project failures are frequently ascribed to process and product maturity. The hidden human psychology factors are seldom acknowledged by senior management. It is important to bring these factors to light and explore in depth the adverse impact they may have on building Agile team autonomy that leads to Agile project success. There is no single research study that has examined the full spectrum of human psychology factors arising from Leadership Style, Organization Structure, HR Practices and Stakeholder Engagement that influence emergence of Agile team autonomy.

Additionally, most studies have used the case study method to find correlation among variables. The drawback of these qualitative studies is that it is difficult to demonstrate a clear

correlation based on conversational data provided by the interviewees since such subjective data is often hard to codify into clear themes. This causes case studies to have poor external validity (Schein, 1985). They may be limited in their ability to contribute towards hypothesis testing and theory building with the amount of time and expenses required (Bernard, 1995). This study will avoid this pitfall by choosing a quantitative research methodology.

There is no agreement among the studies on which factor(s) contributes the highest to Agile project success. There are different terms used to present the same theoretical construct like Agile Leadership, Shared Leadership, Distributed Leadership or Innovation Leadership but with same insights.

The above studies show that a lot has been written about Agile processes and tools but there is very little research done into the risks posed by human psychology factors that contribute to the success or failure of Agile projects in software firms. This study will provide useful insights into factors that impede management and team effectiveness. This will help organizations to design the right incentive programs to mitigate risks to organization agility in software firms.

The study has applicability in both planning and execution phases of the Department of Defense System Acquisition pathway for software intensive systems. The research will reveal Human psychological factors that are necessary for Agile Scrum projects success. These factors if carefully addressed during planning phase will foster autonomy in teams. This will in turn help build autonomous and resilient teams that deliver software rapidly and iteratively in the execution phase to meet the highest priority user needs. The practical implications of my research findings to the Department of Defense System Acquisition pathway for software intensive systems will be discussed in the study conclusions.

Adoption of Agile process and tools alone is not enough to change the Agile mindset, which is the key driver of Agile project success. The mindset change can only be brought in by holistically understanding and addressing the human psychological factors that influence Agile team autonomy that leads to Agile project success.

Even though an increasing number of organizations strive to implement agile teams, it is not entirely clear how teams can adopt the agile way of working (Moe et al., 2010; Nerur et al., 2005). Especially rather bureaucratic companies seem to struggle in their agile transformation (Moe et al., 2009; Nerur et al., 2005). Fitting leadership behavior is found to be one key success factor for evolving into an agile self-organized team (Gren et al., 2019). However, which kind of leadership agile teams need is not yet clear.

Hobbs and Petit (2017) argue that implementation of agile methods in a large organization with well-established traditional methods is a significant organizational change. As with any significant change, management support is critical. The acceptance and support of IT and business unit managers as well as development personnel are also very important. Being knowledgeable of agile methods is a necessary condition for support.

There are fundamental contradictions between large bureaucratic organizations with well-established traditional software development methods and agile principles and practices. The resolution of these contradictions is currently ongoing but is still incomplete. Some aspects of the forms these will take in the future are already quite clear, but others will only become clear as the evolutionary process progresses. Little research is done on what an ideal Agile organization structure should look like. The changes required to HR practices to enable Agile team autonomy are well covered in the extant literature, but this factor needs to be investigated together with Leadership and Stakeholders factors. The stakeholder mindset changes required for

Agile team autonomy that leads to Agile project success is just beginning to be explored in the research community.

Finally, there is little research coverage so far on how the impact of the above human psychology factors may have changed after the Covid-19 pandemic and how they may influence emergence of Agile team autonomy that ultimately leads to Agile project success, in the predominantly remote workplace of the future. My study seeks to address these hitherto neglected topics in Agile project management research.

# CHAPTER 3

# RESEARCH METHODOLOGY

## 3.1 METHODOLOGY OVERVIEW

The research methodology details the overall approach to the entire process of the research study (Collis & Hussey, 2009). This chapter covers the overall research methodology, research questions and research strategy by which they were explored. This chapter also discusses the research paradigm, variables of interest and methods by which they were measured, including the review of instruments, reliability, and validity. Rationale for the research methodology is also explained in this chapter.

## 3.2 RESEARCH FRAMEWORK

**Table 2. Research Paradigms/Worldviews (Creswell, 2003)**

| | | |
|---|---|---|
| Ontological Position | Positivistic | Knowledge is conjectural; absolute truth can never be found. |
| Epistemological Position | Empiricist | Data, evidence, and rational considerations can generate knowledge. |

| | | |
|---|---|---|
| | | Information will be collected on instruments based on measures. |
| Methodology Employed | Quantitative | Seeks to develop relevant, true statements, ones that describe relationships of interest, through testing of hypotheses. |
| Mode of Reasoning | Deductive | Reduce ideas into a discrete set to test. |

## 3.3 RESEARCH STRATEGY

Research is the process of collecting, analyzing, and interpreting data in order to understand a phenomenon (Leedy and Ormrod, 2001). The research process is systematic in that defining the objective, managing the data, and communicating the findings occur within established frameworks and in accordance with existing guidelines. The frameworks and guidelines provide researchers with an indication of what to include in the research, how to perform the research, and what types of inferences are probable based on the data collected (Williams, 2007).

The three common approaches to conducting research are quantitative, qualitative, and mixed methods. The researcher anticipates the type of data needed to respond to the research question. The type of data can be numerical, textural, or both numerical and textural data. Based on this assessment, the researcher selects one of the three aforementioned approaches to conduct research. Researchers typically select the quantitative approach to respond to research questions requiring numerical data, the qualitative approach for research questions requiring textural data, and the mixed methods approach for research questions requiring both numerical and textural data.

## 3.4 QUANTITATIVE RESEARCH APPROACH

Quantitative research emerged around 1250 A.D. and was driven by investigators with the need to quantify data. Since then, quantitative research has dominated the western cultural as the research method to create meaning and new knowledge. What constitutes a quantitative research method involves a numeric or statistical approach to research design? Leedy and Ormrod (2001) alleged that quantitative research is specific in its surveying and experimentation, as it builds upon existing theories. The methodology of a quantitative research maintains the assumption of an empiricist paradigm (Creswell, 2003). The research itself is independent of the researcher. As a result, data is used to objectively measure reality. Quantitative research creates meaning through objectivity uncovered in the collected data. Quantitative research can be used in response to relational questions of variables within the research.

"Quantitative researchers seek explanations and predictions that will generate to other persons and places. The intent is to establish, confirm, or validate relationships and to develop generalizations that contribute to theory" (Leedy and Ormrod, 2001, p. 102). Quantitative research begins with a problem statement and involves the formation of a hypothesis, a literature review, and a quantitative data analysis. Creswell (2003) states, quantitative research "employ strategies of inquiry such as experimental and surveys, and collect data on predetermined instruments that yield statistical data" (p. 18). The findings from quantitative research can be predictive, explanatory, and confirming. The next section focuses on quantitative research methodology.

## 3.5 QUANTIATIVE RESEARCH METHODOLOGY

Research methodology is defined by Leedy and Ormrod (2001) as "the general approach the researcher takes in carrying out the research project" (p. 14). Quantitative research involves

the collection of data so that information can be quantified and subjected to statistical treatment in order to support or refute “alternate knowledge claims” (Creswell, 2003, p. 153). Creswell, (2002) asserts that quantitative research originated in the physical sciences, particularly in chemistry and physics. The researcher uses mathematical models as the methodology of data analysis.

Three historical trends pertaining to quantitative research include research design, test and measurement procedures, and statistical analysis. Quantitative research also involves data collection that is typically numeric, and the researcher tends to use mathematical models as the methodology of data analysis. Additionally, the researcher uses the inquiry methods to ensure alignment with statistical data collection methodology.

There are three broad classifications of quantitative research: descriptive, experimental, and causal comparative (Leedy and Ormrod, 2001). The descriptive research approach is a basic research method that examines the situation, as it exists in its current state. Descriptive research involves identification of attributes of a particular
phenomenon based on an observational basis, or the exploration of correlation between two or more phenomena.

During the experimental research, the researcher investigates the treatment of an intervention into the study group and then measures the outcomes of the treatment. There are three types of exploratory approaches: pre-experimental, true experimental, and quasi-experimental (Leedy and Ormrod, 2001). The pre-experimental design involves an independent variable that does not vary or a control group that is not randomly selected. Campbell and Stanley (1963) endorsed the true experimental design, which provides a higher

degree of control in the experiment and produces a higher degree of validity. The true experimental designs result in a systemic approach to quantitative data collection involving mathematical models in the analyses. The quasi-experimental design involves nonrandom selection of study participants. Therefore, control is limited, and true experimentation is not possible. Since the variable cannot be controlled, validity may be sacrificed.

In the causal comparative research, the researcher examines how the independent variables are affected by the dependent variables and involves cause and effect relationships between the variables. The factorial design focuses on two or more categories with the independent variables as compared to the dependent variable (Vogt and Kalveram, 1999). The causal comparative research design provides the researcher the opportunity to examine the interaction between independent variables and their influence on dependent variables.

## 3.6 METHODS TO CONDUCT QUANTIATIVE RESEARCH

Several research methods exist to conduct quantitative research. In descriptive research method, correlational, developmental design, observational studies, and survey research are used. These research methods may also be used in various degrees with experimental and causal comparative research.

In the correlational research method, the research examines the differences between the two characteristics of the study group. Leedy and Ormrod (2001) felt that it is crucial to observe the extent to which a researcher discovers statistical correlation between two characteristics depending on some degree of how well those characteristics have been calculated. Hence, validity and reliability are important components that affect correlation coefficients. Creswell

(2002) defined correlation as a statistical test to establish patterns for two variables. The statistical analysis of the research question can be conducted through a progression or sequence of analyses using a standard test for correlation that produces a result called “r.” The r coefficient is reported with a decimal numeral in a process known as the Pearson Correlation Coefficient (Cooper and Schindler, 2001).

During the development design, the researcher explores how characteristics may change over time within a study group. Two types of development designs include cross-sectional and longitudinal. In the cross-sectional study, the researcher compares two different groups within the same parameters. Whereas the longitudinal study is commonly used in child development research to better understand a phenomena of particular age groups or to study a group over a specific period of time (Leedy and Ormrod, 2001).

In the observational study method, the researcher observes a particular aspect of human behavior with as much objectivity as possible and records the data. This research method may provide an alternative to various qualitative research methods. In the survey research method, the researcher tends to capture phenomena at the moment. This method is used for sampling data from respondents that are representative of a population and uses a closed ended instrument or open-ended items. A survey is one of the popular ways to gather data in the social sciences and will be employed for this study.

## 3.7 RESEARCH DESIGN

The research design chosen for the study was a non-experimental design grounded in quantitative analysis. For this type of design, Creswell (2003) suggests the use of correlational statistics to explain and measure the association between two or more variables. The literature

review identified four independent variables in Leadership Style, Organization Structure, HR Practices and Stakeholder Engagement. The purpose of the study was to understand if there is a relationship to a dependent variable in Team Autonomy. The goal was to gather survey data from all participants and use it for analysis without manipulating the variables or participants as is done in an experimental design.

The specific steps to conduct the research are listed in Figure 2 below. As each step in the process progresses, new information may require iterations back to previous steps to incorporate the new findings or knowledge.

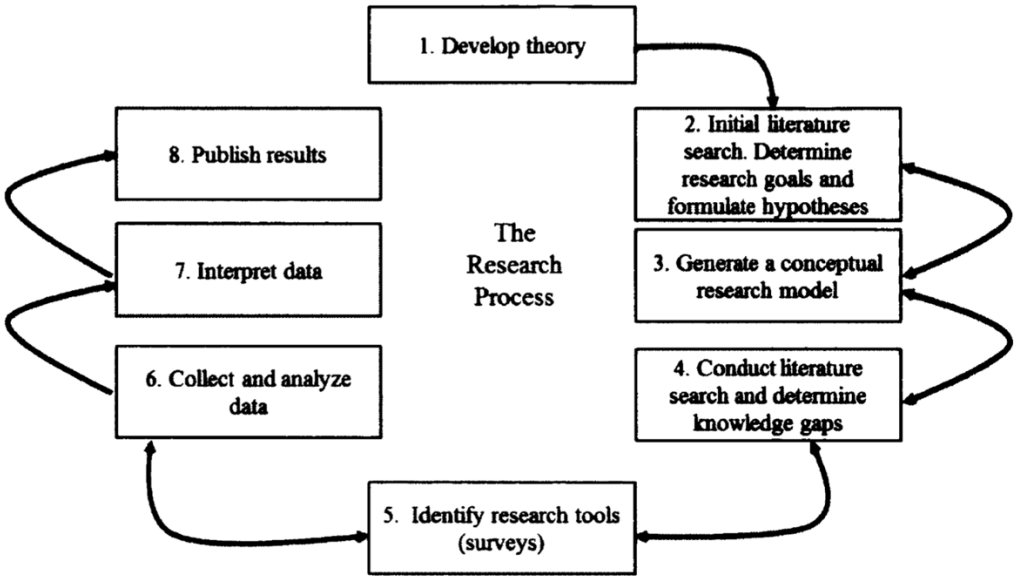


**Figure 2. The Research Process**

**Rationale for Survey Research**

According to Marshall and Rossman (2006), survey research is appropriate for using data collected from a relatively small number of individuals from a group to make inferences about a

large group of people. An online survey instrument was used to collect data from agile practitioners and other personnel involved in Agile projects in software companies. Laanti et al. (2011) posit that online instruments provide faster, and easier data collection and analysis methods as opposed to direct interviews. Organizations have moved online in order to promote their presence to consumers, providing an outreach opportunity for researchers to access a variety of populations who are involved with the interests of these groups (Wright, 2005).

A survey can collect data to run both descriptive and inferential statistics. The descriptive information provides basic respondent information such as any practice experience with Agile project management methods (Yes/No for screening), role. The inferential data provides information on the relationship between the independent predictor variables and the dependent variable of team autonomy.

The survey administration process is depicted in Figure 3.

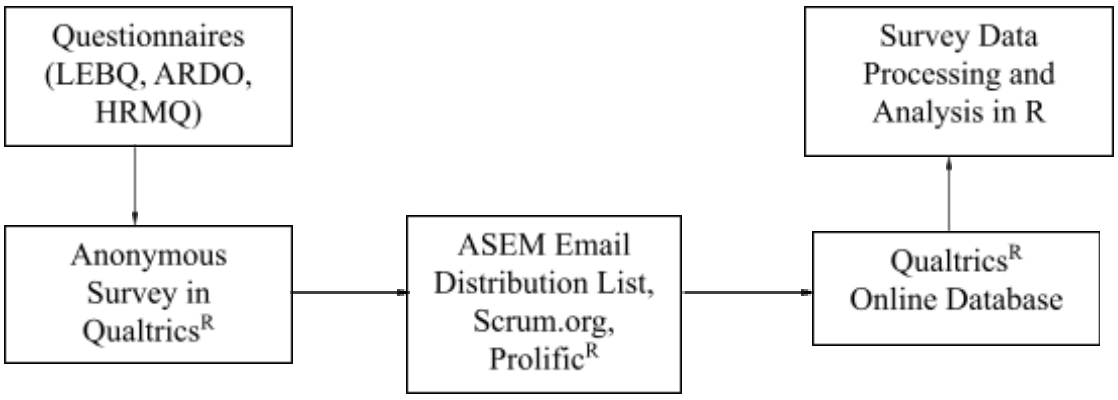


**Figure 3. The Survey Administration Process**

## 3.8 POPULATION AND REPRESENTATIVE SAMPLE

The study targeted software professionals from US software companies with any experience in an Agile Scrum Team Member role. The population was the US software industry. The primary target for outreach were professional associations like The American Society of Engineering Management and Scrum.org. Membership includes practitioners that hold a variety of positions within their companies. This ensured internal validity of the data being collected from a broad spectrum of US software industry professionals. These software professionals can work in large corporations as well as start-ups in the software industry. An auxiliary medium for outreach was via social media i.e., Linked-in groups like SCRUMstudy associated with Agile project management body of knowledge and my professional network. The target sample size for the study was 300 but the survey was able to get sufficient data from 137 responses (Bordens and Abbott, 2011). It was made clear in the survey invite letter that participation is purely voluntary. The survey input data did not require participants to disclose any personal or confidential information.

One of the key aspects of protecting individuals participating in research is making assurances to those participants regarding how their personal information will be protected. This includes protecting participants' privacy, keeping information confidential, and allowing the participant to remain anonymous. All these aspects were duly considered in the research study. The survey was completely anonymous and no identifying personal information was collected. The data was securely stored in the hard drive of my computer, strongly encrypted with a 24-character password. The data will be retained for one year only.

Each survey question required a single response in a 7-item Likert scale to indicate the respondent's preference. The data analysis process is shown in Figure 4.

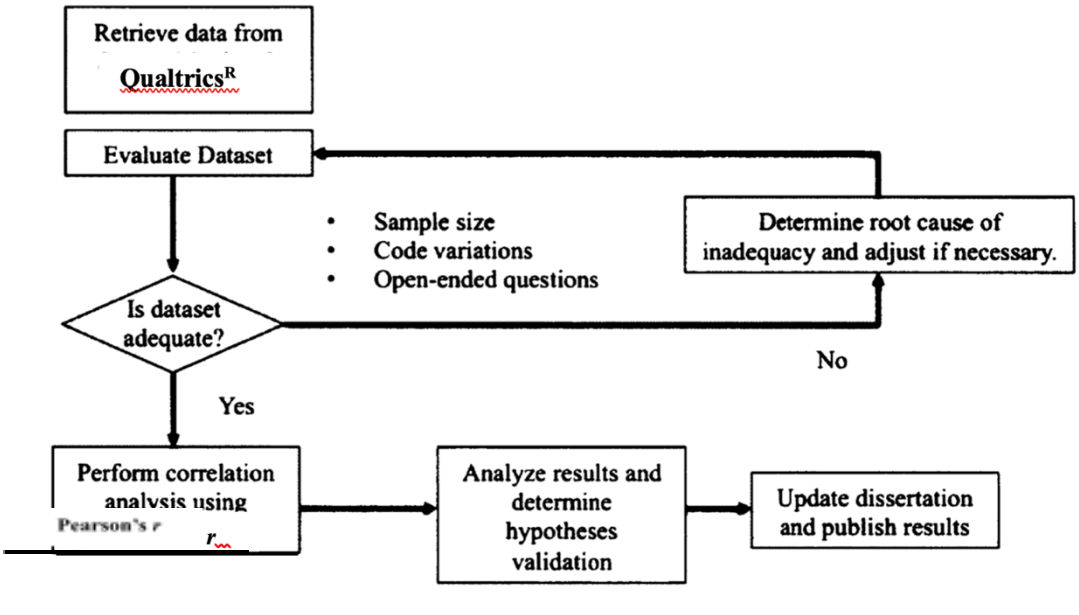


**Figure 4. The Data Analysis Process**

### Human Subjects Institutional Review Board (HSIRB)

Prior to administering the survey instrument, the survey document, and information about the study population were submitted to the College of Engineering Human Subjects Institutional Review Board to obtain approval to proceed. The research was exempted from a full review by the IRB since it presented no more than minimal risk of harm to subjects. The survey input data was collected online and did not require participants to disclose personal or confidential information.

## 3.9 INSTRUMENT

The data collection instrument was a survey conducted via an online questionnaire. A survey questionnaire seeks the opinions of individuals in a sample or a population on issues directly related to the objectives of the research study. The questionnaire consists of a set of

structured and unstructured questions designed by researchers to obtain data from the respondents. The advantage of using a questionnaire is that it guarantees the anonymity of the respondents; it facilitates the collection of large amounts of data in a relatively short period and it is economical to administer. The major demerit of the method is that some confusing and misleading questions cannot be clarified as the researcher may not be there to explain the questions, and some questions may be comprehended differently by different individuals.

The survey questions were developed around the identification of human psychology factor variables that may have an influence on team autonomy (a strong antecedent to Agile project success). These variables were identified from the literature review as well as personal knowledge gathered at local and national conferences on this topic. The survey instrument was grounded in the theory presented in the literature review as well as experienced in practice. The researcher has been practicing Agile project management for 27 years in leading software companies and has access to several professionals and groups that have implemented agile project management processes within their companies. Informal conversations with these members regarding their use of agile techniques provided an opportunity to learn about the struggles and benefits faced by these users in the use of the Agile Scrum methodology. These conversations also helped shape the format and content of the survey instrument. Building the survey in this manner provided the reliability necessary for others to carry-out similar data collection and analysis activities on similar samples in the field.

The survey was written and formatted using Qualtrics$^{R}$, a web-based survey software platform. The intent was to keep the survey short (within 10 minutes) to encourage participants to complete all the questions without survey fatigue. Most of the survey was designed to collect data associated with independent and dependent variables of interest; however, there were a few

questions used for classification and demographic information. The survey collected basic screening information on whether the respondent belonged to the software industry and had any experience as an Agile Scrum team member in the organization.

The intent of the instrument and data collection procedure was that it can be easily duplicated, thus providing a level of reliability that can be repeated by future studies. Industry standard questionnaires were chosen to provide an internally reliable, face valid, and psychometrically robust measure of the human psychological factors under study. The face validity of the questionnaires was also established through pilot testing with my PhD research advisor, dissertation committee members, ODU faculty and leading researchers on Agile teams (Taherdoost, 2016).

The questionnaires met content validity as they fully represent the full spectrum of human psychology factors arising from Leadership Style, Organization Structure, HR Practices and Stakeholder Engagement that influence the emergence of Agile team autonomy in a post-pandemic remote workplace. The Doctoral committee is familiar with the construct of interest and are experts on the research subject. All questionnaire items were cross-checked for readability, clarity and comprehensiveness and there were only minor changes made to the questionnaire (Del Greco et al., 1987). The survey responses were rated in a 7-item Likert scale that ranged from 1 (“strongly disagree”) to 7 (“strongly agree”). Major drawback of content validity is that it is also adjudged to be highly subjective like face validity. So, it was important to employ more than one form of validity to increase validity strength of the questionnaires. The content validity was combined with criterion validity which consists of concurrent or predictive validity. The questionnaire was benchmarked with a mixed methods based research on Agile team performance (Russo et al., 2021) for concurrent validity. Predictive validity i.e., the ability

of the questionnaire (instrument) to forecast future Agile project outcomes was measured using correlation and linear regression. Construct validity was established through Confirmatory Factor Analysis (CFA).

Random sampling of software professionals from the US Software industry (population) was done to assure a representative sample of the target population and ensure that the findings were generalizable to the accessible population. The study findings have applicability to the US software industry but may not be generalizable globally due to potential effect of culture on human psychological factors which was not in scope for this study.

**Leadership Measure**

The study used the Leader Empowering Behavior Questionnaire (LEBQ) developed by Konczak et al. (2000). LEBQ consists of 17 items under six proposed dimensions of leader-empowering behaviors listed in Appendix A. The LEBQ contains 17 items grouped in six dimensions (three items per construct, except for one of them):

1. *Delegation of authority refers to whether the leaders grant power to subordinates.*
2. *Accountability for outcomes addresses the leader's emphasis on taking responsibility for consequences.*
3. *Self-directed decision making implies that the leader encourages independent decision-making.*
4. *Information sharing evaluates whether the leaders share information and knowledge with the employees.*
5. *Skill development is concerned with the extent to which the leader facilitates the development of skills and secures appropriate training for employees.*

6. *Coaching for innovative performance is related to behavior that encourages calculated risk-taking and new ideas and provides performance feedback to employees, treating their mistakes and setbacks as opportunities to learn*.

The LEBQ is answered on a Likert-type scale that ranges from 1 ("strongly disagree") to 7 ("strongly agree"). Higher scores indicate higher employee perceptions of leader empowering behaviors. All Cronbach's alpha reliability coefficients for scores on the six-factor model are acceptable (range = .82 to .90). All standardized factor coefficients are greater than .78 with the exception of Item 6 (.65) and Item 12 (.62 There is moderate variability in the scales as indicated by the standard deviations (SDs = 0.99 to 1.37). The inter-factor correlations range from .40 to .88. Overall, these results indicate that a six-factor model provides a good description of the relationships among the LEBQ items. For measurement of Agile leadership style, the LEBQ appears to be a psychometrically sound instrument for the survey.

**Organization Structure, Stakeholder Integration and Team Autonomy Measure**

The study employed three of the six dimensions of the Agile R&D units' organization (ARDO) questionnaire developed by Meier and Kock (2021) listed in Appendix A. These three dimensions are:

1. *The stakeholder integration (or customer integration) scale comprises four items assessing how the stakeholders are involved in the R&D unit's product development process.*
2. *The team autonomy (or autonomy) scale reflects the extent to which the team can make its own decisions regarding how tasks should be done.*
3. *The organization structure (or flat hierarchies) scale measures the organization structure using four items.*

All items were measured on a ratio Likert scale with anchors at 1 (“does not apply at all”) to 7 (“applies completely”). All values for Cronbach’s alpha are above 0.70 suggesting high-scale reliability.

**Human Resource Practices Measure**

The study used the opportunity-enhancing (HRM practices of the HRM questionnaire developed by Zavyalova et al. (2018) listed in Appendix A. These practices are referred to as Empowerment-enhancing HR practices by Gardner et al. (2011). The scale for opportunity-enhancing (HRM practices includes four items. All items in the questionnaire take the form of “How often are the following HRM practices used in your organization?” with scales ranging from 1 (not used at all) to 5 (very often). Cronbach’s alpha is 0.91, indicating good internal consistency of the construct.

# CHAPTER 4

# RESULTS

## 4.1 SURVEY OVERVIEW

The data collection for this research study was conducted via an online, anonymous survey in  tool and shared it on the Prolific[R] data collection platform, various Scrum related forums including Scrum.org, subreddits on Agile Scrum and Programming, IEEE Software and the ASEM mailing list over a period of 2 weeks. The survey received 137 responses from software engineers working on Agile Scrum teams in the United States. This chapter provides a detailed analysis of the results of the data collected.

## 4.2 SURVEY RESPONSES

The survey collected 137 responses and they were all complete since the survey tool forced a response to each survey question to proceed further. With 4 predictor variables, this is a sufficient sample size to allow useful analysis (Russo et al., 2021). The demographics of the 137 responses are summarized in Table 3.

**Table 3. Survey Response Demographics**

| **Demographic** | **Classification** | **Frequency**<br><br>**(n=137)** | **Percentage** |
|---|---|---|---|
| Agile Scrum Experience | 1-3 years<br>3-5 years<br>5-10 years.<br>More than 10 years | 70<br>36<br>22<br>9 | 51%<br>26%<br>16%<br>7% |
| Work Location | Remote (3-5 days remote)<br>Onsite (0-2 days remote) | 104<br>33 | 76%<br>24% |

Most responses came from Software engineers with 1-3 years of Scrum experience which is the dominant category of software engineers in the US. Software professionals with more than 10 years of Agile Scrum experience is harder to find since the Scrum methodology itself has been mainstream only for about 15 years. Remote workers, who work 3-5 days per week remotely, were more strongly represented in the survey than onsite workers. This statistic is in harmony with the current workplace trend in the US software industry. Responses were collected on a 7-point Likert scale ranging from 1 (Strongly disagree) to 7 (Strongly agree). The descriptive statistics for the four predictor variables and one dependent variable are shown in Table 4.

**Table 4. Descriptive Statistics**

| Variable | N | Mean | Standard Deviation | Variance |
|---|---|---|---|---|
| Leadership Style (P1) | 137 | 5.730 | 1.010996 | 1.022112 |
| Stakeholder Collaboration (P2) | 137 | 4.650 | 1.483196 | 2.199871 |
| Organization Structure (P3) | 137 | 5.234 | 1.116473 | 1.246511 |
| Human Resource Practices (P4) | 137 | 5.102 | 1.431190 | 2.048304 |
| Team Autonomy (D) | 137 | 5.489 | 1.207311 | 1.457600 |

## 4.3 DATA ANALYSIS

The survey results for three scenarios are analyzed below.

### All Responses

Figure 5 shows a scatter plot of the variables in this study. Team Autonomy shows significant correlation with Leadership Style and Organization Structure. This is validated by the

Pearson's correlation coefficients ($r$) summarized in Table 5. In Social Sciences and Psychology research, $r \geq 0.30$ is considered significant (Russo et al., 2021).

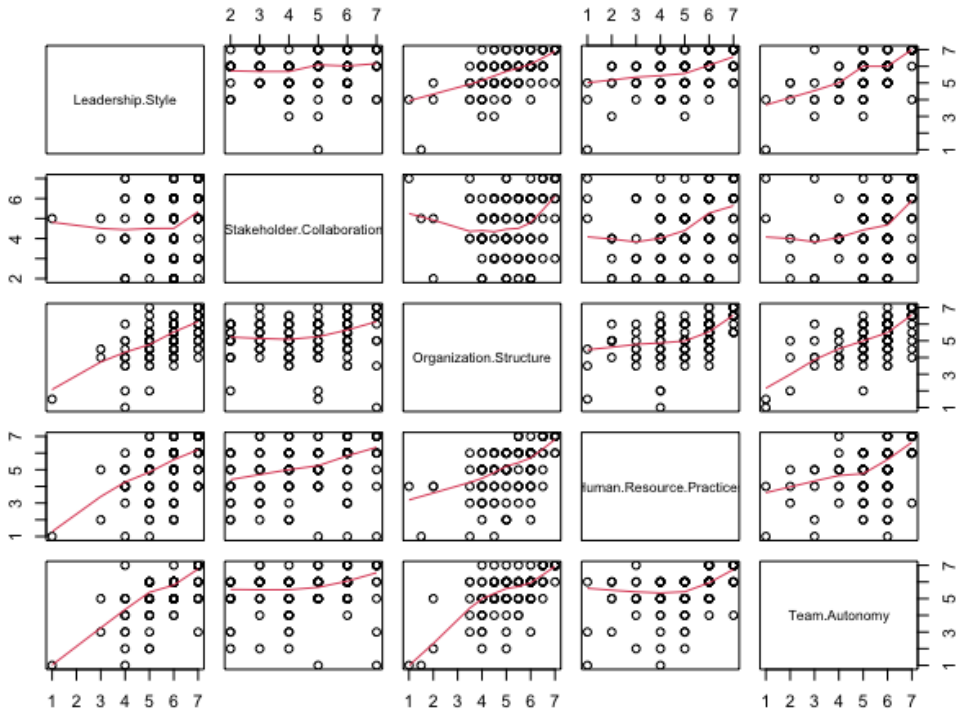


**Figure 5. Scatter Plot (All responses)**

**Table 5. Pearson Correlation Coefficients.**

| **Predictor Variable** | **Team Autonomy (D)** | **Cronbach's Alpha** |
|---|---|---|
| Leadership Style (P1) | **0.39235398**** | 0.86 |
| Stakeholder Collaboration (P2) | 0.16260179 | 0.80 |
| Organization Structure (P3) | **0.34844601**** | 0.80 |
| Human Resource Practices (P4) | 0.09290828 | 0.91 |
| N | 137 | |

The p-value of the correlation between Team Autonomy with Leadership Style is 2.749650e-06 which is lower than $\alpha = 0.05$. The p-value of the correlation between Team Autonomy with Organization Structure is 3.694010e-05 which is lower than $\alpha = 0.05$. The low p-values suggest these relationships are representative of the population.

A linear model is constructed as follows:

$$TeamAutonomy = \beta_0 + \beta_1 * LeadershipStyle + \beta_2 * StakeholderCollaboration + \beta_3 * OrganizationStructure + \beta_4 * HumanResourcePractices$$

Based on regression analysis, the linear model becomes:

$$Team.Autonomy = 0.15626 + 0.45526 * LeadershipStyle + 0.09652 * StakeholderCollaboration + 0.36887 * OrganizationStructure + 0.06760 * HumanResourcePractices$$

Given Adjusted R-squared = 0.5177 and close to Multiple R-squared = 0.5319, the model appears adequate for use. In Social Sciences and Psychology research, $R^2 \geq 0.50$ is considered acceptable (Russo et al., 2021).

A lack of fit test of this linear model was conducted using One-way ANOVA with a quadratic model and an interactions model. In both tests, the p-value was greater than $\alpha = 0.05$ giving no reason to reject the null hypothesis. This implies there is no significant difference between the linear and quadratic model as well as between the linear and interactions model. Hence, the linear model appears to provide a reasonable fit to the data. A quadratic or interactions model is not justified.

**Responses from Remote Employees**

Figure 6 shows a scatter plot of the variables in this study. Team Autonomy still shows significant correlation with Leadership Style but not anymore with Organization Structure. This

is validated by the Pearson's correlation coefficients ($r$) summarized in Table 6. In Social Sciences and Psychology research, $r \geq 0.30$ is considered significant (Russo et al., 2021).

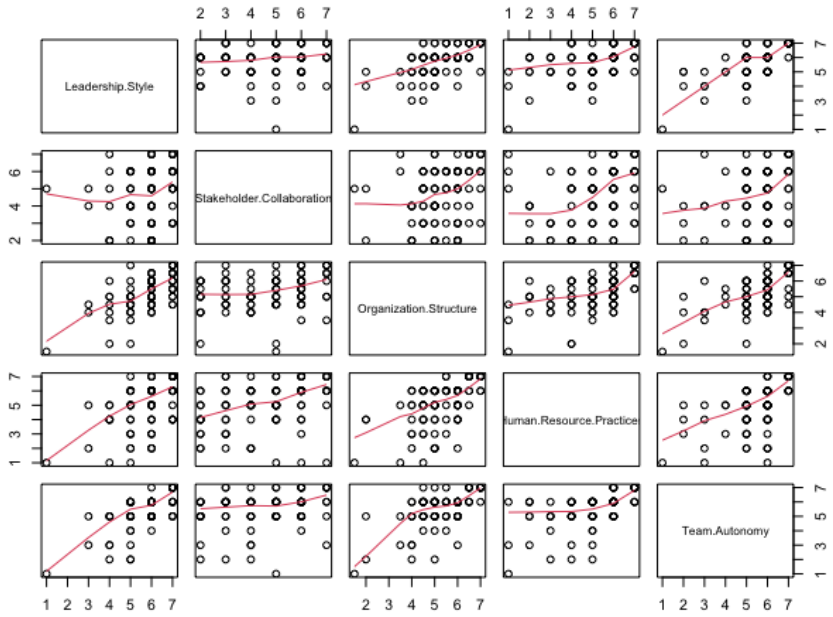


**Figure 6. Scatter Plot (Remote Employee Responses)**

**Table 6. Pearson Correlation Coefficients**

| **Predictor Variable** | **Team Autonomy (D)** | **Cronbach's Alpha** |
|---|---|---|
| Leadership Style (P1) | **0.4701560**** | 0.86 |
| Stakeholder Collaboration (P2) | 0.1245505 | 0.80 |
| Organization Structure (P3) | 0.2379136 | 0.80 |
| Human Resource Practices (P4) | 0.1963714 | 0.91 |
| N | 104 | |

The p-value of the correlation between Team Autonomy with Leadership Style is lower at 5.420111e-07 as compared to $\alpha = 0.05$. The low p-value suggests this relationship is representative of the population segment of remote workers.

**Responses from Onsite Employees**

Figure 7 shows a scatter plot of the variables in this study. A smaller number of responses were received from onsite employees as compared to remote employees. In Social Sciences and Psychology research, $n \geq 30$ is considered adequate to provide representative results (Russo et al., 2021). Team Autonomy shows a strong correlation with Organization Structure but not with Leadership Style. Additionally, Team Autonomy shows a moderate correlation with Stakeholder Collaboration. This is validated by the Pearson's correlation coefficients ($r$) summarized in Table 7. In Social Sciences and Psychology research, $r \geq 0.30$ is considered significant (Russo et al., 2021).

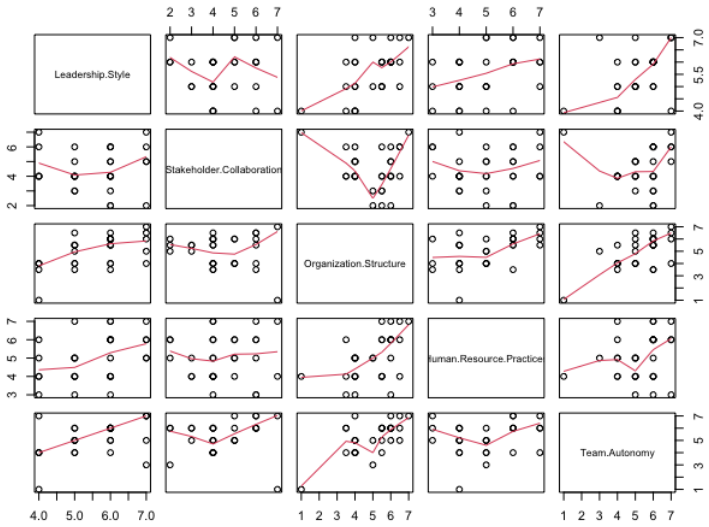


**Figure 7. Scatter Plot (Onsite Employee Responses).**

**Table 7. Pearson Correlation Coefficients.**

| **Predictor Variable** | **Team Autonomy (D)** | **Cronbach's Alpha** |
|---|---|---|
| Leadership Style (P1) | 0.1505391 | 0.86 |
| Stakeholder Collaboration (P2) | 0.3176873 | 0.80 |
| Organization Structure (P3) | **0.6080591**** | 0.80 |
| Human Resource Practices (P4) | -0.2218603 | 0.91 |
| N | 33 | |

The p-value of the correlation between Team Autonomy with Organization Structure is 0.0006 which is lower than $\alpha = 0.05$. However, the p-value of the correlation between Team Autonomy with Stakeholder Collaboration is 0.099 which is higher than $\alpha = 0.05$. This implies that only the relationship between Team Autonomy with Organization Structure is statistically significant and thus representative of the population segment of onsite workers.

## 4.4 HYPOTHESIS TESTING

*H01: No significant relationship exists between leadership style and team autonomy.*

This is measured by the LEBQ survey questionnaire, at a construct level, and the Agile Scrum Team's perception of the Leadership Style, at the construct level.

This hypothesis is rejected. There is a relationship between Leadership Style, at the construct level, and Team Autonomy, at the construct level ($r = 0.392$, p = 2.75e-06) at $\alpha = 0.05$, as shown in Table 5.

*H02: No significant relationship exists between stakeholder collaboration and team autonomy.*

This is measured by the ARDO survey questionnaire, at a construct level, and the Agile Scrum Team's perception of Stakeholder Collaboration, at the construct level.

This hypothesis is accepted. There is no significant relationship between Stakeholder Collaboration, at the construct level, and Team Autonomy, at the construct level ($r$ = 0.163, p = 6.05e-02) at α = 0.05, as shown in Table 5.

*H03: No significant relationship exists between organization structure and team autonomy.*

This is measured by the ARDO survey questionnaire, at a construct level, and the Agile Scrum Team's perception of the Organization Structure, at the construct level.

This hypothesis is rejected. There is a relationship between Organization Structure, at the construct level, and Team Autonomy, at the construct level ($r$ = 0.348, p = 3.69e-05) at α = 0.05, as shown in Table 5.

*H04: No significant relationship exists between human resource practices and team autonomy.*

This is measured by the HRM survey questionnaire, at a construct level, and the Agile Scrum Team's perception of the Human Resource Practices, at the construct level.

This hypothesis is accepted. There is no significant relationship between Human Resource Practices, at the construct level, and Team Autonomy, at the construct level ($r$ = 0.093, p = 2.86e-01) at α = 0.05, as shown in Table 5.

*H05: The relationship between leadership style and team autonomy if exists is not moderated by a remote workplace.*

This hypothesis is accepted. There is still a relationship between Leadership Style, at the construct level, and Team Autonomy, at the construct level in a remote workplace ($r$ = 0.470, p = 5.42e-07) at α = 0.05, as shown in Table 6.

*H06: The relationship between stakeholder collaboration and team autonomy if exists is not moderated by a remote workplace.*

This hypothesis is accepted. There is still no significant relationship between Stakeholder Collaboration, at the construct level, and Team Autonomy, at the construct level in a remote workplace ($r$ = 0.124, p = 2.1e-01) at α = 0.05, as shown in Table 6.

*H07: The relationship between organization structure and team autonomy if exists is not moderated by a remote workplace.*

This hypothesis is rejected. There is no significant relationship between Organization Structure, at the construct level, and Team Autonomy, at the construct level in a remote workplace ($r$ = 0.238, p = 1.55e-02) at α = 0.05, as shown in Table 6.

*H08: The relationship between human resource practices and team autonomy if exists is not moderated by a remote workplace.*

This hypothesis is accepted. There is still no significant relationship between Human Resource Practices, at the construct level, and Team Autonomy, at the construct level in a remote workplace ($r$ = 0.196, p = 4.68e-02) at α = 0.05, as shown in Table 6.

Figure 8 illustrates the human psychology factors that influence Agile team autonomy for the population of the US software industry. Figure 9 presents the human psychology factors that influence Agile team autonomy for the population segment of remote workers in the US software industry. Finally, Figure 10 presents the human psychology factors that influence Agile team autonomy for the population segment of onsite workers in the US software industry.

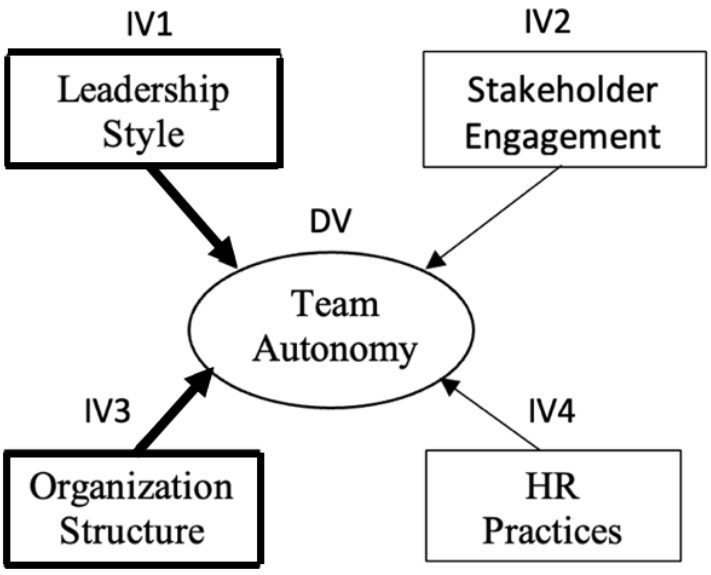


**Figure 8. Human Psychology Factors That Influence Agile Team Autonomy**

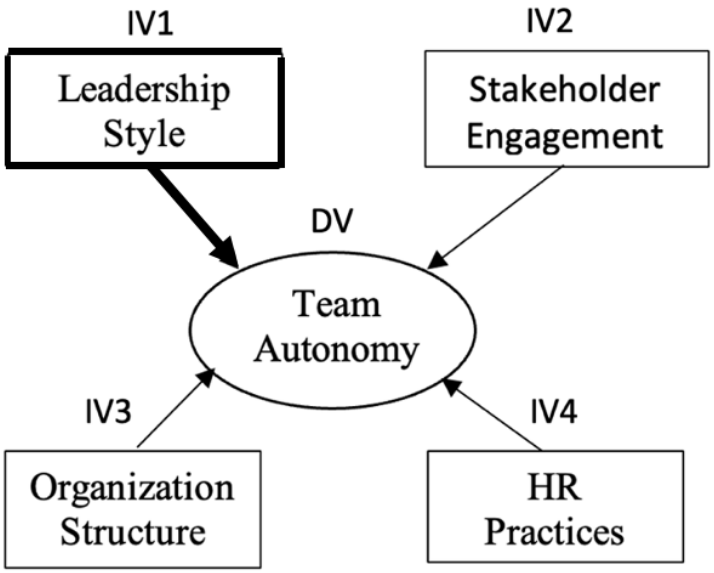


**Figure 9. Human Psychology Factors Influencing Agile Team Autonomy (Remote).**

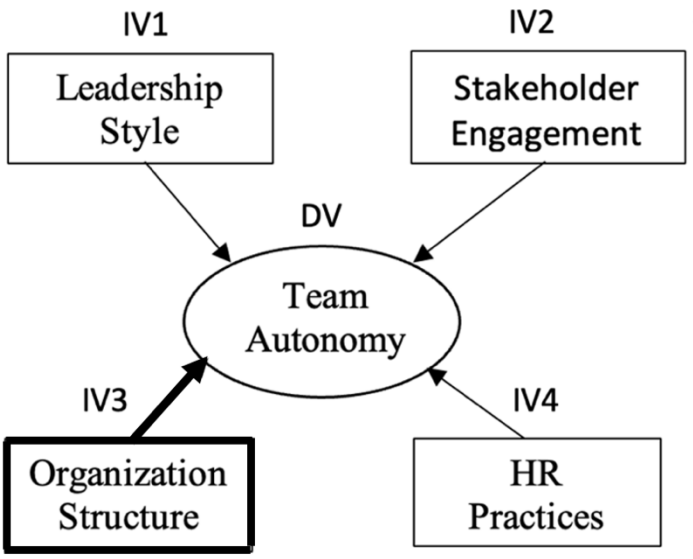


**Figure 10. Human Psychology Factors Influencing Agile Team Autonomy (Onsite).**

## Other Results

There is no statistically significant correlation between being remote and perception of team autonomy ($r = 0.148$). There is also no statistically significant correlation between being remote and perception of "relatedness to team members" (Russo et al., 2021) ($r = 0.016$).

## Construct Validity

Construct validity was established through Confirmatory Factor Analysis (CFA) in R. Factor loading values of at least 0.4 are considered adequate for this research and may be used to measure construct validity (MacCallum et al., 1999). LEBQ factor loading values, shown in Table 8, are greater than 0.4 for each question which is a confirmation of construct validity (MacCallum et al., 1999).

**Table 8. Factor Loading Values for the LEBQ.**

| Item | Question | Factor Loading |
|---|---|---|
| LS-1 | My manager gives me the authority I need to make decisions that improve work processes and procedures. | 0.627 |
| LS-2 | My manager gives me the authority to make changes necessary to improve things. | 0.688 |
| LS-3 | My manager delegates authority to me that is equal to my level of responsibility. | 0.640 |
| LS-4 | My manager holds me accountable for the work I am assigned. | 0.451 |
| LS-5 | I am held accountable for performance and results. | 0.459 |
| LS-6 | My manager holds people in the team accountable for customer satisfaction. | 0.418 |
| LS-7 | My manager lets me arrive at my own solutions when problems arise, rather than telling me what to do. | 0.661 |
| LS-8 | My manager relies on me to make my own decisions about issues that affect my work. | 0.658 |
| LS-9 | My manager encourages me to develop my own solutions to problems I encounter in my work. | 0.705 |
| LS-10 | My manager shares information that I need to ensure high quality results. | 0.720 |
| LS-11 | My manager provides me with the information I need to meet customers' needs. | 0.697 |
| LS-12 | My manager encourages me to use systematic problem-solving methods. | 0.645 |
| LS-13 | My manager provides me with frequent opportunities to develop new skills. | 0.670 |
| LS-14 | My manager considers continuous learning and skill development as priorities in our team. | 0.699 |
| LS-15 | My manager is willing to risk mistakes on my part if, over the long term, I will learn and develop from the experience. | 0.647 |
| LS-16 | I am encouraged to try out new ideas even if there is a chance they may not succeed. | 0.583 |
| LS-17 | My manager focuses on corrective action rather than placing blame when I make a mistake. | 0.750 |

CFA on the ARDO and HRM Questionnaires also gives factor loading values, shown in Tables 9 and 10 respectively, that are greater than 0.4 for each question which is a confirmation of construct validity (MacCallum et al., 1999).

**Table 9. Factor Loading Values for the ARDO Questionnaire**

| Item | Question | Factor Loading |
|---|---|---|
| SC-1 | We involve customers in all development stages. | 0.644 |
| SC-2 | We co-design products and services with our customers. | 0.591 |
| SC-3 | We often gather customers' opinions on prototypes. | 0.504 |
| SC-4 | Customers join our team temporarily to test new products and services. | 0.527 |
| TA-1 | In my team, developers are strongly encouraged to make their own decisions. | 0.761 |
| TA-2 | In my team, developers have the opportunity to choose different ways to do their tasks. | 0.723 |
| TA-3 | In my team, developers make their own decisions without detailed management influence. | 0.625 |
| TA-4 | In my team, developers determine how tasks are done as a team. | 0.668 |
| TA-5 | In my team, developers feel connected to their teammates. | 0.502 |
| OS-1 | In my organization, we have flat structures and short information paths. | 0.420 |
| OS-2 | In my organization, decisions are made on a professionally appropriate hierarchical level. | 0.625 |
| OS-3 | In my organization, we openly share information and appreciate discussions and different opinions. | 0.644 |
| OS-4 | In my organization, we can continue working even if the supervisor has not approved a decision. | 0.456 |

**Table 10. Factor Loading Values for the HRM Questionnaire**

| Item | Question | Factor Loading |
|---|---|---|
| HRP-1 | In my organization, we have a reasonable and fair employee feedback process provided by HR. | 0.722 |
| HRP-2 | In my organization, teams are actively involved in quality-improvement groups, problem-solving groups, roundtable discussions, or suggestion systems. | 0.586 |
| HRP-3 | In my organization, teams are incentivized to communicate independently with teams in other organization units to solve problems and meet deadlines. | 0.643 |
| HRP-4 | In my organization, we receive formal company communication regarding the goal setting and strategy processes. | 0.440 |
| HRP-5 | In my organization, team level goals are mandatory and carry more weightage than individual goals in the employee performance management process. | 0.404 |

# CHAPTER 5

# DISCUSSION

## 5.1 OVERVIEW OF FINDINGS

The first hypothesis seeks to determine whether there is a correlation between leadership style and team autonomy. Based on data from all 137 responses collected, it is evident that there is a correlation between the two variables. Upon segmenting this data by workplace type (remote vs. onsite), we continue to see a strong correlation between leadership style and team autonomy in the remote workplace. However, there is no correlation seen between these two variables for onsite workers. The leadership questions emphasize Agile or collaborative leadership style. It can be concluded that remote teams regard collaborative leadership to be a critical enabler for attaining team autonomy. This is however not the case for the onsite teams where some other human psychology factor may be dominant.

The third hypothesis seeks to determine whether there is a correlation between organization structure and team autonomy. Based on data from all 137 responses collected, it is evident that there is a correlation between the two variables. Upon segmenting this data by workplace type (remote vs. onsite), we do not see a correlation between organization structure and team autonomy in the remote workplace. However, there is a strong correlation seen between these two variables for onsite workers. The organization structure questions enquire about the extent of hierarchy and speed of decision making in the organization. It can be concluded that remote teams seem to feel the impact of hierarchy and power distance less than their onsite counterparts because they are “not physically present” in the company office. A corner office of a leader can be more intimidating when a worker is sitting in a cube in the same

physical workplace. The level of intimidation and nervousness also goes down in online vs. onsite meetings.

The second and fourth hypotheses were not rejected since there was no significant influence of stakeholder collaboration or human resource practices on team autonomy. The stakeholder adoption of Agile Scrum methodology is still low in organizations and is a greenfield area for growth of Agile Scrum. Most Human Resource departments are still learning how to incentivize team practices and deemphasize individual performance. This remains an uncharted territory for Agile Scrum practitioners.

Additionally, and mainly out of curiosity, a correlation test was done between being remote and perception of team autonomy as well as between being remote and perception of relatedness to team members. Neither of the relationships were found to be statistically significant. This implies that remote working has not impacted the level of team autonomy or connectedness for Agile Scrum teams. This can possibly be explained by the ready availability of company reimbursed and cost-effective home internet plans as well as collaborative software tools that came up with new features to improve intra-team communications during the COVID-19 pandemic. The leadership in these software firms also deserve a shout out for their efforts in keeping the company brand identity alive with online and snail mailed swags for employees to show off in their remote offices. People managers are having more 1:1s with their direct reports online and organizing more in-person team events for team building and cohesion.

## 5.2 RESEARCH IMPLICATIONS

The study shows how the human psychology factors behind collaborative leadership and organization structure can influence Agile Scrum team autonomy. It is also seen that these

influences can change depending upon the workplace type. It is also evident from the $R^2$ values that there are more human psychology factors in play in an organization that may have an influence on Agile Scrum team autonomy.

According to the self-determination theory, team autonomy is an important element of Agile Scrum project success (Ryan and Deci, 2000). The study behooves leaders in the organization to make a sincere effort to empower Agile scrum teams for making their daily decisions with minimum guidance. Such leadership behavior will foster innovation, problem-solving agility and resilience in Agile Scrum teams and ultimately lead to a resilient organization that can weather any market storm. Additionally, if teams are finding creative ways to solve problems, new opportunities and increased organizational efficiencies may arise. This may remove the need to have deep hierarchies to achieve worker efficiency. Leadership can devote more time to surveying the future and understanding the business environment.

The software engineering domain has become highly complex and the ability to create pathbreaking products needs complex, unbridled human thought. As the work of software engineers becomes more complex, more decisions must be made at the team level than at the leadership level. It is crucial to empower Agile Scrum teams to make independent judgment calls so that software firms can ethically deploy new technologies and effectively manage existing technologies. Taking action and offering Agile Scrum teams the opportunity to grow will evolve their role, strengthen their loyalty towards the organization and promote employee retention.

## 5.3 RESEARCH LIMITATIONS

It is hard to establish strong correlations in research studies in the fields of social sciences and organization psychology. This research likewise did not establish cause and effect. The

correlations cited demonstrated a relationship. Further research may develop a more robust understanding of the relationships between the four human psychology factors and Agile Scrum team autonomy.

This research was limited to software engineers with Agile experience in the United States. It is likely that a specific set of biases based on the knowledge, training and experience of a US based software engineer may be present. While this research provides insight into the influence of four human psychology factors on the autonomy of Agile Scrum teams, it is by no means an exhaustive coverage of all factors. There is evidence that there are more human psychology factors in play in an organization that are waiting to be revealed.

The study also suffered from a lower number of responses from software engineers working onsite. There may be an opportunity here to revisit the effect of organization structure on team autonomy with a sample size of 100 or more onsite software engineers. The study was based on a pragmatic definition of "remote" where remote denotes working away from company office for 3-5 days in every work week. This definition takes into consideration the current policy of most software companies to only require 3 days of onsite presence in every work week, in the name of "onsite".

The study did not ask for personal information from respondents like age, gender, extroversion, level of education and overall years of work experience. There may be hidden variables here waiting to be revealed. The study was cross-sectional but not longitudinal to keep it dissertation size and time boxed. There is a risk of the data and findings becoming less relevant after a period especially with re-organizations and layoffs. Organization history may be a hidden variable but was not in scope for this research study.

# CHAPTER 6

# CONCLUSIONS

## 6.1 PRIMARY CONTRIBUTIONS OF THIS STUDY

Majority of Agile project management research has focused on the Agile Scrum Process and Tools but very little focus on human psychology factors. *We have Methodology without Psychology.* There is no agreement among the studies on which factor(s) contributes the highest to Agile project success. There are different terms used to present the same theoretical construct as Agile Leadership, Shared Leadership, Distributed Leadership or Innovation Leadership but with same insights. There is no single study that examines the combined influence of multiple human psychological factors on Agile team autonomy. Additionally, most studies on autonomy in organizations have focused on individual autonomy alone (Verwijs and Russo, 2023). The human psychological factors influencing team autonomy have been largely neglected. This is the first study that considers team autonomy as a dependent variable.

Adoption of Agile process and tools alone is not enough to change the Agile mindset. The mindset change can only be brought in by holistically understanding and addressing the human psychological factors behind Agile project success. Even though an increasing number of organizations strive to implement agile teams, it is not entirely clear how teams can adopt the agile way of working (Moe et al., 2010; Nerur et al., 2005). Especially rather bureaucratic companies seem to struggle in their agile transformation (Moe et al., 2009; Nerur et al., 2005). Fitting leadership behavior is found to be one key success factor for evolving into an agile self-organized team (Gren et al., 2019). However, which kind of leadership agile teams need is not yet clear.

There are fundamental contradictions between large bureaucratic organizations with well-established traditional software development methods and agile principles and practices. The resolution of these contradictions is currently ongoing but is still incomplete. No decisive playbook has emerged. Little research is done on what an ideal Agile organization structure should look like. The changes required to human resource practices need to be investigated together with Leadership and Stakeholders mindset changes.

There is a lot of coverage on self-managing, autonomous teams and claims are made that it leads to psychological safety and ultimately team resilience to changing market requirements and Agile project success. However, a strong relationship is yet to be established. Finally, there is little research coverage so far on how the impact of the above human psychology factors may have changed after the Covid-19 pandemic and how they will affect Agile project success in the predominantly hybrid/remote workplace of the future.

This research study comes at an opportune time and confirms that supportive and collaborative leadership can indeed neutralize the adverse effect of uncooperative stakeholders, hierarchical organization structure and outdated human resource practices on Agile Scrum team autonomy, regardless of the work setting. Software organizations can start to experimentally ascertain that adopting these recommendations will increase team autonomy and eventually Agile project success.

The COVID-19 pandemic added a new twist to the four human psychological factors discussed in this study by forcing software engineers to embrace remote working as a mainstream practice. Initially, the abrupt lockdown and quarantine measures during the pandemic disrupted the working lives of software engineers. Software engineers, in line with most knowledge workers, started to work from home with unprecedented challenges. But after

three years of working remotely since the onset of the pandemic, software engineers have regrouped with new tools for remote communication and collaboration. This has heralded a new future of work where employees can work away from the company office for majority of the work week on a regular basis.

This study has provided useful insights into human psychology factors that are under the organization iceberg but still impede team effectiveness. This will help organizations to design the right incentive programs to mitigate risks to organization agility in software firms. This research addresses hitherto neglected topics in Agile teams' research. The findings will add value to the Engineering Management domains of Project Management, Leadership & Organizational Management and Management of Technology, Research, and Development.

## 6.2 WIDENING THE SCOPE

This research elicited responses related to an Agile Scrum team member's perception about leadership style, stakeholder collaboration, organization structure and human resource practices as enablers for team autonomy. The influence of human psychology factors on team autonomy in a remote workplace like never ending working times and distractions at home should be studied. There could be other perspectives to consider here like that of the people manager, project manager, scrum master, product owner and customer that may prove to be insightful. Another, more complex approach, would involve the development of a longitudinal study to determine the long-term influence of the four human psychology factors on Agile Scrum team autonomy and project success.

## 6.3 SUGGESTIONS FOR FUTURE RESEARCH

This study was focused on the influence of four specific human psychology factors on Agile Scrum team autonomy. Future studies can explore the existence and impact of additional human psychology factors on Agile Scrum team autonomy in the US software industry. This study used a particular definition of remote work but there may be other ways to define remote work. The definition of what constitutes remote work will evolve over time. Future investigation on potential parameters defining remote work would be highly beneficial to both research and practice.

This study did not collect personal information from respondents like age, gender, extroversion, level of education and overall years of work experience. There may be hidden variables here waiting to be revealed in a future study that asks for this information with informed consent.

This research study can be extended to other countries with large number of software engineers like Romania, Brazil, India, and Singapore. This will enable the exploration of a country's culture as a human psychological factor affecting team autonomy. The cultural dimensions of power distance and individualism can vary with country and may have an influence on the emergence of team autonomy. The study findings can also be used to explore team autonomy in other industries where remote work has become a dominant paradigm.

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# APPENDICES

## A: SURVEY INSTRUMENTS

### Leader Empowering Behavior Questionnaire (LEBQ)

| Dimension and Item | Standardized Factor Coefficient | *t* Value |
|---|---|---|
| Delegation of Authority | | |
| 1. My manager gives me the authority I need to make decisions that improve work processes and procedures. | .86 | 16.80 |
| 2. My manager gives me the authority to make changes necessary to improve things. | .86 | 16.64 |
| 3. My manager delegates authority to me that is equal to the level of responsibility that I am assigned. | .83 | 15.72 |
| Accountability | | |
| 4. My manager holds me accountable for the work I am assigned. | .87 | 16.72 |
| 5. I am held accountable for performance and results. | .91 | 17.82 |
| 6. My manager holds people in the department accountable for customer satisfaction. | .67 | 11.53 |
| Self-Directed Decision Making | | |
| 7. My manager tries to help me arrive at my own solutions when problems arise, rather than telling me what he/she would do. | .81 | 15.14 |
| 8. My manager relies on me to make my own decisions about issues that affect how work gets done. | .79 | 14.58 |
| 9. My manager encourages me to develop my own solutions to problems I encounter in my work. | .87 | 16.89 |
| Information Sharing | | |
| 10. My manager shares information that I need to ensure high quality results. | .88 | 17.11 |
| 11. My manager provides me with the information I need to meet customers' needs. | .96 | 19.26 |
| Skill Development | | |
| 12. My manager encourages me to use systematic problem-solving methods (e.g., the seven-step problem-solving model). | .55 | 9.04 |
| 13. My manager provides me with frequent opportunities to develop new skills. | .88 | 16.79 |
| 14. My manager ensures that continuous learning and skill development are priorities in our department. | .86 | 16.19 |
| Coaching for Innovative Performance | | |
| 15. My manager is willing to risk mistakes on my part if, over the long term, I will learn and develop as a result of the experience. | .80 | 14.82 |
| 16. I am encouraged to try out new ideas even if there is a chance they may not succeed. | .87 | 16.50 |
| 17. My manager focuses on corrective action rather than placing blame when I make a mistake. | .79 | 14.34 |

**Agile R&D Units Organization (ARDO) Questionnaire**

| **Dimensions**/Items |
| --- |
| **Customer Integration** ($\alpha$ = .90; $\omega$ = .91) |
| During the development of new products and services in my unit … |
| … we involve customers in all development stages. |
| … we co-design products and services with our customers. |
| … we often gather customers' opinions on prototypes. |
| *… customers join our product development team temporarily, e.g., to test new products and services.* |
| **Flat Hierarchies** ($\alpha$ = .75; $\omega$ = .75) |
| My unit is characterized by flat structures and short information paths. |
| In my unit, decisions are made on a professionally appropriate hierarchical level. |
| In my unit, the communication is open, i.e., we share information and appreciate discussions and different opinions. |
| *In my unit, there are limited opportunities to continue working until the supervisor has approved a decision.* |
| **Autonomy** ($\alpha$ = .77; $\omega$ = .79) |
| In my unit, employees … |
| … are strongly encouraged to make their own decisions. |
| … have the opportunity to select different ways to do their tasks. |
| ... make their own decisions without detailed management influence. |
| *... determine how tasks are done as a team.* |

**Opportunity-Enhancing HR Practices Questionnaire**

| Item No. | How often in your organization the following HRM practices are used? | Calibration logic |
|---|---|---|
| 1. | Employees in this job have a reasonable and fair complaint process. | Likert scale |
| 2. | Employees in this job are involved in formal participation processes such as quality-improvement groups, problem-solving groups, roundtable discussions, or suggestion systems. | Likert scale |
| 3. | Employees in this job communicate with people in other departments to solve problems and meet deadlines. | Likert scale |
| 4. | Employees in this job receive formal company communication regarding the goal setting and strategy processes. | Likert scale |

**Demographic Questions**

How many years of experience do you have as a Software developer in an Agile Scrum Team?

- ○ 1 - 3 years
- ○ 3 - 5 years
- ○ 5 - 10 years
- ○ More than 10 years

How many days in a 5-day work week do you work remotely?

- ○ 0 days
- ○ 1 - 2 days
- ○ 3 - 4 days
- ○ All 5 days

## B: ELECTRONIC MESSAGE TO SURVEY PARTICIPANTS

Subject: Research Assistance
Greetings;
My name is Ravi Kalluri and 1 aw a PhD student in Engineering Management at the Old Dominion University in Norfolk, Virginia. I am conducting research to understand the adverse impact of human psychology factors on Agile team autonomy.
You have been selected to participate in this survey because of your association with the American Society of Engineering Managers (ASEM) and past experience as an Agile practitioner. Your candid feedback to the survey will be a vital component of the research project and all responses will be confidential. No personal identification data will be collected during the survey process. The survey should take about 15 minutes to complete.
Please check your spam filter to make sure you receive the survey when it arrives. Thank you for taking the time to support this research project.
Yours truly,
Ravi Kalluri

PhD Student
Engineering Management and Systems Engineering
Old Dominion University
Norfolk, Virginia 23529
rkall003@odu.edu

## C: INSTITUTIONAL REVIEW BOARD APPROVAL

OLD DOMINION UNIVERSITY

OFFICE OF THE VICE PRESIDENT FOR RESEARCH

**Physical Address**
4111 Monarch Way, Suite 203
Norfolk, Virginia 23508
**Mailing Address**
Office of Research
1 Old Dominion University
Norfolk, Virginia 23529
Phone(757) 683-3460
Fax(757) 683-5902

| | |
|---|---|
| DATE: | February 14, 2023 |
| TO: | Charles Daniels, Ph.D. |
| FROM: | Old Dominion University Engineering Human Subjects Review Committee |
| PROJECT TITLE: | [1984468-1] HUMAN PSYCHOLOGY FACTORS INFLUENCING AGILE TEAM AUTONOMY IN POST-PANDEMIC REMOTE/HYBRID SOFTWARE ORGANIZATIONS |
| REFERENCE #: | |
| SUBMISSION TYPE: | New Project |
| ACTION: | DETERMINATION OF EXEMPT STATUS |
| DECISION DATE: | |
| REVIEW CATEGORY: | Exemption category # 2 |

Thank you for your submission of New Project materials for this project. The Old Dominion University Engineering Human Subjects Review Committee has determined this project is EXEMPT FROM IRB REVIEW according to federal regulations.

We will retain a copy of this correspondence within our records.

If you have any questions, please contact Kim Bullington at (757) 684-4938 or kbulling@odu.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within Old Dominion University Engineering Human Subjects Review Committee's records.





## D: SURVEY INSTRUMENT (QUALTRICS)

## Leadership Style: Delegation of Authority

| | Strongly disagree | Disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Agree | Strongly agree |
|---|---|---|---|---|---|---|---|
| My manager gives me the authority I need to make decisions that improve work processes and procedures. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| My manager gives me the authority to make changes necessary to improve things. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| My manager delegates authority to me that is equal to my level of responsibility. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

## Leadership Style: Accountability

| | Strongly disagree | Disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Agree | Strongly agree |
|---|---|---|---|---|---|---|---|
| My manager holds me accountable for the work I am assigned. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I am held accountable for performance and results. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| My manager holds people in the team accountable for customer satisfaction. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

## Leadership Style: Self-Directed Decision Making

| | Strongly disagree | Disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Agree | Strongly agree |
|---|---|---|---|---|---|---|---|
| My manager lets me arrive at my own solutions when problems arise, rather than telling me what to do. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| My manager relies on me to make my own decisions about issues that affect my work. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| My manager encourages me to develop my own solutions to problems I encounter in my work. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

## Leadership Style: Information Sharing

| | Strongly disagree | Disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Agree | Strongly agree |
|---|---|---|---|---|---|---|---|
| My manager shares information that I need to ensure high quality results. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| My manager provides me with the information I need to meet customers' needs. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

## Leadership Style: Skill Development

| | Strongly disagree | Disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Agree | Strongly agree |
|---|---|---|---|---|---|---|---|
| My manager encourages me to use systematic problem-solving methods. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| My manager provides me with frequent opportunities to develop new skills. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| My manager considers continuous learning and skill development as priorities in our team. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

## Leadership Style: Coaching for Innovative Performance

| | Strongly disagree | Disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Agree | Strongly agree |
|---|---|---|---|---|---|---|---|
| My manager is willing to risk mistakes on my part if, over the long term, I will learn and develop from the experience. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I am encouraged to try out new ideas even if there is a chance they may not succeed. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| My manager focuses on corrective action rather than placing blame when I make a mistake. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

## Stakeholder Collaboration:

During the development of new products and services using Agile Scrum in my team ...

| | Strongly disagree | Disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Agree | Strongly agree |
|---|---|---|---|---|---|---|---|
| We involve customers in all development stages. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| We co-design products and services with our customers. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| We often gather customers' opinions on prototypes. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Customers join our team temporarily to test new products and services. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

## Team Autonomy:

In my team, developers ...

| | Strongly disagree | Disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Agree | Strongly agree |
|---|---|---|---|---|---|---|---|
| Are strongly encouraged to make their own decisions. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Have the opportunity to choose different ways to do their tasks. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Make their own decisions without detailed management influence. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Determine how tasks are done as a team. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Feel connected to their team mates. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

## Organization Structure:

In my organization ...

| | Strongly disagree | Disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Agree | Strongly agree |
|---|---|---|---|---|---|---|---|
| We have flat structures and short information paths. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Decisions are made on a professionally appropriate hierarchical level. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| We openly share information and appreciate discussions and different opinions. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| We can continue working even if the supervisor has not approved a decision. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

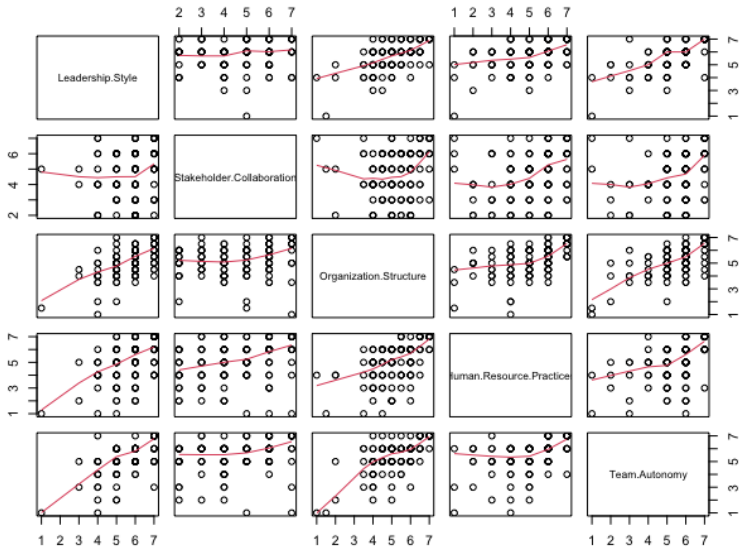
## Human Resource Practices:

In my organization ...

| | Strongly disagree | Disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Agree | Strongly agree |
|---|---|---|---|---|---|---|---|
| We have a reasonable and fair employee feedback process provided by HR. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Teams are actively involved in quality-improvement groups, problem-solving groups, roundtable discussions, or suggestion systems. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Teams are incentivized to communicate independently with teams in other organization units to solve problems and meet deadlines. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| We receive formal company communication regarding the goal setting and strategy processes. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Team level goals are mandatory and carry more weightage than individual goals in the employee performance management process. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

**E: RESULTS IN R**

**Overall Data:**



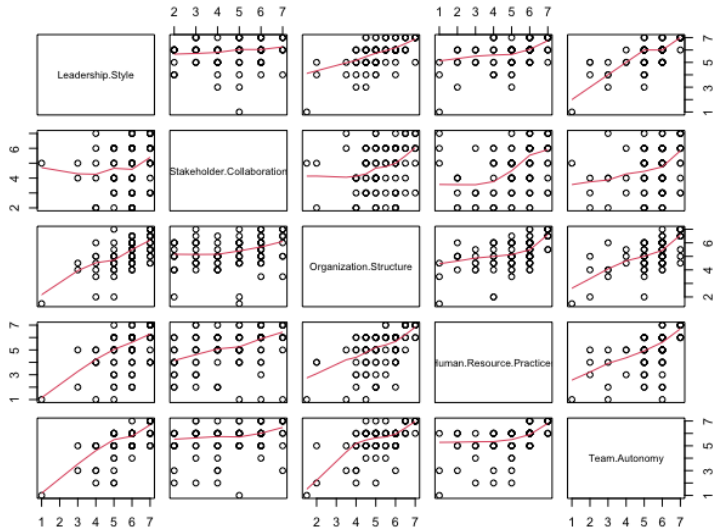

```
> summary(cards)
 Leadership.Style Stakeholder.Collaboration Organization.Structure Human.Resource.Practices
 Min.   :1.00     Min.   :2.00              Min.   :1.000           Min.   :1.000
 1st Qu.:5.00     1st Qu.:4.00              1st Qu.:4.500           1st Qu.:4.000
 Median :6.00     Median :5.00              Median :5.500           Median :5.000
 Mean   :5.73     Mean   :4.65              Mean   :5.234           Mean   :5.102
 3rd Qu.:6.00     3rd Qu.:6.00              3rd Qu.:6.000           3rd Qu.:6.000
 Max.   :7.00     Max.   :7.00              Max.   :7.000           Max.   :7.000

 Team.Autonomy
 Min.   :1.000
 1st Qu.:5.000
 Median :6.000
 Mean   :5.489
 3rd Qu.:6.000
 Max.   :7.000

> plot.ts(cards2)
Error in NCOL(x) : object 'cards2' not found
> cards <- read.table(file.choose(), header = T)
Error in scan(file = file, what = what, sep = sep, quote = quote, dec = dec,  :
  line 1 did not have 7 elements
```

```
> cards <- read.csv(file.choose(), header = T)
> attach(cards)
> head(cards)
  Leadership.Style Stakeholder.Collaboration Organization.Structure Human.Resource.Practices
1                5                        6                    4.5                        6
2                6                        2                    6.0                        2
3                6                        2                    6.0                        4
4                7                        6                    7.0                        7
5                6                        6                    6.0                        6
6                6                        6                    6.0                        6
  Team.Autonomy
1             6
2             5
3             5
4             7
5             6
6             6
> mean(mpg)
Error in mean(mpg) : object 'mpg' not found
> par(mfrow=c(1,1))
> plot(cards)
> pairs(cards,panel=panel.smooth)

> head(cards)
  Leadership.Style Stakeholder.Collaboration Organization.Structure Human.Resource.Practices
1                5                        6                    4.5                        6
2                6                        2                    6.0                        2
3                6                        2                    6.0                        4
4                7                        6                    7.0                        7
5                6                        6                    6.0                        6
6                6                        6                    6.0                        6
  Team.Autonomy
1             6
2             5
3             5
4             7
5             6
6             6

> summary(cards)
 Leadership.Style Stakeholder.Collaboration Organization.Structure Human.Resource.Practices
 Min.   :1.00     Min.   :2.00              Min.   :1.000           Min.   :1.000
 1st Qu.:5.00     1st Qu.:4.00              1st Qu.:4.500           1st Qu.:4.000
 Median :6.00     Median :5.00              Median :5.500           Median :5.000
 Mean   :5.73     Mean   :4.65              Mean   :5.234           Mean   :5.102
 3rd Qu.:6.00     3rd Qu.:6.00              3rd Qu.:6.000           3rd Qu.:6.000
```

```
 Max.   :7.00     Max.   :7.00           Max.   :7.000         Max.   :7.000
Team.Autonomy
 Min.   :1.000
 1st Qu.:5.000
 Median :6.000
 Mean   :5.489
 3rd Qu.:6.000
 Max.   :7.000

> pcor(cards,method="pearson")
$estimate

                        Leadership.Style Stakeholder.Collaboration Organization.Structure
Leadership.Style              1.00000000             -0.09153138             0.2782957
Stakeholder.Collaboration     -0.09153138              1.00000000            -0.0330281
Organization.Structure         0.27829572             -0.03302810             1.0000000
Human.Resource.Practices       0.18707966              0.23948377             0.2580930
Team.Autonomy                  0.39235398              0.16260179             0.3484460
                        Human.Resource.Practices Team.Autonomy
Leadership.Style                     0.18707966    0.39235398
Stakeholder.Collaboration            0.23948377    0.16260179
Organization.Structure               0.25809299    0.34844601
Human.Resource.Practices             1.00000000    0.09290828
Team.Autonomy                        0.09290828    1.00000000

$p.value
                        Leadership.Style Stakeholder.Collaboration Organization.Structure
Leadership.Style           0.000000e+00             0.292874987         0.0011303647
Stakeholder.Collaboration  2.928750e-01             0.000000000         0.7047996673
Organization.Structure     1.130365e-03             0.704799667         0.0000000000
Human.Resource.Practices   3.042889e-02             0.005321034         0.0026053096
Team.Autonomy              2.749650e-06             0.060500268         0.0000369401
                        Human.Resource.Practices Team.Autonomy
Leadership.Style                   0.030428892  2.749650e-06
Stakeholder.Collaboration          0.005321034  6.050027e-02
Organization.Structure             0.002605310  3.694010e-05
Human.Resource.Practices           0.000000000  2.856439e-01
Team.Autonomy                      0.285643886  0.000000e+00

$statistic
                        Leadership.Style Stakeholder.Collaboration Organization.Structure
Leadership.Style              0.000000             -1.0560486             3.3288804
Stakeholder.Collaboration     -1.056049             0.0000000            -0.3796712
Organization.Structure         3.328880            -0.3796712             0.0000000
Human.Resource.Practices       2.188012             2.8339253             3.0692487
Team.Autonomy                  4.900776             1.8933495             4.2710088
```

```
                        Human.Resource.Practices Team.Autonomy
Leadership.Style                        2.188012      4.900776
Stakeholder.Collaboration               2.833925      1.893349
Organization.Structure                  3.069249      4.271009
Human.Resource.Practices                0.000000      1.072072
Team.Autonomy                           1.072072      0.000000

$n
[1] 137
$gp
[1] 3
$method
[1] "pearson"


> lmSolfull <- lm(Team.Autonomy ~ Leadership.Style + Stakeholder.Collaboration +
Organization.Structure + Human.Resource.Practices)
> summary(lmSolfull)

Call:
lm(formula = Team.Autonomy ~ Leadership.Style + Stakeholder.Collaboration +
    Organization.Structure + Human.Resource.Practices)

Residuals:
     Min       1Q   Median       3Q      Max
-3.00098 -0.30928  0.07838  0.44725  2.76532

Coefficients:
                        Estimate Std. Error t value Pr(>|t|)
(Intercept)              0.15626    0.45763   0.341   0.7333
Leadership.Style         0.45526    0.09290   4.901 2.75e-06 ***
Stakeholder.Collaboration  0.09652    0.05098   1.893   0.0605 .
Organization.Structure     0.36887    0.08637   4.271 3.69e-05 ***
Human.Resource.Practices   0.06760    0.06306   1.072   0.2856
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.8384 on 132 degrees of freedom
  (1 observation deleted due to missingness)
Multiple R-squared:  0.5319,  Adjusted R-squared:  0.5177
F-statistic:  37.5 on 4 and 132 DF,  p-value: < 2.2e-16
```

**Remote Data:**

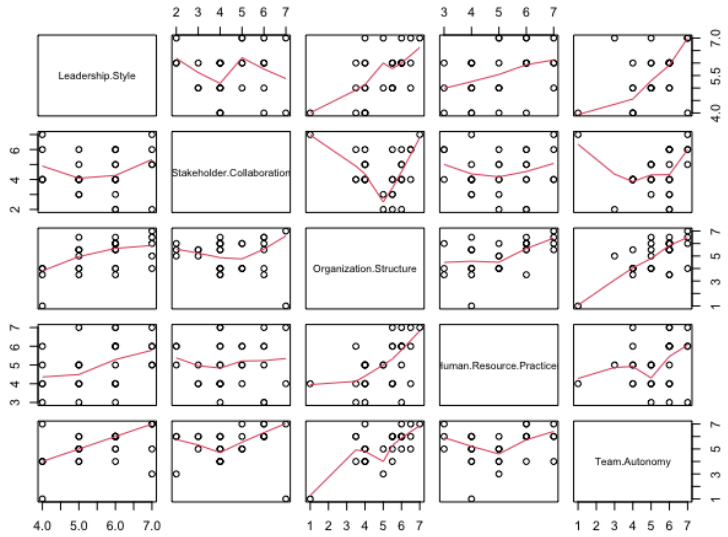



```
> summary(remote)
 Leadership.Style Stakeholder.Collaboration Organization.Structure Human.Resource.Practices
 Min.   :1.000    Min.   :2.000             Min.   :1.500           Min.   :1.000
 1st Qu.:5.000    1st Qu.:4.000             1st Qu.:4.500           1st Qu.:4.000
 Median :6.000    Median :5.000             Median :5.500           Median :6.000
 Mean   :5.774    Mean   :4.708             Mean   :5.302           Mean   :5.123
 3rd Qu.:6.000    3rd Qu.:6.000             3rd Qu.:6.000           3rd Qu.:6.000
 Max.   :7.000    Max.   :7.000             Max.   :7.000           Max.   :7.000
 Team.Autonomy
 Min.   :1.000
 1st Qu.:5.000
 Median :6.000
 Mean   :5.557
 3rd Qu.:6.000
 Max.   :7.000

> pcor(remote,method="pearson")
$estimate
                          Leadership.Style Stakeholder.Collaboration Organization.Structure
Leadership.Style                1.0000000             -0.13178050           0.31050529
Stakeholder.Collaboration      -0.1317805              1.00000000           0.07587048
Organization.Structure          0.3105053              0.07587048           1.00000000
Human.Resource.Practices        0.1404974              0.25519140           0.22596314
Team.Autonomy                   0.4701560              0.12455051           0.23791358
```

```
                          Human.Resource.Practices Team.Autonomy
Leadership.Style                         0.1404974     0.4701560
Stakeholder.Collaboration                0.2551914     0.1245505
Organization.Structure                   0.2259631     0.2379136
Human.Resource.Practices                 1.0000000     0.1963714
Team.Autonomy                            0.1963714     1.0000000

$p.value
                          Leadership.Style Stakeholder.Collaboration Organization.Structure
Leadership.Style             0.000000e+00               0.184542230           0.001412355
Stakeholder.Collaboration    1.845422e-01               0.000000000           0.446237382
Organization.Structure       1.412355e-03               0.446237382           0.000000000
Human.Resource.Practices     1.569153e-01               0.009281011           0.021729873
Team.Autonomy                5.420111e-07               0.210020040           0.015522773
                          Human.Resource.Practices Team.Autonomy
Leadership.Style                     0.156915350  5.420111e-07
Stakeholder.Collaboration            0.009281011  2.100200e-01
Organization.Structure               0.021729873  1.552277e-02
Human.Resource.Practices             0.000000000  4.680821e-02
Team.Autonomy                        0.046808212  0.000000e+00

$statistic
                          Leadership.Style Stakeholder.Collaboration Organization.Structure
Leadership.Style                 0.000000               -1.336029             3.282803
Stakeholder.Collaboration       -1.336029                0.000000             0.764693
Organization.Structure           3.282803                0.764693             0.000000
Human.Resource.Practices         1.426127                2.652463             2.331196
Team.Autonomy                    5.353613                1.261540             2.461686
                          Human.Resource.Practices Team.Autonomy
Leadership.Style                          1.426127      5.353613
Stakeholder.Collaboration                 2.652463      1.261540
Organization.Structure                    2.331196      2.461686
Human.Resource.Practices                  0.000000      2.012697
Team.Autonomy                             2.012697      0.000000

$n
[1] 106

$gp
[1] 3

$method
[1] "pearson"

> lmSolfullr <- lm(Team.Autonomy ~ Leadership.Style + Stakeholder.Collaboration +
Organization.Structure + Human.Resource.Practices)
```

```
> summary(lmSolfullr)

Call:
lm(formula = Team.Autonomy ~ Leadership.Style + Stakeholder.Collaboration +
    Organization.Structure + Human.Resource.Practices)

Residuals:
    Min      1Q  Median      3Q     Max
-3.0104 -0.2728  0.1042  0.4505  1.5013

Coefficients:
                          Estimate Std. Error t value Pr(>|t|)
(Intercept)               0.22646    0.47944   0.472   0.6377
Leadership.Style          0.52829    0.09868   5.354 5.42e-07 ***
Stakeholder.Collaboration 0.06807    0.05396   1.262   0.2100
Organization.Structure    0.24238    0.09846   2.462   0.0155 *
Human.Resource.Practices  0.13167    0.06542   2.013   0.0468 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.7762 on 101 degrees of freedom
Multiple R-squared:  0.5779,  Adjusted R-squared:  0.5612
F-statistic: 34.57 on 4 and 101 DF,  p-value: < 2.2e-16
```

**Onsite Data:**




```
> summary(onsite)
```

```
 Leadership.Style Stakeholder.Collaboration Organization.Structure Human.Resource.Practices
 Min.   :4.000    Min.   :2.000             Min.   :1.0             Min.   :3.000
 1st Qu.:5.000    1st Qu.:4.000             1st Qu.:4.0             1st Qu.:4.000
 Median :6.000    Median :4.000             Median :5.5             Median :5.000
 Mean   :5.581    Mean   :4.452             Mean   :5.0             Mean   :5.032
 3rd Qu.:6.000    3rd Qu.:5.500             3rd Qu.:6.0             3rd Qu.:6.000
 Max.   :7.000    Max.   :7.000             Max.   :7.0             Max.   :7.000
 Team.Autonomy
 Min.   :1.000
 1st Qu.:4.500
 Median :6.000
 Mean   :5.258
 3rd Qu.:6.000
 Max.   :7.000

> pcor(onsite,method="pearson")
$estimate
                        Leadership.Style Stakeholder.Collaboration Organization.Structure
Leadership.Style              1.00000000              0.02078953             0.2801456
Stakeholder.Collaboration     0.02078953              1.00000000            -0.3319970
Organization.Structure        0.28014564             -0.33199701             1.0000000
Human.Resource.Practices      0.16092837              0.16419067             0.4272837
Team.Autonomy                 0.15053910              0.31768727             0.6080591
                        Human.Resource.Practices Team.Autonomy
Leadership.Style                       0.1609284     0.1505391
Stakeholder.Collaboration              0.1641907     0.3176873
Organization.Structure                 0.4272837     0.6080591
Human.Resource.Practices               1.0000000    -0.2218603
Team.Autonomy                         -0.2218603     1.0000000

$p.value
                        Leadership.Style Stakeholder.Collaboration Organization.Structure
Leadership.Style              0.0000000              0.91637308          0.1487661095
Stakeholder.Collaboration     0.9163731              0.00000000          0.0843454415
Organization.Structure        0.1487661              0.08434544          0.0000000000
Human.Resource.Practices      0.4133109              0.40377846          0.0233367223
Team.Autonomy                 0.4444899              0.09947672          0.0005979576
                        Human.Resource.Practices Team.Autonomy
Leadership.Style                     0.41331087   0.4444898651
Stakeholder.Collaboration            0.40377846   0.0994767244
Organization.Structure               0.02333672   0.0005979576
Human.Resource.Practices             0.00000000   0.2565170464
Team.Autonomy                        0.25651705   0.0000000000

$statistic
                        Leadership.Style Stakeholder.Collaboration Organization.Structure
```

```
Leadership.Style              0.0000000          0.1060291          1.488053
Stakeholder.Collaboration     0.1060291          0.0000000         -1.794651
Organization.Structure        1.4880534         -1.7946510          0.000000
Human.Resource.Practices      0.8314135          0.8487298          2.409784
Team.Autonomy                 0.7764502          1.7083961          3.905451
                        Human.Resource.Practices Team.Autonomy
Leadership.Style                      0.8314135     0.7764502
Stakeholder.Collaboration             0.8487298     1.7083961
Organization.Structure                2.4097835     3.9054509
Human.Resource.Practices              0.0000000    -1.1601835
Team.Autonomy                        -1.1601835     0.0000000

$n
[1] 31

$gp
[1] 3

$method
[1] "pearson"


> lmSolfullo <- lm(Team.Autonomy ~ Leadership.Style + Stakeholder.Collaboration +
Organization.Structure + Human.Resource.Practices)
> summary(lmSolfullo)

Call:
lm(formula = Team.Autonomy ~ Leadership.Style + Stakeholder.Collaboration +
    Organization.Structure + Human.Resource.Practices)

Residuals:
    Min      1Q  Median      3Q     Max
-1.95616 -0.39608  0.07673  0.43776  1.98582

Coefficients:
                      Estimate Std. Error t value Pr(>|t|)
(Intercept)             0.6388     1.2659   0.505 0.618081
Leadership.Style        0.1787     0.2301   0.776 0.444490
Stakeholder.Collaboration 0.2292   0.1342   1.708 0.099477 .
Organization.Structure  0.7205     0.1845   3.905 0.000598 ***
Human.Resource.Practices -0.1989   0.1714  -1.160 0.256517
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.9833 on 26 degrees of freedom
Multiple R-squared:  0.5159,  Adjusted R-squared:  0.4415
```

F-statistic: 6.928 on 4 and 26 DF,  p-value: 0.0006176

**Remoteness vs. Team Autonomy:**

```
> pcor(remaut,method="pearson")
$estimate
             Remoteness Team.Autonomy
Remoteness     1.0000000     0.1485114
Team.Autonomy  0.1485114     1.0000000

$p.value
             Remoteness Team.Autonomy
Remoteness    0.00000000    0.08327858
Team.Autonomy 0.08327858    0.00000000

$statistic
             Remoteness Team.Autonomy
Remoteness      0.000000      1.744896
Team.Autonomy   1.744896      0.000000

$n
[1] 137

$gp
[1] 0

$method
[1] "pearson"

> lmSolfulla <- lm(Team.Autonomy ~ Remoteness)
> summary(lmSolfulla)

Call:
lm(formula = Team.Autonomy ~ Remoteness)

Residuals:
   Min      1Q  Median      3Q     Max
-4.6310 -0.6310  0.3690  0.5524  1.9192

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   4.8973     0.3542  13.826   <2e-16 ***
Remoteness    0.1834     0.1051   1.745   0.0833 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.198 on 135 degrees of freedom
```

Multiple R-squared: 0.02206, Adjusted R-squared: 0.01481
F-statistic: 3.045 on 1 and 135 DF, p-value: 0.08328

**No correlation seen:**

> cor(Remoteness, Team.Autonomy, method = "pearson")
[1] **0.1485114**

> cor(Remoteness, Relatedness, method = "pearson")
**[1] 0.0157942**

**1. Lack of fit test:**

**a. With Quadratic model:**

```
> fit_1 <- lmSolfull
> fit_2 = lm(Team.Autonomy ~ poly(Leadership.Style,2) + Stakeholder.Collaboration +
poly(Organization.Structure,2) + Human.Resource.Practices, data = cards)
> print(anova(fit_1,fit_2))
Analysis of Variance Table

Model 1: Team.Autonomy ~ Leadership.Style + Stakeholder.Collaboration +
    Organization.Structure + Human.Resource.Practices
Model 2: Team.Autonomy ~ poly(Leadership.Style, 2) + Stakeholder.Collaboration +
    poly(Organization.Structure, 2) + Human.Resource.Practices
  Res.Df    RSS Df Sum of Sq      F  Pr(>F)
1    132 92.793
2    130 89.003  2    3.7894 2.7674 0.06653 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

**There is no significant difference between the linear and quadratic model.**
**Hence, a linear model appears to provide a reasonable fit to the data. A quadratic model is not justified.**

**b. With Interactions model:**

```
> fit_1 <- lmSolfull
> fit_3 = lm(Team.Autonomy ~ Leadership.Style + Stakeholder.Collaboration +
Organization.Structure + Human.Resource.Practices + Leadership.Style*Organization.Structure,
data = cards)
> print(anova(fit_1,fit_3))
Analysis of Variance Table

Model 1: Team.Autonomy ~ Leadership.Style + Stakeholder.Collaboration +
    Organization.Structure + Human.Resource.Practices
```

Model 2: Team.Autonomy ~ Leadership.Style + Stakeholder.Collaboration +
Organization.Structure + Human.Resource.Practices + Leadership.Style *
Organization.Structure

| | Res.Df | RSS | Df | Sum of Sq | F | Pr(>F) |
|---|---|---|---|---|---|---|
| 1 | 132 | 92.793 | | | | |
| 2 | 131 | 91.015 | 1 | 1.7773 | 2.5582 | **0.1121** |

**There is no significant difference between the linear and interactions model. Hence, a linear model appears to provide a reasonable fit to the data. A quadratic or interactions model is not justified.**

**Linear model is:**

**Team.Autonomy = 0.15626 + 0.45526*Leadership.Style + 0.09652*Stakeholder.Collaboration + 0.36887*Organization.Structure + 0.06760 *Human.Resource.Practices**

# VITA

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PhD, Engineering Management, Old Dominion University. Estimated completion, August 2023.
Master of Science, Mechanical Engineering, The Ohio State University, Columbus, Ohio, August 1997.
Bachelor of Engineering, Mechanical Engineering, Anna University, Chennai, Tamil Nadu, India, May 1995.

**Work Experience:**

Mr. Kalluri is currently an Adjunct Lecturer in the Engineering Management and Systems Engineering Department of the Batten College of Engineering and Technology of the Old Dominion University. He has over 30 years of experience in project management, operations management and leadership, communications systems, information systems, management consulting, change management, employee and leadership development in leading commercial enterprises. He specializes in program management for large scale, mission-critical systems; system development lifecycle analysis; planning and implementation; engineering management; culture change and management consulting. He has held senior program management leadership roles in leading technology firms like AT&T, Lucent, Alcatel, Ericsson, Cisco and Amazon.

**Publications:**

Kalluri, Ravi. (2022). A Human Factors Study of Risk Management of Complex Agile Scrum Projects in Large Enterprises. International Journal of Business & Management Studies. 03. 38-44. 10.56734/ijbms.v3n8a6.