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Measuring system that contributes to the engineering productivity during the design phase by including the impacting factors

Master thesis in a master program of Construction Management and Building Informatics 4th semester

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Preface and Acknowledgements

The project is written as a compulsory part of the 4th semester master's degree program of Construction Management and Building Informatics at Aalborg University. The report is written in the form of master thesis and it targets the building industry. The aim of the report is to analyse the topic of engineering productivity, how it is measured and why it is essential for the building industry. Measuring the engineering productivity also includes distinguishing the impacting factors.

The idea for writing this project came from various research, written for measuring the construction productivity, and applying some of the methods to the design office. Essential part of each construction project is keeping it in track and measure its productiveness.

The basis for the project is the courses taught during the first three semesters of the Construction Management and Building Informatics education. Additionally, an extensive literature review has been performed for familiarization with the problem. The need for further investigation of the topic and data gathering emerged the usage of three interviews and a survey.

The topic engineering productivity brings certain difficulties. The topic has been rarely discussed by the academia and this reflected on the data gathering process. Mainly construction productivity research was used for extracting information and used it as basis for discussing its compatibility with the engineering productivity. The topic itself is more familiar to professionals mostly on management positions, and due to their preoccupation, they were harder to reach for interviews. Furthermore, the continuation of the Covid-19 pandemic made corresponding with professionals more difficult.

The difficulty of the topic was minimized with the guidance and help from Kjeld Svidt and Søren Munch Lindhard, who were supervising the process and to whom the authors want to express their most sincere gratitude. The supervision and the critical insights enhanced the awareness for essential details and brought the research to a more professional level.

Abstract

Currently when talking about labour productivity in the building sector, it is mainly considered for the building site and less discussed for the design office. The main aim of the report is to bring awareness about the labour productivity in the design office, referred as engineering productivity in the academia. The purpose is to find possible problems that may occur while measuring the level of productivity in a company.

The initial literature review has led to the main problem, that the industry has no standard for collecting engineering productivity data and standardization in measuring it. The continuation of analysing the problem led to outlining the most likely high impacting factors. The research proposed a productivity framework to help raise the level of productivity.

The application of productivity framework includes three phases that were considered for proposing solution to the industry. The findings of the report concluded that the application of Artificial Neural Networking (ANN) can provide the companies with a knowledge of their weaknesses and strengths, so they can monitor their productivity and work on raising it.

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1 Introduction

The construction projects are impacted by many circumstances, that can affect their time, economy, quality and productivity. Since nowadays projects are becoming bigger and more complex, these uncertainties can be crucial for the success of the whole process – from the initial design to the end of the building's life cycle. The construction industry is highly competitive, and many are trying to achieve more for less. The aim of many companies in the building sector are searching for new organizational methods and tools for distributing their time and resources in more structured and precise manner. At the same time there is a need for measuring, analysing and identifying the crucial aspects that must be improved and how these improvements can be made. One of these aspects that has a high impact and needs to be investigated among the professionals is the productivity.

There are many definitions that identify what productivity is. According to Prokopenko (1987) productivity is:

"…the relationship between the output generated by a production or service system and the input provided to create this output. Thus, productivity is defined as the efficient use of resources - labour, capital, land, materials, energy, information - in the production of various goods and services."

As shown in the formula below the ratio between the output and the input in a project forms its productivity. Kim (2007) specify this formula as the classical way for defining productivity.

Productivity = $\frac{Output}{Input}$

However, the opposite measurement, as shown in the formula below, is also used. This measures the unit productivity rate, which is a common approach in the construction industry, since it *"…places paramount importance upon costs during both estimating and project execution…"* (Kim I. , 2007).

Productivity = $\frac{Input}{Output}$

In the construction industry the American Association of Cost Engineers defines productivity as *"…relative measure of labour efficiency, either good or bad, when compared to an established base or norm."* (Yi & Chan, 2014).

Many *"…project managers and construction professionals define labor productivity as a ratio of actual over expected productivity…"* (Yi & Chan, 2014) as shown on the formula below.

Performance ratio $=\frac{Actual\ productivity}{Expected\ productivity}$

"There are many different productivity measures. The choice between them depends on the purpose of productivity measurement and, in many instances, on the availability of data." (Schreyer, 2001).

The calculation for productivity in the construction industry is tightly connected to the collection of large amounts of data, which include project performance data, payroll and labour hours, labour productivity data, safety data, environmental data, logistics data, equipment and materials tracking. In order this data to be used efficiently it also needs to be collected efficiently in a structured databases.

The importance of measuring labour productivity is becoming discussed topic when it comes to construction works, but when it comes to the design process of a project, it is still rarely talked about. In the industry the labour productivity during the design phase is referred as an Engineering productivity. The academia reveals that, the "…*engineering productivity is directly connected with the project cost and change performance…* " (Liao, 2008), but since, *"…there is no reliable, cost-effective method for measuring productivity in design organizations…"* (Thomas, Korte, Sandivo, & Parfitt, 1999), this issue can result as inefficiency during the design of a project, loss of resources and can negatively influence the outcome of the project. Ramadorai and Harris (2003) say *"…most company realize that greater engineering productivity can be a major competitive weapon, they have been unable to define and measure it consistently…".* A common path for collecting engineering productivity data and a way of systemizing it, can impact on the engineering productivity measurement. The usage of this data can guide companies and organizations in cutting waste during the design phase.

The process of designing buildings has changed rapidly and continues to change. The progress in developing new technologies is transforming the norms and standards of designing. The engineering process involves conceptual design, structural analysis, layout, detailing and fabrication, activities that are all transformed by the techno-change and can be performed with a single click on the computer with the various tools that the industry adapts. Sacks and Barak (2008) talk about the use of three-dimensional (3D) models compared to the use of two-dimensional (2D) drawings for architecture and engineering that have *"…brought into question the relevance of traditional measures, such as hours per drawing…"* (Liao, O'Brien, Thomas, Dai, & Mulva, 2011) (Sacks & Barak, 2008) (Song & AbouRizk, 2005). The design process also involves other activities such as: various meetings, schedules preparation, problem solving, decision making, prototyping and testing. All these activities are not measured by the equation hours per drawing and yet are part of the input for producing the output.

In the industry various methods are used for measuring engineering productivity: hours per drawing (Thomas, Korte, Sandivo, & Parfitt, 1999) (Chang & Ibbs, 2006), hours per drafting unit (Song & AbouRizk, 2005), and hours per engineered quantity (Kim I. , 2007). There is not a common method that the organizations are using or the one that are in use are outdated as the measurement - hours per drawing, that is mentioned above in the chapter.

There are many factors that affect the engineering productivity during the design phase of a project. Every project in the industry is unique – the size, level of complexity, scope, etc. are different. At the same time, the industry fragmentation also leads to new team formations for each project. This means that all the different factors affecting the productivity can then have different impact over the different projects. Establishing how the factors affect the project and to what extent, can lead to higher productivity rate by helping the companies to adjust the design process.

The aim of this study is to identify the factors and to what degree they have an impact over the engineering productivity. To identify the methods that are used for calculating the engineering productivity from both the academia and the industry itself. And to propose a framework for including the impacting factors to the productivity measurement for following and improving the productivity level of an organization.

2 Methodology

The *"…plan or proposal used to conduct research…"* (Creswell, 2014) is positioned in this chapter to provide knowledge about the composition of the research. The used research design, research strategies together with the data collection techniques and procedures for gathering research data are stating the project framework.

2.1 Methodological approach – Mixed methods

There are three different methods of data collection: Quantitative, Qualitative and Mixed methods, distinguished by their attributes (Creswell, 2014).

"Mixed methods research is an approach to inquiry that combines or associates both qualitative and quantitative forms. It involves philosophical assumptions, the use of qualitative and quantitative approaches, and the mixing of both approaches in a study (Creswell, 2014)."

The source of information for this paper is both from primary and secondary data sources, which are both qualitative and quantitative in accordance with the literature. The data obtained from academia in the form of books, articles, online sources is the primary data for the case. All the additionally collected data such as: interviews and survey is secondary data. Part of the research is based on interpretation of the collected primary and secondary data in the form of literature and interviews, which is corresponding to the qualitative methods. The other part, based on the survey analysis, is statistically tested and quantitative data is extracted, this leads the research towards the combination of both qualitative and quantitative methods which is characteristic of the mixed methodological approach.

2.2 Data collection – Literature review, Interviews, Survey

The research emerged the need for gathering literature review that would clear the horizons of the topic engineering productivity during the design phase. In an industry that is continuously changing, all the possible options for improvement need to be considered, which is possible after gaining knowledge about the current situation. The literature review has the role of outlining the current situation and guide the research to its continuation and completion. The gathered literature review consists of relevant for the case data from reliable academic sources and the data collected in the literature review is then systemized and stated in the research by its relevance to the topic.

The additional information needed is collected by scheduled interviews with professionals within the construction industry. The interviewees are picked with a concern about their prior working experience and field of work from various working organizations that are managing engineering productivity. The structure of the interviews is semi-structured, with questions based on the findings and knowledge gaps established from the literature so it can provide us with knowledge about the situation in the industry and how it is handled. The questions have an open end so the interviewees can be provoked to answer in a more extensive way. The interviews are held individually, since it gives the opportunity to focus only on one participant and ensures a calmer atmosphere without interruptions. The target group consist of three professionals working in the industry.

The gaps in the collected information from the literature review and the interviews are filled by conducting a survey. The survey as tool can benefit the research by gathering large amount of quantitative data for a short period of time, it is conducted anonymously and does not consume a lot of time (Denscombe, 2014). The idea behind using this method is reaching out to more professionals, who can contribute to the problem investigation and identify the factors affecting the engineering productivity. The usage of this type of data collection is chosen to further enrich and validate the findings made.

2.3 Data analysis methods

Methods for analysing the interviews

For analysing the interviews, a thematic data analysis approach is chosen. Thematic analysis is a common method used for qualitative data research. Together with the use of other data analysis methods the amount of the accumulated data is reduced by narrowing it down to the most relevant information (Castleberry & Nolen , 2018). This helps to reach the conclusions by only focusing on the important aspect from the conducted interviews. The thematic analysis is carried out together with the use of coding. The coding method helps *"…in the process of turning raw qualitative data into a communicative and trustworthy…"* data, by *"…examining a coherent portion of your empirical material – a word, a paragraph, a page – and labelling it with a word or short phrase that summarizes its content"* (Linneberg & Korsgaard, 2019). By finding the relations between the different words and phrases, coding makes it easier to analyse and summarise interviews, open-end survey question or customers' feedback (Medelyan, 2020).

Since the interview's topic and questions are based on a specific problem, a deductive coding method is chosen for this research. Deductive coding is used when there are predefined set of codes, which will be further assigned to the interview's data (Linneberg & Korsgaard, 2019). The predefined codes are themes or concepts taken out from the performed literature review.

The first step after conducting the interviews is to get familiarized with the interviews' data (Castleberry & Nolen , 2018). This can be done through transcribing but for this research, a detailed summary of each interview is made instead.

The next step is to identify words or phrases, that are important for the research (Castleberry & Nolen , 2018). They are labelled with the use of the predefined codes.

After all the data is labelled, different themes, important to the research, are identified. The codes are then mapped in a coding frame (Medelyan, 2020). For this research, a hierarchical frame is chosen. It gives the opportunity to divide and properly organise the codes into groups based on their themes (Castleberry & Nolen , 2018).

The final step includes the making of a conclusion, which gives answers to the researched topics.

Methods for analysing the survey results

The first step after conducting a survey is to analyse its validity. After gathering the data from the respondents, a measurement based on the Cronbach Alpha statistical scale is used to assess the reliability and the internal consistency of the responses (Taber, 2016). The Cronbach alpha is calculated with the following formula (Gunduz & Abu-Hijleh, 2020):

$$\alpha = \frac{N.C}{v + (N - 1).C}$$

Where:

N is the number of items

C is the average covariance between items pairs

v is the average variance.

In this case version 27.0 of SPSS Statistical Analysis software is used as a tool for calculation. The normal range of Cronbach's Alpha value is between 0 and 1. The higher value reflects on the higher degree of consistency, which is a sign of data with a higher reliability value. The acceptance value from the Cronbach Alpha measurement is above 0.7 (Taber, 2016).

The aim of the survey is to rank the engineering productivity factors based on their relation to the level of engineering productivity for this case. In order to do that the respondents are asked to evaluate the severity of importance of each factor by the usage of five-level Likert scale, where 1 have the lowest impact and 5 have the highest (Upton & Cook, 2014). After the results from the survey are collected, the approach for testing the data is chosen as the Friedman's test. The Friedman's test is a non-parametric statistical test, which purpose is to identify whether the tested samples are equal, or if the null hypothesis is rejected (Friedman, 1937) (MacDonald & Headlam, 2008).

- Null Hypothesis ***H0***: Median treatment effects of the population are all the same
- Alternative Hypothesis ***H1***: There is a difference in treatment effects

Each factor is ranked across and the ranks are summed. The testing of the hypothesis is made by calculation of the critical value for chi-squared in Excel by using the function for CHISQ.INV.RT, based on the α value of 0.05, which corresponds to 5% risk of concluding that a difference exists, when there is no actual difference (Fisher, 1934) and the degree of freedom from the number of factors minus 1 (Bluttman, 2018), against the actual chi-squared, which is calculated with the following formula (Friedman, 1937):

$$X^2r = \left[\frac{12}{n(p)(p+1)}\sum_{j=1}^{p} r_j^2\right] - 3n(p+1)$$

Where:

p is the number of treatments

n is the number of knows (respondents)

$\boldsymbol{r_j^2}$ is the squared sum of the rank for sample treatment (column) ***j***

By comparing the results from the calculations of the actual chi-squared and the critical value for chi-squared, an acceptance or rejection of the null hypothesis can be concluded.

To validate the result from the Friedman's test, a calculation of the p-value is needed, which is used to check if the differences between the medians are statistically significant. The p-value is calculated in Excel with using the function for CHISQ.DIST.RT, the result from the Friedman's test and the degree of freedom from the number of treatments minus 1 (Bluttman, 2018). If the p-value is less or equal to the significance level of α, a rejection of the null hypothesis is valid and conclusion that not all the group medians are equal can be made.

The aggregate ranking of the factors taken from the Friedman's test is further divided into two sections. The first section is most likely high and the second most likely low impacting factors. The procedure is accomplished by adding the aggregate value of all the factors and divided by the number of factors. The range from the highest score to the mean value is evaluated as having most likely high impact and the range from the mean value below to the lowest score as having most likely low impact.

After the aggregate ranking of the groups of factors is performed an additional Wilcoxon test is used as a continuation to observe, if there is significant difference in the ranking positions of the factors. The Wilcoxon test is a non-parametric test that compares two samples at a time, the same procedure is performed for all possible pairs of samples. The assumptions from the Wilcoxon signed rank sum test are used to test the null hypothesis that the median of a distribution is equal, if otherwise a statistically significant difference appears (Wilcoxon, 1945) (Deshpande, Naik-Nimbalkar, & Dewan, 2017). The Wilcoxon test is carried out in version 27.0 of SPSS Statistical Analysis Software. The result from the Wilcoxon's test (p-value) is further adjusted with Holm's correction method. The Holm's correction method is used to test the results from previous tests for Type 1 error, which assumes that the null hypothesis is rejected when is true (Madeyski, 2009). The procedure is executed in Excel worksheet, from which the α value is being adjusted. The last step is to compare the p-value from the Wilcoxon test with the adjusted α-value from the Holm's correction method, if the p-value is lower or equal to the α-value, an assumption can be made that there is a difference (Madeyski, 2009). The purpose for testing the ranking of the groups of factors is to establish if there is statistically significant difference between the ranking positions, the same procedure is executed for the factors to check if the variance in the ranking is significant.

The last question of the survey is in the form of an open-ended question for which deductive coding method with pre-defined codes is used as explained previously in the data analysis procedures for the interviews, to extract the underlaying data for further analysis and interpretations (Linneberg & Korsgaard, 2019).

3 Problem statement

The initial research based on literature review, reveals that the industry has established labour productivity measuring systems and procedures for the construction phase of a project but is struggling with developing a common engineering productivity measuring system. Many approaches are developed, but are not comparable, because of the basis they are calculated on. The uniqueness of each project brings a variability of what factors have impact for the different cases. Since the construction projects are getting bigger and more complex, the need for precise tracking of the resources arise for the successful completion of a project. Among the academia, focussing on construction and engineering productivity, different approaches are considered, but are only partially covering the components that need to be included for a standardized measurement. The research also shows that the rapidly changing technologies, such as CAD, BIM and even AI, need to be considered for a new approach towards the productivity data collection and previous approaches such as drawing per hour are more likely irrelevant. The aim of this research is to account the influencing components for an engineering productivity system into a framework that is possible to use among different companies for measuring their productivity level during the design phase. The mentioned above considerations are leading to the following problem formulation and it is following sub-questions:

How the impacting factors can be implemented in a measuring system that can contribute to the engineering productivity during the design phase?

What are the main factors affecting the engineering productivity?

What are the different methods used for establishing engineering productivity?

What is the current situation when it comes to engineering productivity in Denmark?

What are the steps for creating an efficient productivity framework?

Which method can be used to include the impacting factors?

4 Delimitations

The research is limited by circumstances, which the authors cannot control but is also delimited by the authors themselves, because of the choices made during the research (Simon & Goes, 2013). The purpose of this chapter is to bring light to the choices made by the authors that delimits the report scope.

The report will incorporate analysis of companies and professionals only in Denmark, because of the short time for conducting the research. Another reason for that decision is that the research is performed in the form of a master thesis for Alborg University Denmark and it is considered by the authors to be more beneficial to focus only on the industry in Denmark.

The term engineering productivity delimits the investigation from consideration for the whole construction industry and will only focus on the work performed during the design phases of projects, which is rarely discussed topic.

The factors that are impacting the engineering productivity according to the literature review are graded by professionals in a survey but delimited by the authors to contact only professionals who are tightly connected to the topic and can be beneficial to the research in a certain period chosen by the authors. The different methods for measuring productivity are further analysed in the research taken out from the literature review and by conducting interviews with professionals on top management positions. Further evaluation of the methods as a follow up is within the content of the report, but it was decided that there are not enough resources and time to carry out a research to see how the methods for measuring engineering productivity can impact the budget, quality or time of a project.

The research will focus on investigating the industry approaches for measuring engineering productivity, propose a framework and productivity modelling technique but will not further investigate the solution that different companies can implement due to the lack of reliable and consistent historical data.

5 Literature review

Literature review is essential part of the research phase. The main goal is to establish what already has been researched and discovered when it comes to engineering productivity in the academic sphere. This chapter will provide an overview of what has been found to be relevant for this research and will be used as a guidance for the further investigation and solution of the problem.

5.1 Productivity definition

Productivity has been defined in many ways in the industry since there is no standard that has been made. Attar, Gupta and Desai (2007) discuss the different definitions of labour productivity in the construction industry, such as the ratio between the output and the labour cost or the ratio between the output and the work hour. The main measure used for productivity is the hourly outputs, which is considered as more reliable than a cost-based outputs (Eastman & Sacks, 2008) (Yi & Chan, 2014). Sacks and Barak (2008) say that the engineering output are more elusive that the engineering inputs, which are more easily defined. Ultimately a lot of engineering productivity is measured as the ratio of drawings produced to time spend (Thomas, Korte, Sandivo, & Parfitt, 1999) (Song & AbouRizk, 2005) (Chang & Ibbs, 2006) (Kim I. , 2007) (Song & AbouRizk, 2008). There are two main measures for productivity – single factor input and multi-factor input productivity (Attar, Gupta, & Desai, 2007). The productivity can then be measured based on gross output or value-added. According to the paper by Attar, Gupta and Desai (2007), the barriers for improving the productivity is the lack of properly defined units for measurement, evaluating changes as well as collecting reliable data for both input and output. The use of information technology also makes it difficult to measure the productivity, as nowadays the 3D models are a constant during the design process. However, the paper concludes that the technology development is one of the biggest reasons for increased productivity (Yi & Chan, 2014). Sacks and Barak (2008) prove through two experiments between 2D and 3D approach, that the 3D method is much more effective, saving a lot of time for producing drawings for the projects. They also point out that the 3D modelling is much more effective when it comes to applying changes, which leads to higher productivity. Another major hindrance for calculating the productivity is the lack of a properly defined process for collecting productivity data. Many companies do not have a data collection process or rely on cost-accounting systems or cost-control systems to collect data for amounts of time spent (Song & AbouRizk, 2008) (Song & AbouRizk, 2005). Without enough sufficient data for analysing, the root cause for low productivity cannot be determined and no corrective measures can be taken (Ibbs, 2012). The lack of well-defined, reliable and accurate data is major aspect that needs to be further addressed in order for more precise productivity values to be achieved.

5.2 Factors affecting productivity

The summary made by Yi and Chan (2014) on multiple construction journals, focuses on the construction productivity, that is further divided into three levels: Industry level, Project level and Activity level. The impacting factors for the construction labour productivity at Industry level are management, labour, government, contracts, owner characteristics, and financing. According to the findings, one of the biggest impacting factors of the construction productivity is engineering drawings and materials. Limitations for measuring the productivity at this level include the availability of reliable data and failure to measure important factors, such as management, quality achieved and innovations (Yi & Chan, 2014).

Yi and Chan (2014) point out that time utilization is one of the most important aspects at the Project level productivity. Benchmarking, by the use of indexes and performance ratio, is considered successful when it comes to identifying successful and unsuccessful project, while baseline method by itself is considered as not very objective and different methodologies have been developed for deriving productivity (Yi & Chan, 2014). Productivity is more likely to be increased by repetition (Yi & Chan, 2014) (Liao, O'Brien, Thomas, Dai, & Mulva, 2011) (Alchaer & Issa, 2020).

At the Activity level multiple sources have established that *"…the amount of work, crew size, buildability, environmental conditions, and learning effects produced significant influences on the production rate of all construction tasks"* (Yi & Chan, 2014). According to the paper, the most used method for evaluation of the productivity and the impacting factors is through productivity models.

According to the paper by Attar, Gupta and Desai (2007) the general factors affecting the construction productivity are lack or delay of materials, unclear instructions or poor materials, financial difficulties, poor management or lack of supervision, design changes, poor planning, lack of tools and equipment, lack of skilled workforce, bad weather. Ineffective management is concluded to be the biggest caused for low productivity. (Attar, Gupta, & Desai, 2007)

Hwang, Zhu and Ming (2017) have analysed multiple sources, discussing different factors, affecting the construction productivity. They then identifies 26 factors that they further distributes into 5 main categories - project- , manpower- , management- , technical- and external factors. This contributes to a better understanding of their influence over the productivity.

Chang and Ibbs (2006) examine the engineering productivity factors through the use of a system model of Input-Process-Output, further divided into Work data and Work nature; Work division and Management; and Performance respectively. They used a process similar to data mining for analysing the data, that involve analysing the relationship between the different categories from the model. This paper measures productivity by using the direct and indirect hours per drawing. Liao, O'Brien, Thomas, Dai and Mulva (2011) find this measurement unreliable since the use of CAD tools and programs are not included. More time is spent on creating the 3D model, while making the drawings is much faster. Which is why measuring the productivity as hours per drawing will undoubtably leave out the complexity of creating the model itself. As a result of their work, Chang and Ibbs (2006) found out that project type does not have a significant effect over the productivity, but project size does. The smaller the project, the higher the productivity is.

Liao, O'Brien, Thomas, Dai and Mulva (2011) proposed a system model, similar to the model made by Chang and Ibbs (2006), in which the project characteristics are divided into Input - further divided into Scope and Quantities, Process - further divided into Process data and Process nature and Output categories. In this paper issued for construction quantities are used, *"…which has been shown to correlate significantly with direct work hours."*. They have found out a close relation between project size and the engineering productivity, concluding that bigger size projects have higher productivity. However, it is in direct opposite of the Chang and Ibbs (2006) findings, where they find that the productivity drops when the project size increases.

Kim (2007) have found out that projects which have a bigger amount of modularization and are non-schedule driven tend to have higher productivity. He, also like Liao, O'Brien, Thomas, Dai and Mulva (2011), identifies project size, as the main factor influencing the engineering productivity - the bigger the size, the better the productivity is. This can be explained by the complexity factor which can influence the productivity in any size project.

Design changes and change orders also have an influence over the engineering productivity in the form of rework, additional work, delays or acceleration of the work, cost or schedule changes. Ibbs (2012) concludes that the amount of the change corresponds directly to the amount of productivity loss. When more changes occur, the projects schedule performance also becomes more difficult to predict. He also points out another key factor - the timing of change which can have from very low to doubling consequences for the project. Ibbs (2012) analysed data from 226 project. He found out that changes can affect the project scheduling by causing delays or prolonging deadline. This can lead to bigger cost increments by adding more labour force in order to complete the project. This has negative affect on the companies' profits accordingly. Liao (2008) has also found that the better the productivity is, the better the cost performance of the projects is, but project scheduling has no significant impact on the productivity. Changes are inevitable during the design process but when reduced to minimum, they will have less effect on projects' schedules, costs and productivity (Ibbs, 2012).

In the construction industry professionals from different companies form teams that work together till a project end. This is known as an industry fragmentation. Consequently, a big amount of information is exchanged between them. This also leads to information dependency. Understanding the information dependency and ensuring proper collaboration and exchange of information between the different participant in a project is crucial for the success of the project (Tribelsky & Sacks, 2010) (Liao, 2008). Liao (2008) has found out that information dependency has a big impact on productivity and if one participant is not sharing information effectively, then all participants get affected accordingly. Tribelsky and Sacks (2010) have also concluded that failure to ensure a proper exchange of information among teams can be a root cause for unsuccessful project results. They have discovered that large transfers of information are harder to accumulate, while small amounts of information transfer contribute to a better flow.

5.3 Methods and concepts for measuring productivity

As mentioned above, there is no standard measuring units when it comes to engineering productivity. As a result, from that, different people and organisations use different methods and different measurements, leading to results that cannot be compared (Song & AbouRizk, 2008).

Kim, Lee, Park and Yu (2011) talk about how to calculate the Obtainable productivity (OP) on the construction site through the use of Ideal productivity (IP), Actual productivity (AP) and Reduction factor (RF). Ideal productivity is *"…productivity yielded under an ideal situation…",* while Obtainable productivity is yielded, under the impact of different factors. The reduction factors are further divided into variable, invariable, controllable and uncontrollable factors. They suggest the use of Productivity Achievement Ration (PAR), as a quotient of AP and OP, for evaluating where additional attention is needed, it can be used for assessment productivity management performance. They compare OP to the baseline productivity, pointing out that OP focuses on factors and stays updated while the baseline productivity focuses on events and stays unchangeable over time.

Song and AbouRizk (2005) point out that the project scope definition is crucial for the successful management of a design project and its processes, and poorly defined scope leads to project failure. It identifies the quantity of drawings, documents, specification that need to be produced. According to Song and AbouRizk (2005), the number of physical design deliverables is no longer relevant since it does not capture the complexity coming from the use of CAD tools and programs. They suggest quantitative engineering project scope definition (QEPSD), a method for quantitatively measuring the project scope at the Discipline level, that can be used for productivity modelling. Sacks and Barak (2008) suggest that calculating engineering productivity at the Activity level will lead to the most accurate results and it will easily include the 3D design in it. But they also say that the data collection is *"…a major drawback".*

Another tool, developed by Construction Industry Institute (CII), for scope definition and project planning, addressed by Kim (2007); Liao (2008); and Liao, O'Brien, Thomas, Dai and Mulva (2011) is front end-planning. It consists of five step – organisation (organisation, deliverables, objectives, schedule, etc.); data generation (engineers and designers in-charge, project type, completion date, etc.); evaluation of alternatives (technology, process alternatives, etc.); project definition (analyse project risks, project scope definition, execution approach, etc.); decisions (SWOT analyses, Maslow's pyramid, etc.) (Sarde, 2016). By going through the 5 steps and analysing the different aspects, the project scope is then properly defined. Liao (2008) concludes that having more a good front-end planning will result in better productivity.

Thomas, Korte, Sandivo and Parfitt (1999) suggested a conceptual model for calculating the productivity at the Discipline level. The input is the time spent on preparing all the materials during the design phase, and the output is *"…the number of drawings, specifications, etc"*. The complexity differences between the different outputs are resolved by the use of a conversion factors. A number of partially completed documents or drawings may exist at the end of each evaluating period, hence a rule of credit is also applied. Once the input and the output total numbers are calculated, the productivity is established. The model, however, does not take into account the use of CAD tools and programs.

Song and AbouRizk (2008) suggest the making of a productivity model based on data collection from past projects, such as project scope, progress information and labour expenditure. They talk of the importance of including impacting factors into the productivity data collection and calculation. Considering the complexity of quantifying the relations between the factors and the resulting productivity, the industry heavily relies on individuals' judgement, which can be *"…limited by the level of knowledge and experience…"* (Song & AbouRizk, 2008).

As mentioned above, the lack of standard definition for productivity, measuring method and the impacting factors is one of the biggest setbacks for successful calculation of the engineering productivity. Kim (2007) together with the CII developed the engineering productivity measuring system (EPMS) for measuring the engineering productivity. The study is focused on large industrial process projects, using data from 112 heavy industrial projects. The EPMS uses direct engineering-working hours as an input, excluding indirect hours such as time spent on document control, quality assurance, project management, etc. and design quantities are taken as an output. Time spent for rework is recorded separately. The study defines 6 metric categories for the Discipline level (concrete, steel, electrical, piping, instrumentation, equipment) that is further divided into the Subcategory and Element level. The quantities are however measured in different units, which makes it hard to create a summary metric for a Project level measurement and can lead to uncertainties. Kim (2007) concludes that the detailed Element levels are more accurate than the higher categories. However, collecting such detailed data is very complex and tedious process, and many companies do not even attempt it. Even though the metric system has proven effective and well accepted by the heavy industry only some parts of it can be relevant for the non-heavy building industry.

For getting the productivity at Project level when the productivity measurements are done in different unit at lower levels, an index is necessary. Based on the EPMS, Liao (2008) creates a non-parametric index that uses the Z-score method for standardizing the engineering productivity metrics, weighted by workhours to construct a summary metric. Liao (2008) also analysed in a system model, used in previous studies, (Chang & Ibbs, 2006), different factors that can affect the productivity during the design process. He divided the factors into two main categories – project characteristic and opportunities, and analysed the quantitative relationships between them with the use of the index he has made. Liao has found that larger projects are more likely to have higher engineering productivity, while on the other hand Chang and Ibbs (2006) have found the opposite. Liao used direct engineering hours, while Chang and Ibbs used both direct and indirect engineering hours in their input. Project type and project nature also have an effect on the productivity, mainly when it comes to the complexity. He founds that non-schedule driven projects have better productivity that schedule driven ones, and that the contract type can also have an impact.

Based on the EPMS (Kim I. , 2007) and Liao's paper (2008), Liao and et al. (2012) created a Project level engineering productivity metric (PEMP) for benchmarking, that allows to calculate the productivity at the Project level by using data collected in different units in the discipline or lower levels. Similar to the index made by Liao (2008), the PEMP is based on the Z-score method that includes three main steps: transformation, standardization and aggregation.

Alchaer and Issa (2020) based a productivity calculation on the quadratic equation. A point system is used for classifying different tasks importance for completing the project on time to critical, subcritical and minor subcritical tasks. A sum of the scheduled tasks points is divided by the completed tasks points to get the work value which is then used in the quadratic equation. Factors as repetition and delay are also included into the calculation. The result will give the actual productivity which can be further used for evaluating employees and projects success.

Zhang, Wen and Ashuri (2018) analysed patterns in the 3D model design log files of designers to evaluate the productivity. Through the use of process mining, the most used commands are collected and analysed to build an average time needed for completing identical sequential patterns that can be used to establish the productivity of the designers. Factors such as complexity and the project characteristics needs to be taken into account in the interpretation of the results. When enough data is collected and analysed, a baseline can be determined. At the same time, the results can be used as a project control tool to help managers identify issues that might need additional attention.

6 Analysis of the literature review

6.1 Factors affecting the engineering productivity

Based on the literature review, see Chapter 5, there are different factors that affect the labour productivity. Those factors are of a different nature and are having different impact on the productivity. Some of them are applicable only for the construction process, but others can also be relevant for the engineering productivity, such as lack or delay of materials, poor or unclear materials, financial problems, design changes, poor scheduling, poor management, lack of skills or poor communication. Since, as mentioned before in Chapter 5, there are no standards for measuring productivity, that the whole industry is following, each company or organization is using their own methodology for this process. The companies/organizations are of a different size, have different structures, follow different strategies and work on different projects, which creates a high variability of how the engineering productivity can be measured and yet same general factors are applicable for most of the cases. Based on previous study made by Hwang, Zhu and Ming (2017) the factors affecting the construction productivity can be divided into five main groups according to their nature and into subcategories according to what it is incorporated in the groups. The main five groups of factors are: Projects factors, Labour factors, Management factors, Technical factors and External factors (Hwang, Zhu, & Ming, 2017).

Project factors: Those are the factors that are tightly connected with the nature of the project. The impact of the factors included in this group differ for each project.

Labour factors: In this group of factors the main concern is about the employees and their characteristics, also what influences their behaviour and what can impact on the work performed.

Management factors: In this group of factors are included the main elements of the management process, because of its great impact on the final output.

Technical factors: This group combine the features which relate to the technology, technical components, communication and collaboration.

External factors: As external factors are evaluated the factors that are unpredictable, and which cannot be controlled or managed by a company.

Previous studies use different factors according to their relevance with the topic, in the current situation based on the literature review twenty-five factors are identified to have impact on the engineering productivity. In Table 1, p.24, are shown the 25 factors, distributed into the five main groups of factors and their occurrence in the literature. For further investigation of the factors a survey is conducted, which will help for ranking the factors according to their relevance for the engineering productivity.

Factor groups		Conceptual model for measuring productivity of design engineering	A Study of Various Factors Affecting Labour Productivity and Methods to Improve It.	Critical Review of Labor Productivity Research in Construction Journals	Factors Affecting Engineering Productivity	Productivity Management Methodology Using Productivity Achievement Ratio	Development and Implementation of an Engineering Productivity Measurement System (EPMS) for Benchmarking	System Model for Analyzing Design Productivity	BIM Log Mining: Measuring Design Productivity	Influencing Factors of Engineering Productivity and Their Impact on Project Performance	Quantifying Engineering Project Scope for Productivity Modeling	Engineering Productivity Measurement: A Novel Approach	An Overview of Front-End Planning for Construction Projects	Impact of three-dimensional parametric modeling of buildings on productivity in structural engineering practice	Measuring and Modeling Labor Productivity Using Historical Data	BIM log mining: Exploring design productivity characteristics	Factors Affecting Productivity in Green Building Construction Projects: The Case of Singapore	Factors Affecting Productivity in Green Building Construction Projects: The Case of Singapore
		H. Randolph Thomas, Q. Coco Korte, Victor E. Sanvido, M. Kevin Parfitt (1999)	A .A. Attar, A.K. Gupta, D.B.Desai (2007)	Wen Yi, Albert P. C. Chan (2014)	Pin-Chao Liao, William J. O'Brien, Stephen R. Thomas, Jiukun Dai, Stephen P. Mulva (2011)	Tae Wan Kim, Hyun-soo Lee, Moonseo Park, Jung-Ho Yu (2010)	Inho Kim (2007)	Andrew S. Chang, William Ibbs (2006)	Limao Zhang, Ming Wen, Baabak Ashuri (2018)	Pin-Chao Liao (2008)	Lingguang Song and Simaan M. AbouRizk (2005)	E. AlChaer and C. A. Issa (2020)	Rohit R. Sarde (2016)	Rafael Sacks, Ronen Barak (2008)	Lingguang Song; Simaan M. AbouRizk (2008)	Yue Pan, Limao Zhang (2019)	Bon-Gang Hwang, Lei Zhu and Jonathan Tan Tzu Ming (2017)	Bon-Gang Hwang, Lei Zhu and Jonathan Tan Tzu Ming (2017)
Project factors	Project scope	×	×		×			×		×	×		×		×		×	×
	Project location	×	×		×			×		×			×				×	×
	Project characteristics	×	×		×			×		×			×		×		×	×
	Project complexity	×	×		×			×		×			×		×		×	×
	Rework and delays	×	×			×	×			×		×	×		×		×	×
Labour factors	Employee skill		×	×		×		×	×	×	×	×	×		×	×	×	×
	Employee availability		×	×		×		×	×	×	×	×	×			×	×	×
	Empolyee motivation		×	×		×				×		×					×	×
	Employee experience		×	×		×		×	×		×	×	×		×	×	×	×
	Labor work facilities and satisfaction		×	×									×				×	×
	Labor fatigue		×	×													×	×
Management factors	Supervision	×	×	×	×	×		×		×	×	×	×		×		×	×
	Planning and sequencing	×	×	×	×	×		×		×	×	×	×		×		×	×
	Competency of project manager		×	×	×						×	×	×		×		×	×
	Availability and quality of information	×	×	×	×	×		×		×	×	×	×		×		×	×
	Coordination and collaboration	×	×	×	×	×		×		×	×	×	×		×		×	×
Technical factors	Tools and equipment	×	×	×	×		×	×	×	×	×	×	×	×	×	×	×	×
	Techno changes		×	×	×				×		×	×	×	×		×	×	×
	Design changes		×			×				×		×	×		×		×	×
	Incomplete or unclear specifications		×	×	×					×	×	×	×		×		×	×
	Client and consultants			×									×					
External factors	Weather		×	×									×				×	×
	Financial stability		×	×									×				×	×
	Permits		×	×	×								×				×	×
	Legislation		×	×	×								×				×	×

Table 1 – Factors included in the literature (Own Production, 2020)

6.2 Methods used for measuring engineering productivity

Throughout the literature review 11 methods for measuring engineering productivity are outlined. All the methods are suggested by the academia in the past twenty-one years and have their significant relevance in the industry. Most of the methods incorporate different components that are being measured, even though there are some that are similar. The high diversity comes from the lack of standard definition for engineering productivity, as well as a standard unit for measuring it. The different measuring method are also executed on different level – from Activity level, through Discipline Level, to Project level. The different levels, as mention in Chapter 5, require different methods or a combination of a few for measuring the productivity. Most of them do not take into account the use of CAD programs or tools, which are considered as one of the factors that hinder the achievement of a proper measuring system. The different methods also either do not include any of the impacting factors or include only a few of them. This leads to incomplete understanding of how the productivity is affected by the factors. The methods are gathered and compared in the Table 2, p.26.

	Methods										
	Thomas, Korte, Sandivo and Parfitt (1999)	Song and AbouRizk (2005)	Chang and Ibbs (2006)	Kim (2007)	Song and AbouRizk (2008)	Liao (2008)	Liao, O'Brien, Thomas, Dai and Mulva (2008)	Kim, Lee, Park and Yu (2011) - Productivity Achievement Ration (PAR)	Liao and et al. (2012)	Zhang, Wen and Ashuri (2018)	Alchaer and Issa (2020)
	Conceptual model	QEPSD - Work breakdown structure	System model I-P-O	Enginering Productivity Measuring System (EPMS) - Model for benchmarking	Artificial neural network (ANN)	Nonparametric index - Z-score method/ System model I-P-O	System model I-P-O	Productivity Achievement Ration(PAR) - productivity evaluation indicator	Index for benchmarking - Project Level Engineering Proeductivity (PEMP)	Data/process mining	Quadratic equation
Components included											
Project level					x	x			x		
Discipline Level	x	x		x							
Activty level				x							
Input/output	x	x	x	x	x	x	x		x		
Output/input								x			x
Hours - drawing/quantities	x	x	x	x	x		x				
CAD		x			x					x	
Project scope		x		x	x	x					
Complexity		x		x							
Installed quantities				x	x						
Design effectiveness				x							
Historical data		x			x						
Factors relationships			x		x	x	x	x			
Labour expenditure					x						
Influencing factors					x	x	x				
Direct hours				x							
Benchmarking				x							
Baseline										x	
Management tool								x		x	x
Rework				x							x
Delay											x

Table 2 - Methods included in the literature (Own production,2020)

6.3 Summary of the literature review

The literature review gives an overview of what engineering productivity is - the different definitions it has based on the different points of view, which are different factors that have impact over it, and different developed methods for calculating and establishing it.

The main definition of engineering productivity is the ratio of output to input. But there is no standard that is used for defining what the output or the input should include. Furthermore, there is no standard for the units used or a standard for how to measure it. As mentioned in Chapter 5, engineering productivity can be measured on a few different levels in the companies – Project level, Discipline level and Activity level. This leads to a lot of different definitions made by the companies themselves or by the academia. For the input hours spend or labour cost can be used. For the output number of drawings, or number of drawings, documentation and specification all together, or quantities can be used. At the same time, the different levels of the calculation demand different methods. There are no specific methods per level, but rather multiple different methods or a combination of a few methods. As seen from the analyses of the methods, all of them are different from one another. Different aspects are taken into account in the different methods. For example, the CAD programs and tools, that are currently used in the industry for the creation of the 3D models, are only included into 3 out of the 11 methods identified from the literature review. All this have led to a lot of productivity results that cannot be compared. This further hinders the establishing of the engineering productivity at Industry level as well. At the same time, there is no reliable productivity data. The different companies either collect time spend using cost-accounting systems or have no process at all. The need of a user-friendly system that will ease the process of data collection is of extreme importance.

Another important aspect is the impacting factors. Due to the unique nature of each project and the increased complexity of new projects, there are many factors that impact over the productivity. Identifying the factors is a challenging task. This research has managed to identify 25 factors from the academia, which were further ranked by their importance from professional working in the industry (see Chapter 7). One of the biggest problems for including the factors in the engineering productivity measurement is that they are not easily quantifiable, which is why most of the measuring methods either include only a few of them, or none.

It can be concluded that the lack of standard for the engineering productivity is one of the biggest obstacles for having homogeneity in the industry. This research cannot create a proposition for a standard, but it can evaluate and propose a productivity framework that can help the companies with creating a base for productivity evaluation.

7 Data analysis

The following chapter have the purpose of analysing the secondary data collected from the interviews and the survey by following the methodology chosen. The analysis is separated into three sub-chapters with the purpose of outlining the two data collection methods and a summary of their contribution to the problem investigation.

7.1 Interviews

With these interviews the study aims to establish the current situation of engineering productivity of the industry in Denmark, how it is defined, how it is measured, which are the factors that affect the productivity, to what degree, and what productivity data is collected.

The interviews are semi-structured, individual and anonymous as previously described in Chapter 2.3. The analyse of the interviews is carried in the form of thematic analysis through the use of deductive coding. The interview questions and predefined codes are based on findings and established gaps from the performed literature review (see Table 3). For the interview questions, see Appendix A – 13.1.1 Questions.

Productivity definition

- Company definition
- Standard definition

Productivity measurement

- Company measurement
- Standard measurement

Data collection

- Data base
- Future project assessment

Factors affectiong the productivity

- Project scope
- Project size
- Repetition
- Project type
- Project complexity
- Project budget
- Skills and experience
- Project management
- project planning and schedule
- Information dependability
- Quality of the materials
- Design changes and change orders
- Programs and tools

TABLE 3 – PREDEFINED CODES (OWN PRODUCTION,2020)

The interview target group consist of three professionals working in Denmark. Two of the interviews were made in person, while one of them was conducted through an online platform. The average duration is around 25min.

The first step of coding is the creation of a detailed summary of each interview. Each summary was then analysed, and the predefined codes were used for labelling different word and phrases (see Appendix A – 13.1.2 Summaries). After the codes are applied, the main themes in the interviews are identified and grouped in a hierarchical coding frame, see Figure. 1 below.

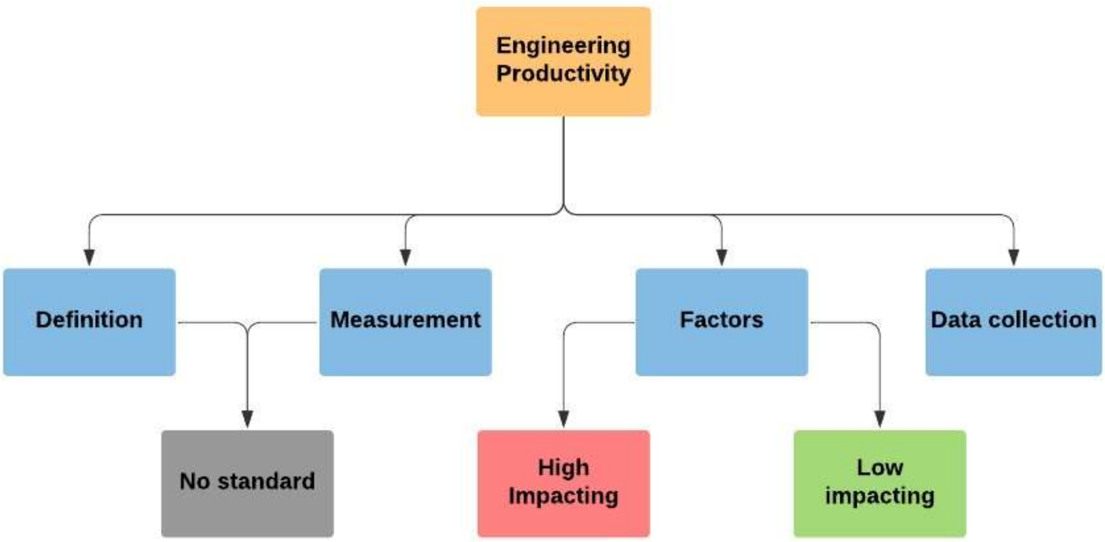

FIGURE 1 – ENGINEERING PRODUCTIVITY CODING FRAME (OWN PRODUCTION,2020)

7.1.1 Interviews summary

In this section a combined summary on all interviews is caried out. It is categorized by the predefined codes and identified themes. This gives a structured perspective of what the interviewees' view of the different topic discussed in the interview is and help the research to reach a conclusion.

The interviews start with the general question of who the interviewee is, the company they work for, his/her role in the company and how many years of experience they have. Person A is a department manager for the building construction department, with 23 years of experience in a big consulting engineering company. Person B is a project manager, managing the structural, electrical and plumbing discipline of a project. He has more than 30 years of experience, working for the same company as Person A, that would be further addressed as Company AB. Person C is a client advisor and a project manager with 9 years of experience, working for small consulting company, that will be further referred to as Company C.

The interview continues by establishing a typical project for the interviewee's company. Company AB's typical company projects are middle and large projects, varying from apartment buildings to offices, school, hospitals, etc. Person B says that the companies project varies a lot and that usually there are many residential projects. Company C's typical projects are residential projects, varying from small to big in size.

Productivity definition

Person A defines good productivity when a project has a good start, with good time plan, and good plan for information coordination and exchange, having skilled and intelligent teams that are aware of the project goals. Person B, on the other hand, defines productivity as an estimation based on the project scope, hours spend and the budget.

Productivity calculation and processes

Person A says that there is not a specific calculation for the productivity. Considering the project complexity, it is hard to make a model for calculating the productivity. An easier approach is used, instead of doing a complicated calculation, in the form of collecting data from past projects about the complexity based on the shape into easy, medium or advanced category and an estimate on how many hours are used per square meter. Person A describes it as a benchmarking based on historical data. Person B says that the productivity estimation is based on hours spend and the time costs, that are collected by an Enterprise Resource Planning program. Bigger projects have their own excel sheets for further tracking. Person C says that the productivity is measured based on the economy of the project that includes project characteristics and budget, the resources put into a project and the output.

Standard for the productivity

All three interviewees confirmed that there is no standard for productivity in Denmark. Person A agrees that a standard will benefit the industry but, according to him, it will be very difficult to make one. Person B says that a standard will help in the creation of a benchmark and the projects would be evaluated easier. Person C, on the other hand, thinks it is not such a good idea since different companies have different ambitions.

Factors affecting the productivity

Person A point out the time planning, how each discipline is acting during the duration of the project, and the ability to solve problems quickly and efficiently, rather than reaching a point of confrontation as the main factors affecting the productivity. Person B also talks about how the different disciplines are performing and adds the team set up as well. Person C talks about the social atmosphere of the company and the integrity of the projects. He also says that *"…a little bit of time pressure also helps on the productivity".*

Project scope

Person A says that the scope is strongly connected with the project planning and good planning is essential for a successful project. Person B says that it gets reviewed by the team to ensure that everyone is aware what needs to be done. And Person C says that the scope affects the strategy that will be used. Person A also talks about the level of detail (LOD) for the models. It is something that is agreed upon at the beginning of a project and can also have an influence over the productivity. Sometimes a lot of information is asked to be implemented, but it can be something that the client does not really need.

Project size

Person A says, *"…it is easier to make more money on bigger projects…"*, which means that the productivity is better since there are more hours for completing the project. Person C also says that bigger project has higher monetary value. He also emphasised that no matter the size, all projects need the basics, which makes smaller project's schedule having less time for solving other problems. Person B would prefer to work on the bigger projects, because the work itself does not increase so much due to the repletion that exist in big projects. And more repetition means higher productivity. But he also says that big projects can be very complicated. He points out that in very big projects there are a lot of people with different skill sets, that can make it very difficult to manage and a lot of time is spend to *"…making it all together…"*.

Repetition

More repetition results in higher productivity. Person A also says that each project is unique to itself and it is very hard to reuse aspects from previous projects. Person B and C point out that bigger project tend to have more repetitions.

Project type

All three agree that the project type does not have a big influence over the productivity but rather that different project types have different levels of complexity.

Complexity

Complexity has a big impact on the productivity. Person A says that residential buildings are often less complex, but they also have less monetary value and bigger competition. Person B says that when a project starts, an analyse is made to evaluate what can be done better and easier in order to fulfil the scope.

Budgets effect on the project and the team

Person A says that budget size can affect the choices that need to be made - if something can be left out on contract bases, you can complete the project for less hours. Person B points out that the budget has some effect on the choice of the team members since different people have different cost based on their experience. Person C also says that the budget has some effect on the project and what resources are put in it. The choice of the people on the project depends more on their availability. All three say that there is always a percentage of the whole project budget for unforeseen problems.

Skills and experience of the team

The project team and their experience are very important, and they affect the productivity a lot. All of them point out that it is never a good idea to make team member changes in the process of the project. Keeping the same team from the beginning till the end ensures higher productivity. At the same time having too many beginners on the project will have negative effect over the productivity. Person A points out that team formation is based on personal knowledge of the skills people possess, how they work with one another and their availability.

Management

All three of them emphasized on the importance of the role of the project manager. Good management affect the productivity in a positive direction. All three described his role as the person who keeps the project in the right direction.

Planning and scheduling

Planning and scheduling have an effect over the productivity to some effect. Person B point out that the right schedule is very import. There can be situation when the schedule can be too big or too compact. Both situations lead to complications. Person B also emphasises on the importance to keep a good track over the project schedule and to react as soon as problems occur, while Person C also adds the stress factor that can occur if too much work needs to be done in a short period of time. All three say that if the project progress is behind with an approaching deadline, more people are added to the project. They all agreed that if it is possible to move the deadline, that would be the better choice. Person C points out that some deadlines are connected to a sanction making them impossible to be prolonged.

Information dependability

The interviewees agree that information dependability or, more specifically, information delays have big negative effect over the productivity. Information delays happen all the time. Person B points out that meetings, with the different parties on the project, for discussing and highlighting what information is needed, will ensure less information delay and smoother communication. Peron C says that the amount of information delay depends on how good the planning is and how committed are everybody on the project. Person A mentions that if the information comes too late, it can be hard to be implemented before the deadline.

Quality of materials

Person A says it often happens that the information or materials deliver by another party is not of a good quality or precise enough, but with good communication, this problem is easily solved. Person C points out that the quality of the information can depend on the project progress and if someone is getting behind schedule.

Design changes and change orders

Changes have an effect over the productivity as well. Some changes can be connected to rework, while others can be connected to additional work. Person A says that there are several stages in a project and some things should be locked when a stage ends, but the clients often comes with changes. Person C says that too many changes can cause an annoyance among the team. Person B emphases that big chances coming from the client that are deviating from the project scope, known as change orders, needs to be paid extra. While Person A also points out that sometimes, in order to have good relations with the client and build good reputation, client changes may not be registered as change orders and they do not get paid.

Programs and tools used

The different programs and tools used during a project also have some effect over the productivity. Person B gave an example where the Architect and the Engineers in a certain project used two different programs for modelling. Person A says that use of advanced programs sometimes can get errors that will result in a lot of time spend for solving them. Person C says that some programs can be more demanding than others.

Data collection

Productivity data is collected to help for future project assessment. Person B includes time and cost spends. Person C adds project characteristics and project scope to the time and cost spend. Person A data collection includes project size and type, complexity, LOD, time and cost spend and a short description of the negative and positive occurrences. He also says that all this data also makes it easier to estimate how beneficial future projects can be.

Suggestions for improvement

Person A says that change orders should be handled “less friendly” with the clients, while Person C recommends good planning.

Biggest problem for the productivity

Person A points out the uniqueness of each project as the biggest problem. This means that each project starts from scratch with completely new teams. Person B points out the changes in team members. Person C points out the busy schedules and that it often happens that too many projects happening at the same time.

7.1.2 Interview analysis and outcome

Even though there are only three interviewees, they all gave very similar answers to the interview questions. This gives the opportunity to get some perspective and to make some conclusions of the current situation of engineering productivity during the design phase in Denmark.

It is confirmed that there is no standard in Denmark for defining or measuring the engineering productivity. Furthermore, all three of the interviewees did not give us a proper definition of what productivity is, but rather explained what contributes to it. This suggests that there is no unified definition in the companies themselves as well. The lack of proper definition leads to confusion, improper use and leads to minimum improvement.

Establishing how the productivity is measured is another important aspect of the interview. All three interviewees gave different but similar answers. The main components the productivity is based on are the size of the project, the budget that it has, and the hours spend. Person A, as a department leader, only pays attention to the productivity of the structural department. He uses the estimations together with some extra collected data for making decisions and for establishing the profit for future projects. While Person B, as a project manager, uses the productivity measurement as a tool for tracking the progress of the project for all discipline from the company (structural, electrical and plumbing) working on the project. Person C works in a smaller company, so he always measures the productivity for every discipline they have on a project, and just like Person A, uses the collected data for future projects establishments and decisions.

From these it becomes clear that the productivity can be useful not only for establishing for the success of the project, but also for tracking the progress and having the opportunity for acting upon problems as soon as possible, and assessments of future projects for choosing the strategy at the beginning. The productivity is not used to its full potential due to the fact that there is no unified definition and measurement across the industry. Also, the companies themselves have not developed a measurement that includes the impacting factors, but rather measure the productivity at more basic level and rely on personal experience and feelings.

All three emphasized on the importance of having a good productivity and that there are many different factors affecting it. On Figure 2, p.38 you can see a visual representation of the impacting factors and their impact on the productivity based on the interview's outcome.

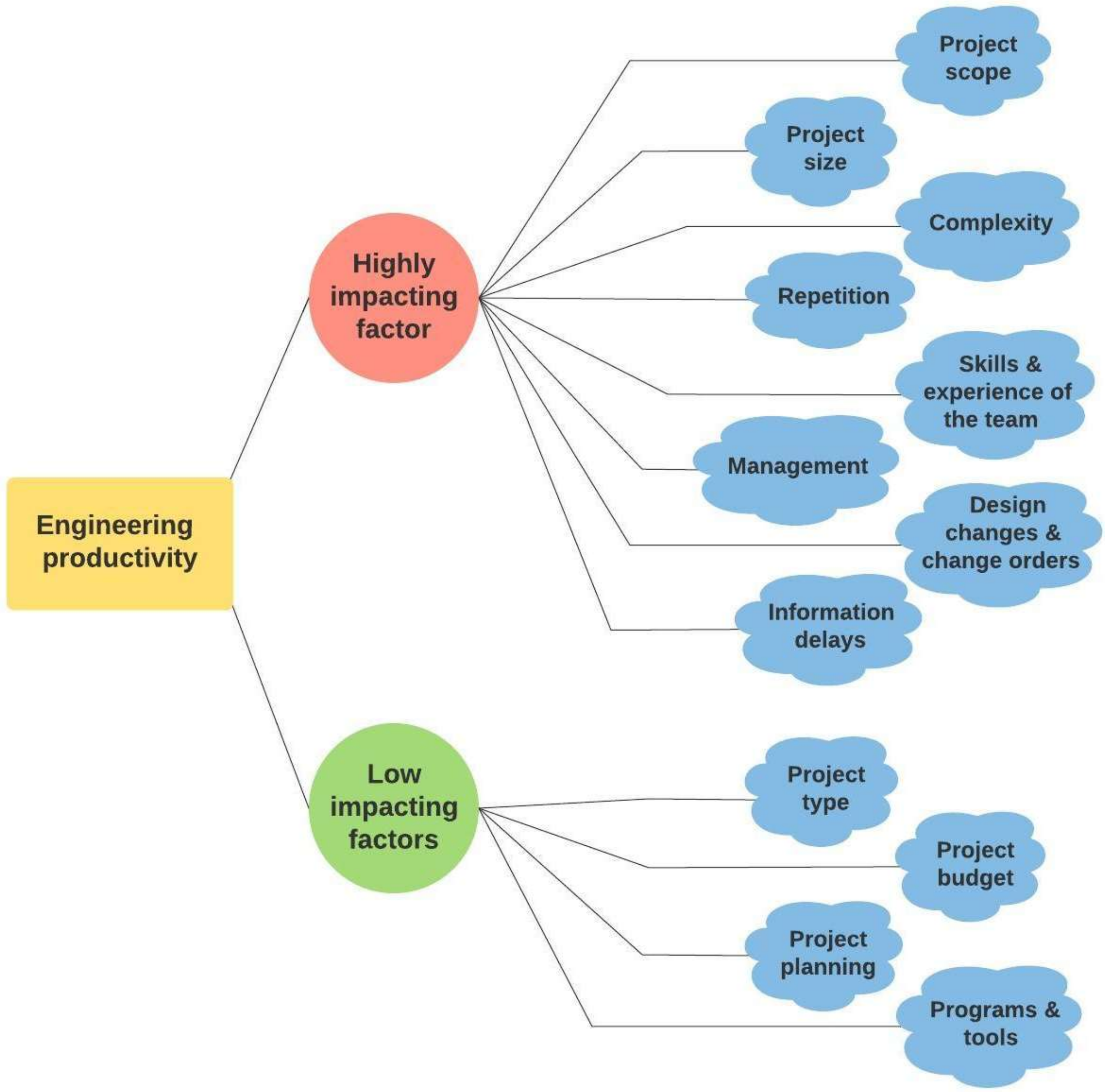

FIGURE 2 - IMPACTING FACTORS ACCORDING TO THE INTERVIEWS (OWN PRODUCTION,2020)

The project scope is considered import part of the project characteristic, that gives a feeling of the project, what needs to be done and give the direction of the project. Good project scope definition also results in a good planning, which immensely lead to better project performance. The project size, complexity, team members' experience and skills, management, together with the change orders and communication flow are the factors that were mostly emphasized on. Project size and the complexity are tightly connected with each other. Bigger projects can lead to bigger complexity but also can lead to more repetition. More repetition can lead to lower complexity. Smaller projects tend to have little to no repetition and the shorter duration of the project lead to higher complexity. Having the right team, as Person A says, is highly important. The right mix of experienced members with new beginners can be one of the biggest contributions to higher productivity. At the same time, the inner team atmosphere and relations are as important as the experience they have. All three of the interviewees said multiple times that having the same team from the beginning till the end of the project is very important. The project manager plays a key role for the keeping everyone on track, to solve problems and make quick decisions. If ineffective, the project progress gets behind schedule, which leads to worse quality and low productivity. Changes are part of the design process and are a constant. There are some changes, like change orders or design changes made in the wrong time, that lead to a lot of rework or extra work, which always have a negative effect over the productivity. The information dependability is also another immutable part of the design process. Having good communication and smooth information flow ensures high productivity, while having to stop the progress and wait for crucial information can lead to negative impact.

Project type, project budget and planning, and different programs and tools used have less affect over the productivity. The project budget can have some effect over the choice of the team members. Smaller project budgets can have bigger effect over the productivity, since their complexity can be higher, but their project duration is short. Project planning also have less effect over the productivity. If it is necessary more people can be added to the project or, in some cases, the deadlines can be pushed. The use of different programs and tools can have some effect over the productivity, as the given example by Person B points out. The decision of what will be used is decided at the beginning of each project. Person B also pointed out that sometimes it is hard to predict what effect can a certain program have over the project.

The data that is being collected for the productivity is not very detailed when it comes to the impacting factors established from the academia and the interviews. The level of impact of the different factors is not measured and this make it hard to say which factor has the biggest effect over a certain project. Person B, as mentioned above, uses the productivity estimation for keeping track over the project progress. If the factors are tracked more carefully and detailed, and the productivity is then measured during the project including the factors' impact, then project managers can have more information to act upon during the project. At the same time the different components of the data collection depend on the use – project forecast, project progress or project evaluation.

The biggest problems for the productivity mentioned by the interviewees include the uniqueness nature of each project, the changes in the team members and the busy schedules. The industry fragmentation and the uniqueness of project is a fact in the construction industry. The development of the new technologies and different tools that can assist the industry and help eliminate reoccurring problems. The changes in the different teams is controlled by the companies themselves. All three interviewees stressed upon that these changes should be minimized. Of course, the availability is another aspect of the team formation. This can lead to the management aspect, that with a good management changes in the team members can be avoided. The busy schedules can be eliminated by good planning. Another aspect that was pointed out – good planning leads to better results.

7.2 Survey

Professionals, who work in the construction industry took a participation in a short survey with the purpose of ranking the groups of factors and the factors that affect the engineering productivity during the design phases of a project. The total number of respondents who took participation in the survey is 37. The survey consisted of 34 questions in total of which 33 with multiple choice questions and 1 open-end question.

By asking the first question the respondents were asked to introduce their working position as shown on Figure 3, p.41. As shown 40,5% are on management positions, who directly work with managing engineering productivity. Another 29,7% are on engineering positions and the rest 29,8% are occupied as constructing architects and technical designers, who all directly affect the level of productivity as a labour force in the design office.

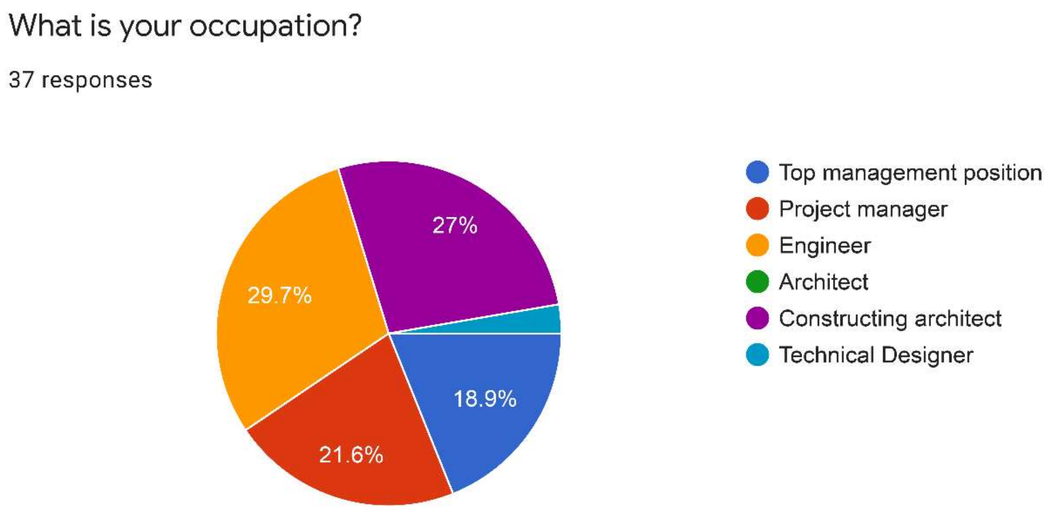

FIGURE 3 – OCCUPATION OF THE RESPONDENTS OF THE SURVEY

The responses from top managers and managers are further placed in one group and the engineers, constructing architects and technical designers, placed in another group, were further tested with Friedman's ranking test. The purpose behind analysing the ranking order from the two groups is to see if there is difference between ranking from the management level and the operation level. In Table 4, p.42, the visualization in the ranking from the two observed groups is outlined and an indication of the difference in positioning is additionally marked with red and green arrows. This analyse is showing that for some of the factors there is a different ranking positioning, but for further analysis of the data all the responses will be analysed and used as a one group, because the productivity depends on all levels of performing the design phase.

Factor groups	***Factors***	***Top management rank***	***Pos.:***	***Labor rank***	***Pos.:***	***Difference***
General groups	Project factors	***15,1***	4	***12,73***	4	***Yes***
	Labour factors	***15,53***	3	***16,66***	2	1
	Management factors	***20,30***	1	***21,98***	1	***Yes***
	Technical factors	***16,23***	2	***13,68***	3	-1
	External factors	***5,83***	5	***4,86***	5	***Yes***
Project factors	Project scope	***15,03***	15	***15,14***	14	1
	Project location	***8,10***	23	***5,66***	25	-2
	Project characteristics (size, buildability and ect.)	***15,07***	14	***18,02***	12	2
	Project complexity	***20,37***	6	***23,02***	1	5
	Rework and delays	***15,60***	12	***21,05***	6	6
Labour factors	Employee skills	***16,67***	10	***19,39***	8	2
	Employee availability	***15,03***	15	***18,89***	9	6
	Employee motivation	***20,60***	5	***18,5***	10	-5
	Employee experience	***13,50***	18	***14,48***	15	3
	Labour work facilities and satisfaction	***14,73***	17	***13,61***	18	-1
	Labour fatigue	***12,90***	19	***14,11***	17	2
Management factors	Supervision	***15,77***	11	***12,91***	19	-8
	Planning and sequencing	***20,37***	6	***22,89***	2	4
	Competency of project manager	***18,90***	8	***21,89***	5	3
	Availability and quality of information	***21,83***	3	***21,93***	4	-1
	Coordination and collaboration	***22,13***	1	***22,39***	3	-2
Technical factors	Tools and programs	***15,30***	13	***14,27***	16	-3
	Techno changes	***12,50***	20	***11,05***	20	***Yes***
	Design changes	***18,10***	9	***18,18***	11	-2
	Incomplete or unclear specification of the work	***21,13***	4	***20,98***	7	-3
	Client and consultants	***21,93***	2	***17,73***	13	-11
External factors	Financial stability	***7,53***	24	***6,25***	23	1
	Permits	***11,27***	22	***9,07***	21	1
	Legislation	***11,53***	21	***7,86***	22	-1
	Weather	***6,10***	25	***5,84***	24	1

TABLE 4 - RANKING DIFFERENCES FROM THE OCCUPATIONAL GROUPS (OWN PRODUCTION,2020)

The internal evaluation of the respondent's answers to the first-two questions shows that most of the participants 75,7% have more than 5 years of experience in the construction sector (see Figure 4).

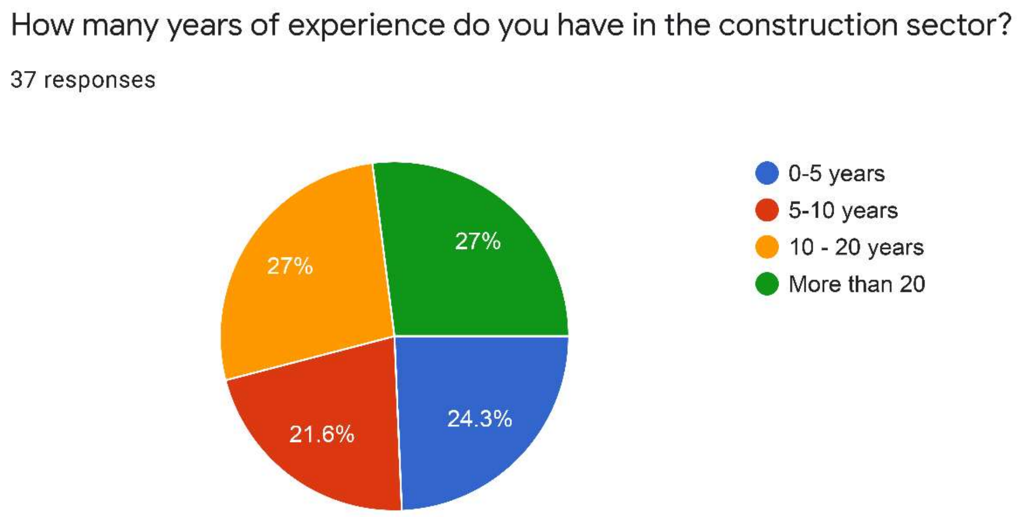

FIGURE 4 – YEARS OF EXPERIENCE OF THE RESPONDENTS FROM THE SURVEY

After introducing themselves the respondents were asked to choose, which groups of factors have effect on the engineering productivity by marking 1 or more checkboxes as follows in Appendix B – 13.2.1 Questions. The initial answer to the question shows that the most impacting group of factors is the Management category (see Appendix B – 13.2.2 Survey responses), but for further validation the respondents were asked to rank each group of factors and each separate factor with a Likert scale from 1 to 5. Based on the results more statistical tests are performed to investigate the statistical validity of the survey and to rank the factor groups and factors based on their significance to the engineering productivity.

7.2.1 Survey validation test

The consistency of the survey results is tested by calculation of the Cronbach Alpha measurement, see Appendix C. The measurement is taken only for the questions graded by the usage of 5 levelled Likert scale, from which it corresponds to 0.865. According to the data analysis methodology this measurement is referring to a good consistency and the survey pass the reliability test. In Appendix C a mean value and a standard deviation from the respondents scaling is calculated for each item. Also, Cronbach alpha value is recalculated if the different items were deleted and excluded from the survey, which visualize the impact and the reliability across the different components of the survey over the Cronbach Alpha measurement. The study shows good consistency in all the cases tested in all the variation is above 0.8.

7.2.2 Friedman's ranking

The grading of the factors with the Likert scale from 1 to 5 shows for each group of factors and each factor the weight given by the respondents. By calculations carried out for each factor an aggregate rank is outlined (see Table 5, p.45, see Appendix D) based on the Friedman's test. The data is further systemized in accordance with the factor's impact on the engineering productivity (see Table 5, p.45). The groups of factors are graded in a scale from 1 to 5, based on their rank. As a most influencing was graded the Management group of factors, descending with the Labour group, Technical group, Project group and on 5th position was placed the group of External factors (see Table 5, p.45). The factors in each group were also ordered according to their aggregate rank. The ranks are further marked with the colours red for most likely high impact and green for most likely low impact on the engineering productivity. This action is performed by taking the mean value from all the factors. Based on the respondents answers and the ranking, the grading of the factors corresponds with the ranking of the groups as follow: the most impacting factors are in the Management group with having four out of five factors with most likely high impact on the engineering productivity, followed by the Technical and Project groups with each having three out of five factors with most likely high impact, on the 4th position is the Project factors group with only three out of six factors with most likely high impact and the External group of factors with no factors graded as most likely impacting. The factor having the highest rank according to this survey and the Friedman's test is the communication and collaboration factor, followed by with a slight difference in the ranking by the project complexity. The least impacting factor for the case appears to be the weather factor and its impact on the engineering productivity (see Table 5, p.45).

			Rank
General groups	Project factors	**13,69**	4
	Labour factors	**16,20**	2
	Management factors	**21,30**	1
	Technical factors	**14,72**	3
	External factors	**5,26**	5
Project factors	Project scope	**15,09**	**14**
	Project location	**6,65**	**24**
	Project characteristics (size, buildability and ect.)	**16,82**	**13**
	Project complexity	**21,95**	**2**
	Rework and delays	**18,84**	**9**
Labour factors	Employee skills	**18,28**	**10**
	Employee availability	**17,32**	**12**
	Employee motivation	**19,35**	**8**
	Employee experience	**14,08**	**16**
	Labour work facilities and satisfaction	**14,07**	**17**
	Labour fatigue	**13,62**	**19**
Management factors	Supervision	**14,07**	**17**
	Planning and sequencing	**21,86**	**4**
	Competency of project manager	**20,68**	**6**
	Availability and quality of information	**21,89**	**3**
	Coordination and collaboration	**22,28**	**1**
Technical factors	Tools and programs	**14,69**	**15**
	Techno changes	**11,64**	**20**
	Design changes	**18,15**	**11**
	Incomplete or unclear specification of the work	**21,04**	**5**
	Client and consultants	**19,43**	**7**
External factors	Financial stability	**6,77**	**23**
	Permits	**9,96**	**21**
	Legislation	**9,35**	**22**
	Weather	**5,95**	**25**
	Mean Frequency rank	**15,754**	
	*Ranking of factors with colour:		
(green)	most likely low impact from 15,754 below		
(red)	most likely high impact above 15,754		

TABLE 5 – AGGREGATE RANKING OF THE FACTORS WITH FRIEDMAN'S TEST

7.2.3 Friedman's test

As explained more detailed in sub-chapter 2.3 a testing of the responses by the Friedman's test against the null hypothesis is performed. The test shows that a rejection of the null hypothesis is possible because the actual chi-squared 367,79 is above the critical value of chi-squared 42,56. The differences between the medians is additionally tested by calculating p-value and comparing it with the significance level of α. In this case the results are showing that the samples are having a statistically significant difference, because the p-value is 0,00 (2,380E-60), which is much lower than 0,5(α-value) (see Figure 5, see Appendix D).

Blocks (n)		*37*
Treatments (p)		*30*
Part 1		*0,00035*
Part 2		*10921704*
Part 3		*3441*
alpha		*0,05*
$X^2{}_r$		*367,79*
Critical value chi-square	X^2	*42,56*
p-value		*0,00*
Reject Null?	***Yes***	

$$X^2{}_r = \left[\frac{12}{n(p)(p+1)}\sum_{j=1}^{p} r_j^2\right] - 3n(p+1)$$

FIGURE 5 – FRIEDMAN'S TEST (OWN PRODUCTION IN EXCEL,2020)

7.2.4 Wilcoxon's test with Holm's adjustment

The Wilcoxon's test is used to analyse all the possible pairs of samples and if they are equal as stated in sub-chapter 2.3: for the five groups of factors ten pairs are tested and for the impacting factors three hundred possible pairs are outlined to be tested. The p-values data taken from the Wilcoxon's test in the 27.0 version of SPSS is transferred in Excel worksheet, then the p-values are compared with the adjusted α-value from the Holm's method.

The results from the tested samples of the groups of factors are showing that there is statistical significance in the ranking order of the Management group on 1st position and External group on 5th position, which correspond to accuracy in their ranking positions. The results are also showing that there is no statistical significance in the ranking of the Project, Labour and Technical groups, leading to a conclusion that the ranking difference is not enough to reject the null hypothesis and state that the samples are not equal (see Appendix E).

The results from testing the factors outlined, that there is a statistical difference in the previously distinguished as groups of most likely high and most likely low impacting factors. This led the research to a conclusion that the two groups are significantly different in their positioning and the group ranked as most likely high impacting has actual higher impact on the engineering productivity. The outcome also shows that there is not a statistical difference in between all the factors in the most likely high impacting group and in between the factors in the most likely low impacting group. This shows that the factors in each group are very similar to one another and their positioning in each group can be interpreted as not so prominent.

7.2.5 Survey open-ended question

The last question of the survey had an open-ended form and was not mandatory to answer to. Out of the total number of respondents (37), twenty-four gave their contribution to the investigated problem, but two of the answers to the question were excluded, because of their irrelevance to the topic. The final number of respondents is therefore concluded to be twenty-two. The respondents were asked the following question:

'Based on your own experience which is the biggest problem for achieving high engineering productivity?'

Based on the given answers five main themes were identified – Communication and collaboration, Planning and budgeting, Management, Design changes and Outdated methods and missing standards. Below the answers are summarized and distributed into the groups.

Communication and collaboration

From the data collected from this question can be validated that the communication and collaboration have a major impact on the engineering productivity, but also that there is a lack of communication and collaboration with the usage of digital tools and programs.

Planning and budgeting

The professionals pointed out that the planning procedures have negative impact on the productivity, because unrealistic planning, budgeting and resource allocation are made. Schedules tend to be too tight or miscalculated in accordance with the complexity of the building.

Management

The management procedures and practices are stated as one of the biggest problems for higher productivity. The management need to make decisions at the right time and distribute those decisions to the team. Sometimes, there is a long chain of managers and the information which is getting to the labour is not clear or understandable. Bad management as stated by the respondents can be crucial for good productivity.

Design changes

The analysis of the data brought also as a problem the design-changes at the last stages of a project. This is bad for the overall productivity, because most of the time small and medium size changes occur, but time extension is not usually an option.

Outdated methods and missing standard

Tradition is highly valued among the construction industry, but since each project is unique, a demand for new approaches arise and older procedures sometimes should not be used. Another problem coming from the responses is that there is unclear, unidentified calculation of the productivity, which pressures the development of one that will enhance the productivity.

The information given in the survey's last question by the professionals helps the research to get a more detailed view of the engineering productivity in the construction industry in Denmark. It can be concluded that the information dependency and the industry fragmentation that exist in the construction industry demands a good communication and collaboration plan that will ensure smooth exchange of information. The industry is famous for its conservatism and resistance towards novelties. With the technology development this exchange can be eased when properly implemented and applied. Another aspect pointed out is the planning and budgeting. As mentioned in the interviews, a good planning ensures good results. Once a sufficient data base with past project productivity calculations and impact from the factors is recorded, the predictions for future projects will be improved. This will help with the strategy choices, project planning and resource allocation. The management procedures are stated as the biggest influence over the productivity. The Management factors group is also the highest ranked group having the highest impact over the engineering productivity. The managers play a key role at keeping the project on track and in the right direction. The good inner team communication is as equally important as the communication among the different project teams. Design changes can have a disastrous effect over the project if made in a late stage of the project when their implementation is very difficult. A good planning and the following of the planning should help prevent late design changes. The outdates methods and missing standards is also an aspect that is established by the literature review. It is a problem than exists not only in Denmark but in the whole construction industry. The lack of a standard is considered as the main obstacle for achieving precise engineering productivity establishment from both the academia and the industry itself.

7.3 Summary of the data analysis

The usage of the previously mentioned methods for analysing the outcome of the interviews and the survey (see sub-chapter 7.1 and sub-chapter 7.2), helped to analyse the data, collected from the professionals working in the construction business, and provided the research with information for the factors' relevance for the engineering productivity. For further analysis of the most likely impacting factors, the occurrence of factors, that have most likely high impact are taken out from the interviews are compared with the most likely high impacting factors from the survey (see Table 6, p.51).

The table below represents a visual comparison of the factors stated as most likely high impacting from the interviews and the factors ranked by the Friedman's mean ranking as most likely high impacting and marked with cross and yellow colour. From this analysis of the occurrence of factors with likely high impact there is a deviation for part of the outcome, meaning that some of the factors stated by the interviewees are not ranked as a highly impacting in the results of the survey ranking and the opposite, some of the factors are ranked as a highly impacting from the survey ranks, but not considered in the same way by the interviewees. At the same time there is a compatibility between some of the factors from the interviews and the survey (see Table 6, p.51). Since the interviews are only three and the main goal is to establish the current situation of the engineering productivity in the construction industry in Denmark, not all the factors were included in the questions. The study will proceed with using the analysed in sub-chapter 7.2 factors from the survey, since its only focus is on grading the factors.

Even though the engineering productivity in the industry is mainly based on the personal experience and feeling of the professionals, instead of on actual values from a sophisticated measuring system, this shows that there is a common feeling of the impact of the different factors over the productivity. With a more precise calculation, this influence can be understood even better and can be act upon for achieving better project results.

Groups	Most likely high impacting factors	Interviews	Survey
Project factors	Project scope	X	
	Project location	/	
	Project characteristics (size, buildability and ect.)	X	X
	Project complexity	X	X
	Rework and delays	X	X
Labour factors	Employee skills	X	X
	Employee availability		X
	Employee motivation		X
	Employee experience	X	
	Labour work facilities and satisfaction	/	
	Labour fatigue		
Management factors	Supervision	X	
	Planning and sequencing		X
	Competency of project manager	X	X
	Availability and quality of information	X	X
	Coordination and collaboration	X	X
Technical factors	Tools and programs		
	Techno changes	/	
	Design changes	X	X
	Incomplete or unclear specification of the work	/	X
	Client and consultants		X
External factors	Financial stability	/	
	Permits	/	
	Legislation	/	
	Weather	/	

Table 6 – Comparison of the factors stated as most likely high impacting from the interviews and the survey (Own production, 2020)

8 Productivity framework

This chapter will provide an overview of the proposed framework for identifying and implementing an engineering productivity measurement system which includes the impacting factors. It will focus on the first three main steps 1) productivity measurement 2) data collection 3) productivity modelling (see Figure 6).

FIGURE 6 – FIRST THREE STEPS OF THE PRODUCTIVITY FRAMEWORK (OWN PRODUCTION,2020)

8.1 Productivity measurement including the impacting factors

As established from the literature review, the engineering productivity measurement is based on the output and the input for creating that output. There are many different definitions used among the construction industry. There is the classical definition of output to input ratio, such as number of drawings per work hour. There is also input to output ratio, that is used in the construction industry as well (Kim I. , 2007). As mentioned above, in Chapter 1, this represents the unit rate, in the form of work hours per unit. This approach makes it easy for estimating the costs per units and explains why it is preferred. (Kim I. , 2007)

The literature review shows that the academia has chosen to use this productivity definition. For the input hours spend is the most used unit. According to Song and AbouRizk (2005) *"work hours … are an appropriate measure of design input and are traceable".* The hours spent can be divided into two main categories – direct productivity hours, which are connected to the time spent for producing the final product; and indirect hours, which are connected to time spent for coordinating meetings, QA/QC, etc. Kim (2007), for example, uses only direct hours in his productivity estimation, while Chang and Ibbs (2006) include both direct and indirect hours spend in their system model.

The output, however, is more difficult to be defined (Sacks & Barak, 2008) (Eastman & Sacks, 2008) (Yi & Chan, 2014). As mentioned in Chapter 1, the output can be defined as number of drawings (Thomas, Korte, Sandivo, & Parfitt, 1999), designed units (Song & AbouRizk, 2005), or engineered quantities (Kim I. , 2007). A lot of the methods include the number of drawings or a combination of drawings, specifications and documentations as the output. This is deemed as irrelevant since it fails to incorporate the complexity of creating the 3D model, which is a common practice nowadays. The creation of the 3D geometry of the model is consuming a lot of the designers' time, while creating and preparing the final drawings is significantly fast process, especially when compared with the 2D design method (Sacks & Barak, 2008).

Song and AbouRizk (2008) point out three criteria that need to be considered when defining the output measurement:

- There should be high correlation between the work hours and the output,
- The output measurement should be independent from the impacting factors,
- The output measurement should be easily traceable.

They conducted a correlation analysis to compare different output measurements with the work hours input. The weight, quantity of drawings, quantity of design items and their own proposal – drafting unit, were taken into the analysis. The results showed that the drafting unit has the highest correlation. The drafting unit incorporates the 3D model complexity by using a complexity factor. Song and AbouRizk (2005) *"decompose"* a project to its design items by the use of a work breakdown structure (see Figure 7, a). Then those items get categorized into design categories, based on their design similarities (see Figure 7, b). Each design category has a complexity variable and a complexity function. A base piece is selected and the relationship between the base piece complexity and the design category complexity variable is assumed through a linear function. This will ensure a more accurate complexity calculation. *"Applying this method to various design items, the design output can be measured uniformly* *into an abstract unit of measure"* (Song & AbouRizk, 2005). They define the engineering productivity as input/output as work hours per unit of design, going for the unit rate.

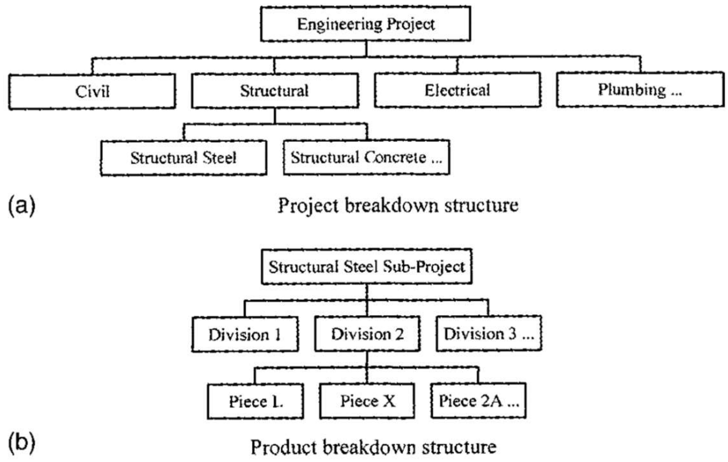

FIGURE 7 – PRODUCTIVITY BREAKDOWN STRUCTURES ((SONG & ABOURIZK, 2005)

Based on use this approach, with the help of professionals (a structural engineer, a project manager and a designer) from Company AB, a more basic project breakdown is made for the Structural project (see Figure 8). The project is divided into the main components it contains: foundation, floors, walls, decks, columns and beams. The main categories are further divided into their composite parts to form the design categories.

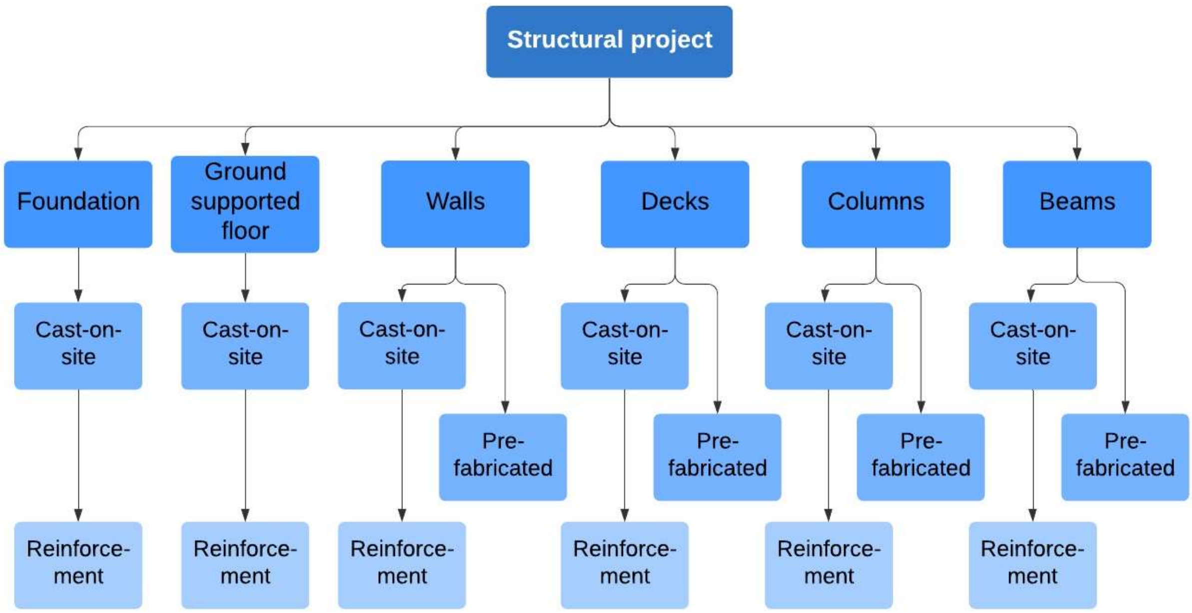

FIGURE 8 – STRUCTURAL PROJECT PRODUCTIVITY BREAKDOWN STRUCTURE, DIVIDED INTO THE MAIN COMPONENTS IN A PROJECT (OWN PRODUCTION,2020)

However, the 3D models are not build the same ways as the actual buildings are (AB/Company, 2020). For example, the prefabricated walls are not split into elements, since adjustments during the design will be very time consuming. At the same time, different Levels of Detail (LOD) exists. The higher the LOD, the more detailed the models are, hence more time is needed for their creation. Which means that the 3D models do not always include all the elements that were identified in the project breakdown structure, such as reinforcement. The different contractors are further modelling the detail elements based on the calculations and analyses made by the engineers (AB/Company, 2020). At the same time, a lot of time is spent on making different calculations and analyses that are not included in the time spent for modelling the models. The different calculations and analyses are not always done for each piece, but rather sections or elevations, containing a few floors or walls, are taken together (AB/Company, 2020). Hence, diving the project into design units creates too many complications for the engineering projects. This also makes the calculation of the productivity as a unit rate unreasonable.

Instead, the measurement of output to input will be more suitable. The input will still include time spend. The output can be measured by number of drawings but as already established, it does not include the complexity of using CAD tools and programs. At the same time, the professionals from Company AB point out that there are a lot of calculations and analyses that are done before the creation of a 3D model begins. This leads to the conclusion that the number of drawings is not at all suitable as an output. However not everything done during the design process is quantifiable. For example, the time spend for different meetings and coordination or QA/QC. This represents another problem for determining the output. During the interviews it was established that the companies are calculating the productivity based on 3 components – budget, square meters and duration that are known from the beginning of the project. Then the established productivity is compared with the actual productivity, measured at the end of the project, based on the same 3 components. The research will use Actual hours over Planned hours instead. This approach is also established from the academia as a reliable productivity measurement (Yi & Chan, 2014). Using this measurement leads to the opportunity to have the project divided at a Discipline level as well. The Project level will be the most desirable level for calculation of the productivity since it offers the easiest way for comparison in the company and with other companies' productivity. But this level can lead to mistakes when it comes to the complexity of the whole design process. The Discipline level should provide a more accurate result. This research divided the Structural project into three main categories – Analyses, Modelling and Management (see Figure 9). Analyses and Modelling are the direct productivity hours spend and the Management is the indirect productivity hours spend. Similar division should be expected for the Architectural, HVAC and El project. The productivity measurement will look like Analyses actual hours per Analyses planed hours, Modelling actual hours per Modelling planned hours and Management actual hours per Management planned hours.

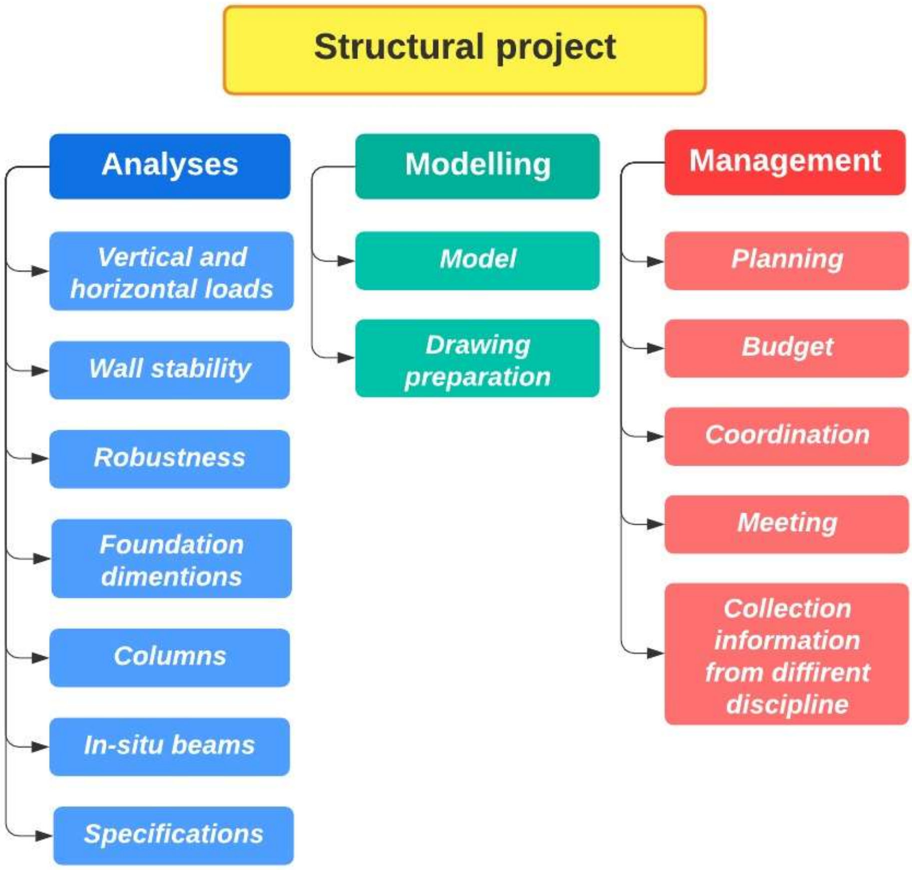

FIGURE 9 – STRUCTURAL PROJECT PRODUCTIVITY BREAKDOWN STRUCTURE DIVIDED INTO 3 DIVISIONS (OWN PRODUCTION,2020)

Another more detailed division would be splitting the project into the different phases it goes through (see Figure 10). This will lead to an opportunity for a check-up of the productivity after each phase and help the management to adjust the project direction if some problems occur. This should lead to more accurate results from the more general calculation, but it will also require a more detailed data collection. If properly implemented, it should help the companies to adjust their processes to be able to achieve the best results possible. The Discipline level productivity or the Phase productivity can be chosen depending on the project characteristics. For smaller projects, the overall Discipline productivity should be more suitable, but for bigger project that require a long duration and/or have high level of complexity, Phase productivity should be more suitable.

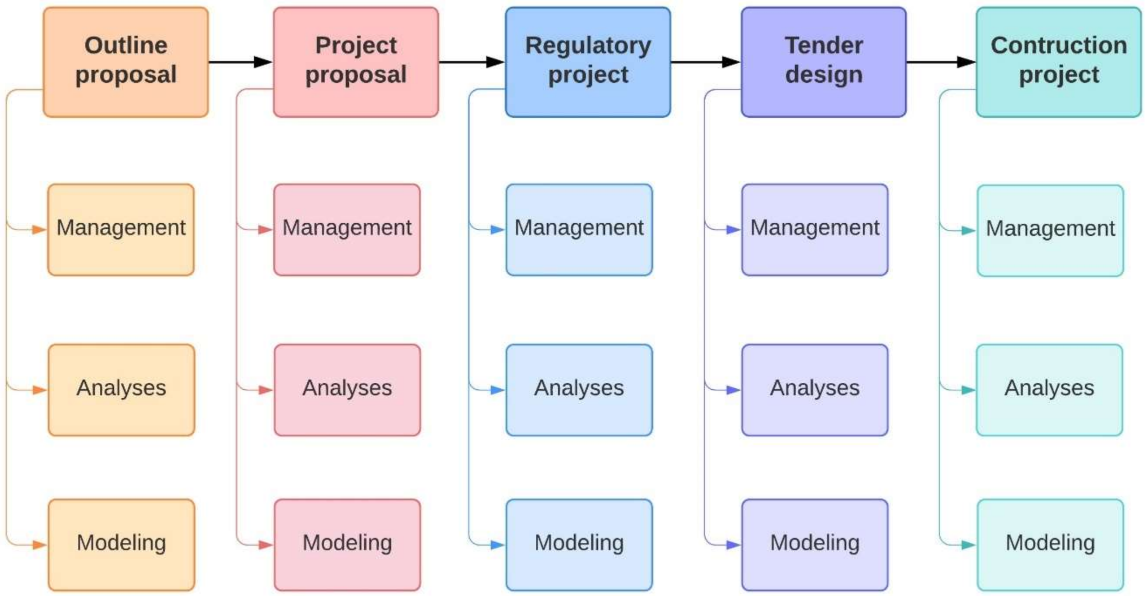

FIGURE 10 – PROJECT PHASES BREAKDOWN STRUCTURE (OWN PRODUCTION,2020)

The impacting factors that have the highest impact need to be taken into consideration when calculating the engineering productivity. Different factors have different impact for developed and developing countries (Nasirzadeh, Kabir, Akbari, Nahavandi, & Carmichael, 2020) (Heravi & Eslamdoost, 2015). According to the literature review 25 influencing factors were identified. The research conducted a survey among professionals working in the construction industry in Denmark (see sub-chapter 7.2). The factors were divided into most likely low impacting and most likely high impacting categories. Only the factors falling into the most likely high impact category will be further implemented into the engineering productivity measurement (see Figure 11). Their influence needs to be measured by the team members by ranking their level of impact at the end of each project or phase. This will help to evaluate the productivity in a more detail level that will help in achieving better results for the future projects.

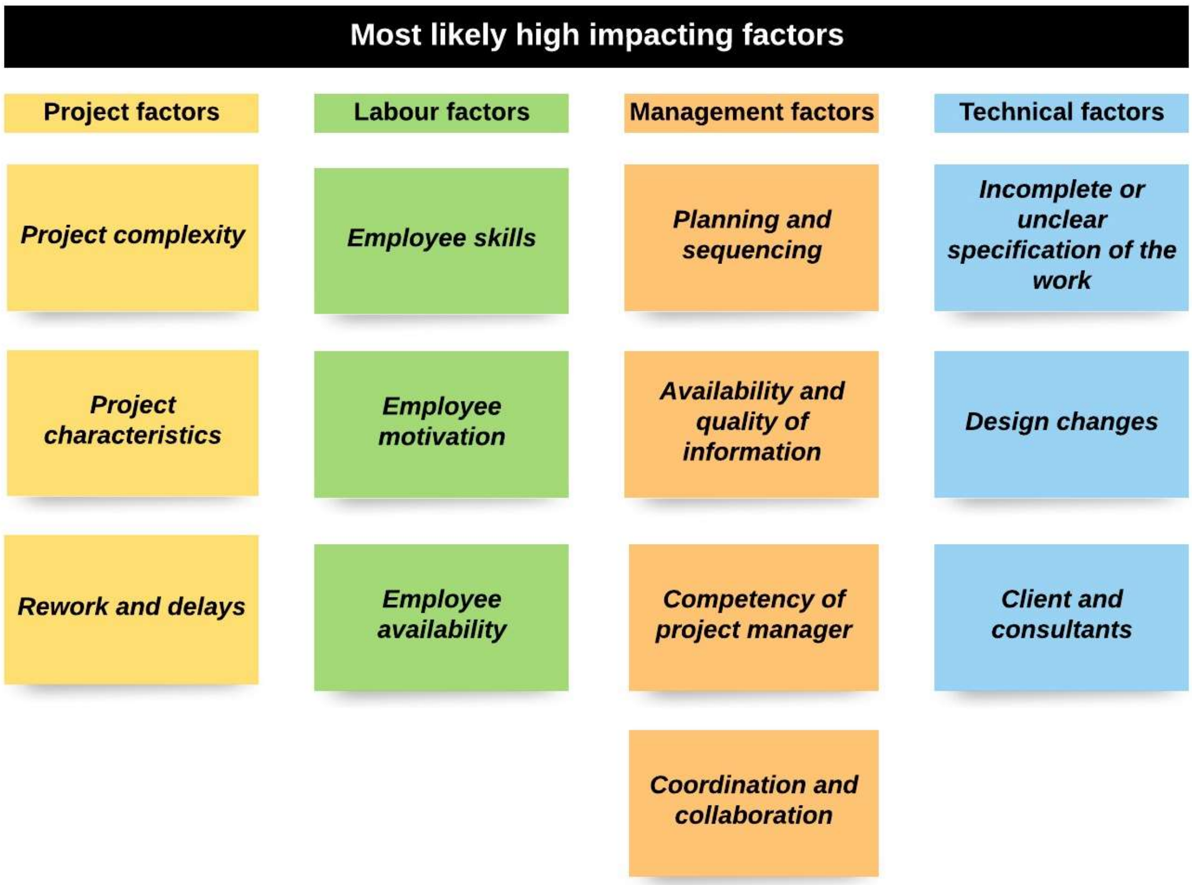

FIGURE 11 – MOST LIKELY HIGH IMPACTING FACTORS INTO THE ENGINEERING PRODUCTIVITY MEASUREMENT (OWN PRODUCTION, 2020)

8.2 Data collection process

Once the productivity measurement and the impacting factors are selected, the data collecting process needs to be determined. The implementation of a new data collection system can be an expensive initiative. It can require a training of the employees and/or an upgrade of the current IT infrastructure (Hadidi, Assaf, & Alkhiami, 2017). As Song and

AbouRizk (2008) point out that a data acquisition system should be *"…integrated into the overall information system framework of a company"* to be feasible.

The system needs to collect data about the time spend for the three main categories established in the previous sub-chapter – Analyses, Modelling and Management. In an addition to this, it needs to collect data about the impacting factors as well.

During the interview phase of this research, one of the interviewees, Person B, mentioned that an Enterprise Resource Planning (ERP) program is used to collect the time spend on the project. The research carried out a further investigation into the for abovementioned. ERP is a business management system that allows the *"…integration of various business processes of an organization... using a single database"* (AboAbdo, Aldhoiena, & Al-Amrib, 2017), that helps in managing and monitoring *"ongoing project's resources and status"* (Gavali & Halder, 2019). This leads to "…*increased information sharing and integrity of the business processes"* (Hadidi, Assaf, & Alkhiami, 2017). An ERP system consist of multiple modules, that have different functions, such as HR, financial, planning, inventory, etc. (Gavali & Halder, 2019) (AboAbdo, Aldhoiena, & Al-Amrib, 2017). Each module is a standalone system, but they are linked together, which ensures the sharing of information and data (AboAbdo, Aldhoiena, & Al-Amrib, 2017). The ERP system are constantly developing by adding more functions (Gavali & Halder, 2019). According to AboAbdo, Aldhoiena and Al-Amrib (2017) implementing such a system in a company will contribute to the simplification of different operations and "…*speed up the decision-making process".*

The Financial module in an ERP system includes data collection for time spend. By adding a module for data collection of the engineering productivity impacting factors to an ERP system can ease the process, can ensure feasibility and can help the improvement of the productivity of the companies.

8.3 Modelling productivity

After the phase of collecting data a question arises of how this data should be systemized and used for modelling and measuring productivity. "*The term "productivity modeling" refers to the approach of analyzing and estimating the impact of productivity-influencing factors on* *construction productivity using historical project data"* (Sonmez & Rowings, 1998) (Song & AbouRizk, 2008). Many different methods are discovered by the academia for modelling productivity. This sub-chapter will evaluate the most used modelling techniques.

Expert systems

One of the models used for productivity estimation is the expert systems. An expert system is a computer program which uses human knowledge to solve a given problem by using "if-then" rules and Artificial Intelligence (AI) methods (Durkin, 1990).

In the construction sector, expert systems used by McGartland and Hendrickson (1985) for construction project monitoring, time, cost, purchasing and inventory control. Later Maher (1987) proposed the possibility of using expert systems during the early stages of designing structures. Faghri, Joshua and Demetsky (1988) used it for railway and highway crossing evaluation. Mikami, Tanaka and Kurachi (1994) made various research based on expert systems and its ability to diagnose steel bridges. Based on all those articles, in order an expert system to be created in a design office on a level that will predict productivity, the people involved in the preparation of the system should have an extensive knowledge about engineering productivity. Robinson, Frank and Blaze (1986) stated that creating an expert system also involve high cost and long time and many years for a strong user involvement. Zahedi (1991) compared the expert systems (AI) with the neural networks (NN) and concluded that a combination of both might be most suitable, but not yet discovered.

In his research Wassermann (1989) pointed that the process of finding solutions by the expert system, might be limited by the personal assumptions and input of the experts. After the introduction of Artificial Neural Network (ANN): Yi and Chan (2014), Heravi and Eslamdoost (2015), El-Gohary, Aziz, and Abdel-Khalek (2017), and Nasirzadeh, Kabir, Akbari, Nahavandi, and Carmichael (2020) conducted research and have further validated Wassermann's (1989) theory regarding the limitations of the expert systems.

Simulation tools

The progress in technology during the years called for development of simulation tools for predicting the processes in the construction industry. This method is based on creation of a model that is trying to predict a real-life situation. For the model to work and predict accurately it should represent the real situation with a high level of similarity and detail. According to Hajjar & AbouRizk (2000) the first steps towards the use of simulation tools in the construction industry were made with the creation of the simulation system CYCLONE by Daniel W. Halpin in 1973. The first three simulation tools thrived by this system were: AP2-Earth for earthmoving analysis, CRUISER for production analysis and CSD for optimization of dewatering operations (Hajjar & AbouRizk, 2000). Later many other simulation tools were developed and adopted for use with predicting construction processes. Zayed and Halpin (2004) used microCYCLONE, to predict the productivity of pile assessment. The microCYCLONE system is based on graphic interpretation and easier to understand than its preceding system CYCLONE (Zayed & Halpin, 2004). Another approach used by Khanzadi, Nasirzadeh, Mir and Nojedehi (2017) incorporated the usage of system dynamic (SD) and agent-based modelling (ABM) for forecasting the labour productivity on the building site. The combination of those two modelling approaches represent the combination of the impacting factors over the productivity as output from the SD, and the labour interaction on the site as output from the ABM. Matejevic, Zlatanovic and Cvetkovic (2018) introduced simulation designed in AnyLogic 7.2.0, which operates in JAVA object-oriented interface, and used it for predicting the productivity of concreting of reinforced concrete slabs. The research also reveals that the AnyLogic simulation tool gives satisfactory results for predicting the productivity on site (Matejevic, Zlatanovic, & Cvetkovic, 2018).

In the above mentioned cases, the simulation tools are widely used for modelling the construction productivity, but no discussion came across for their usage in the design office. Also, Nasirzadeh, Kabir, Akbari, Nahavandi and Carmichael (2020) are considering this method unreliable as it includes personal attributes, because the simulation model is created by professionals, who are using their preceding experience.

Regression analysis and statistical methods

Another modelling method for forecasting productivity used by Hanna, Taylor and Sullivan (2005), Chang, Hanna, Lackney and Sullivan (2007) and Al-Zwainy, Abdulmajeed and Aljumaily (2013) is the Linear Regression (LR) analysis. It is statistical tool used to predict models for the relationship between two variables using the following equation (Illowsky & Dean, 2013, p. 680):

$y = a + bx,$

Where: y is the dependent variable and x is the independent variable.

In a case that more than two independent variables occur a Multiple linear regression model is used to estimate the relationship between the two or more independent variables and one dependent variable with the following formula (Sahay, 2016):

$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \ldots + \beta_k x_k + \varepsilon$

$\boldsymbol{y}$ = the predicted value of the dependent variable

$\boldsymbol{\beta_0}$ = the y -intercept (value of y when all other parameters are set to 0)

$\boldsymbol{\beta_1 x_1}$= the regression coefficient (β_1) of the first independent variable (xi_1) - the effect that increasing the value of the independent variable has on the predicted y value

… = the same procedure for the rest of the independent variables tested

$\boldsymbol{\beta_k x_k}$= the regression coefficient of the last independent variable

$\boldsymbol{\varepsilon}$ = model error - how much variation there is in the estimate of y

This model allows the investigation of how strong the relationship between variables is, such as the factors previously outlined as impacting on the engineering productivity in relation to a project. This model is used to predict the value of the dependent variable (project) at a certain value of the independent variables (factors).

"…the development of an LR model requires many assumptions; for example, normality, constant variance, and linear responses have to be considered. In practice, it is extremely difficult to satisfy all these assumptions for complex problems such as the productivity estimation…" (Rashidi, Nejad, & Maghiar, 2014).

Even though this procedure is considered difficult it is successfully implemented for predicting productivity. The procedure of using a linear regression model relates to validation by creating a Statistical Model to further test the hypothesis. Hanna, Taylor and Sullivan (2005), Chang, Hanna, Lackney and Sullivan (2007) and Rashidi, Nejad and Maghiar (2014) used a R^2 coefficient of correlation for testing the linear regression model with the following formula:

$$R^2 = \frac{SSR}{SST}$$

Where, SSR is the variance explained by the linear regression model and the SST is the total variance. The results from which are showing how close the data are to the regression line. Hanna, Taylor and Sullivan (2005) took the regression model as one whole and tested the overall significance by calculation of a F coefficient. Another test that Hanna, Taylor and Sullivan (2005) is a t-test that they run *"…on the individual predictor variables to determine the statistical significance of each variable's impact on productivity."*

According to the literature many statistical tests can be performed to test the hypothesis with a regression model. Creating a regression model as stated above in the chapter is a complex task that create a difficulty in excluding many assumptions and because of that among the academia is considered "*…limited by the number of influencing factors that can be included and their capability of measuring the combined effect of the influencing factors."* (Song & AbouRizk, 2008).

Artificial Neural Network – ANN

The Artificial Neural Network (ANN) is mathematical method, which simulates the actions of the cells in living organisms (Tareq, Khaleel, & Nassar, 2017). Zahedi (1991) associates the ANN with white box that simulate human intelligence by using a parallel approach and applies inductive reasoning. ANN is an advanced form of machine learning (DataFlair, 2017). Machine learning is *"…giving machines the ability to learn by training algorithms on a huge amount of data"* (DataFlair, 2019). Deep learning is *"…an approach to machine learning, that focuses on learning data representations…"* through neural networks (DataFlair, 2019). One of the most common applications of deep learning is for automated analysis and reporting (DataFlair, 2019).

The ANN consist of three layers: input layer, hidden layer (middle), and output layer (Nasirzadeh, Kabir, Akbari, Nahavandi, & Carmichael, 2020), but according to Heravi and Eslamdoost (2015) the input layer is by default and the ANN consist only of two layers - hidden and output. The number of hidden layers may increase with the development of the model (Nasirzadeh, Kabir, Akbari, Nahavandi, & Carmichael, 2020). In each of the layers there are nodes, which are imitation of the neurons in the human brain. The nodes from the three layers are mainly connected to feed forward: the nodes from the input layer relate to the nodes from the hidden layer and the nodes from the hidden layer with the nodes in the output layer (Zahedi, 1991). Each connection of the nodes has its own weight (Heravi & Eslamdoost, 2015). The adaption of this method uses the impacting factors as input and considers the output as the total measured productivity (Tareq, Khaleel, & Nassar, 2017). Tareq, Khaleel and Nassar (2017) are also stating that the number of nodes in the middle layer can be tested by gradually increasing the number of nodes and finding the optimal number by starting with a number equal to the number of factors plus the output node. The increasement of the nodes increases the network's power, but also requires more computing, which leads to overfitting (Heravi & Eslamdoost, 2015) (El-Gohary, Aziz, & Abdel-Khalek, 2017).

This method is used for measuring and predicting construction-labour productivity by Heravi and Eslamdoost (2015), for predicting productivity and evaluating factors affecting productivity by Tarq, Khaleel and Nassar (2017), to improve and predict construction labour productivity under different influences by El-Gohary, Aziz, and Abdel-Khalek (2017), for prediction of intervals to forecast labour productivity by Nasirzadeh, Kabir, Akbari, Nahavandi and Carmichael (2020) and etc.

8.4 Evaluation of the modelling productivity methods

To choose a modelling productivity method for a continuation of the research, an evaluation has been done. The evaluation is between the four modelling productivity methods analysed previously, namely Expert systems, Simulation tools, Regression analysis and Artificial Neural Network. The criteria chosen for evaluation of the modelling methods are based on the literature about what should a modelling method include and the description of the mentioned above methods. As stated by Sonmez and Rowings (1998) and later by Song and AbouRisk (2008) the productivity modelling should include the impact of the factors by using historical data. Also, the chosen modelling technique for this research should be possible to be implemented in the design office and monitor the engineering productivity. Another aspect that the chosen modelling method should cover is being objective as stated by Wassermann (1989). The last aspect that will be discussed is how much time for data collection the different modelling methods consume for preparation of the productivity framework. The modelling methods are evaluated from 1 to 3, where 1 mean low, 2 moderate and 3 high. The modelling method, which is going to be chosen is the one having the highest score among all of them.

Factors

Based on the previous discoveries all four modelling productivity techniques include the usage of factors. The analysis also showed that only the Regression models are limited in the number of factors that can be included (Song & AbouRizk, 2008) and for that reason the Regression analysis is graded with 2 and the rest with 3 (see Table 7, p.67).

Relevance

The research outlines that all four modelling methods were previously used in the construction sector, but only finds applicable the usage of Expert systems, Regression models and ANN for the engineering productivity and for that reason those are graded with 3. The Simulation tools are graded with 1(see Table 7).

Time for data collection

All four models are based on the collection of large historical data and receive the grading of 1(see Table 7).

Objectiveness

The previous studies revealed that Wassermann (1989) suggests that finding solutions by the expert system, might be limited by the personal assumptions and input of the experts and as stated in the analysis of the method other researchers later agreed with his statement. As mentioned above, Nasirzadeh, Kabir, Akbari, Nahavandi and Carmichael (2020) are considering the Simulation tools as an unreliable as they include personal attributes. The Expert systems and the Simulation tools are graded with 1 based on the literature. The Regression models are graded with 2 because they include only linear assumptions. ANN is graded with 3, because it does not only process the data in a non-linear manner, but it is a part of the deep leaning aspect of the machine learning (see Table 7).

Productivity modelling				
	Expert systems	Simulation tools	Regression analysis	ANN
Factors	3	3	2	3
Relevance	3	1	3	3
Time for data collection	1	1	1	1
Objectiveness	1	1	2	3
Total score	**8**	**6**	**8**	**10**

TABLE 7 – COMPARISON OF THE MODELLING PRODUCTIVITY METHODS BASED ON THE LITERATURE (OWN PRODUCTION,2020)

9 Artificial Neural Network (ANN) Productivity Model

This chapter will provide a detail description of implementation all phases of the chosen in the previous Chapter productivity modelling approach – Artificial Neural Network (see Figure 12)

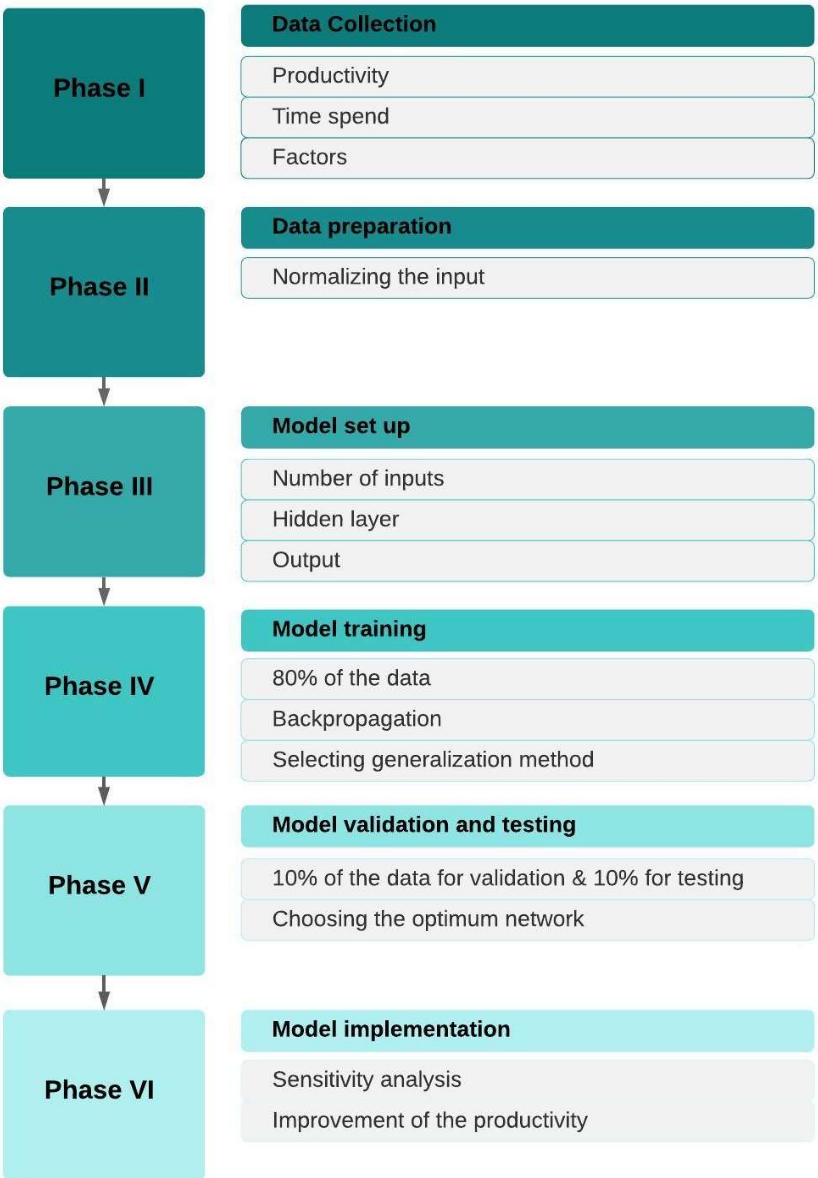

FIGURE 12 – ANN PHASES AS A MODELLING TECHNIQUE (OWN PRODUCTION,2020)

9.1 Data collection

To set up the model, a large amount of historic data is needed. Firstly, the actual productivity rate of past projects needs to be collected based on the productivity measurement, established above, Actual hours over Planned hours. The impacting factors need to be evaluated as well. To ensure the accuracy, at least two or three team members of the past projects need to fill a questionnaire about them. A combination of their responses will be further used (Heravi & Eslamdoost, 2015). The questionnaire will have all the factors listed with the option to rank their influence both with the use of linguistic descriptors and numerical scale, see Table 8, as the data needs to be input into the ANN model in a numerical format (Heravi & Eslamdoost, 2015).

9.2 Data preparation

Once the data is collected, it needs to be normalized (Heravi & Eslamdoost, 2015). Normalization is the process of changing *"…the values of numeric columns in the dataset to a common scale, spanning between 1 and 0, without distorting differences in the ranges of values"* (Lakshmanan, 2019), see. Table 8.

Linguistic descriptors	Numerical scale	Normalized numerical scale
Very good	5	1
Good	4	0,75
Average	3	0,5
Low	2	0,25
Very low	1	0

TABLE 8 – NORMALIZATION SCALE (LAKSHMANAN, 2019)

9.3 Model set up

Based on the approach by Heravi and Eslamdoost (2015) and El-Gohary, Aziz and Abdel-Khalek (2017), a multilayer feedforward neural network with backpropagation is chosen. A multilayer model consists of minimum of an Input layer, one Hidden layer and an Output layer. A feedforward model refers to a model in which the information flows in one direction, from the Input layer towards the Output layer (DataFlair, 2017). The backpropagation is supervised training in which the model is provided with the input and the desired output for comparison with the actual output (El-Gohary, Aziz, & Abdel-Khalek, 2017). It consists of two phases. The first phase is when *"…a training input pattern is received by the input layer and the network propagates (feedforward) the input pattern from layer to layer until the output pattern is generated by the output layer"* (El-Gohary, Aziz, & Abdel-Khalek, 2017). The second phase is when the output pattern is different from the actual productivity output, *"…the relevant error is calculated, and then propagated backward (back-propagation) through the network from the output layer to the input layer"* (El-Gohary, Aziz, & Abdel-Khalek, 2017).

9.4 Training

The next step is the training of the model. The collected data needs to be divided into 3 categories – training, validation and testing. Heravi and Eslamdoost (2015) use 70% - 15% - 15%, Nasirzadeh, Kabir, Akbari, Nahavandi and Carmichael (2020) use 60% - 20% - 20%, while El-Gohary, Aziz and Abdel-Khalek (2017) use 75% for training and 25% for validation. The model should start with one hidden layer and the number can be increased if the performance is not acceptable (Heravi & Eslamdoost, 2015). The number of nodes is determined with a trial-and-error approach, fewer nodes can lead to high training error and too many nodes will minimize the training error and can increase the power of the network but can lead to overfitting (El-Gohary, Aziz, & Abdel-Khalek, 2017). Overfitting occurs when the model learns the training data too well and performs poorly with the validation data or new data (Brownlee, 2019). This means that the model generalization of the data is not reliable (Al-Masri, 2019). *"Generalization is the model's ability to give sensible outputs to sets of input that it has never seen before"* (Al-Masri, 2019). There are a few methods used for correcting the overfitting in the models. Heravi and Eslamdoost (2015) compare two of them, Early Stopping and Bayesian Regularization. They have found out that the Bayesian Regularization gives better results with the generalization of the model.

9.5 Validation and testing

After training a certain number of models, the most appropriate ones are chosen (Heravi & Eslamdoost, 2015). The validation and testing phase has as its goal to check if the training of the model has been successful and if the generalization of the data has a satisfactory result. The model with the best performance is chosen for implementation. At this point the difference between the actual productivity from the historic data and the predicted productivity is calculated to get the average accuracy percentage (El-Gohary, Aziz, & Abdel-Khalek, 2017). The smaller the error percentage is, the more accurate the model is (Heravi & Eslamdoost, 2015).

9.6 Implementation

After the model has been set up and tested, a sensitivity analysis can be performed. "*It shows the cause-and-effect relationship between inputs and outputs…*" (El-Gohary, Aziz, & Abdel-Khalek, 2017). Sensitivity analysis is conducted twice for each factor by varying its value at its positive and then at its negative value, while the rest of the factors are kept at their mean value (El-Gohary, Aziz, & Abdel-Khalek, 2017). This will help into identifying the most impacting over the productivity factors (Heravi & Eslamdoost, 2015). Afterwards the companies can adjust their approaches towards the productivity depending on these factors by improving the design process with new or improved tools, training people or adding more resources.

10 Discussion

Not much research focusing on engineering productivity was discovered during the process of studying the topic. The purpose behind that is perhaps the difficulty of establishing a precise and applicable method for measuring engineering productivity. This research aimed at investigating the engineering productivity measurement approaches and definitions and the impacting factors in order to propose a productivity framework than can help companies achieving a better productivity estimation and improve the design process by evaluating the impact of the factors.

The first thing that the research establish is the lack of a standard. The lack of a standard represents the biggest obstacle for accomplishing better productivity. Different companies are using different measurements that cannot be used for achieving a homogeneity in the industry. The results are difficult or impossible to compare which also leads to lack of competitiveness when it comes to productivity. A very popular definition in the construction industry is the unit rate, which measures the productivity as input over output. The research found this not relevant measurement during the design process and more suitable for the construction process. The measurement of output over input was further investigated. It proves to be more suitable but still hard to apply since a big part of the design process is hard to be quantified. Instead, the measurement of Actual hours per Planned hours was found to be the most suitable. This method, however, needs to be further tested and validated since this research did not have the opportunity to conduct real testing.

The 13 most likely impacting factors discovered by this research are taken out from a sample of 37 professionals. The results show that the management factors are having the highest impact over the engineering productivity. Once the effect of the factors gets evaluated, the companies can adjust the process accordingly. The sample for the survey was targeting respondents only from the danish construction industry, which limit the applicability of the most likely impacting factors in other countries than Denmark, before testing their impact on the industry there. Likewise, each construction project is unique and the factors impacting on one project can vary from other projects. Before considering any of the factors as having high impact on a project or in a study, thorough validation by sampling and testing should be executed.

The research of the topic has led the authors to establish a productivity framework for measuring engineering productivity during the design phase and the opportunity to propose Artificial Neural Network (ANN) as a tool for productivity modelling. The enhanced productivity is vital for the construction industry and, as it is in this case, for the engineering office, but there many factors that reflect on the productivity and they need to be considered. Most of the organizations are calculating their productivity only as an economic measurement, which is excluding the various impacting factors. The ANN modelling method was considered based on the possibility of assessing the impacting factors and its relevance to the productivity in the design office. Also, it was considered objective and not involving personal attributes, which is important for the reliability of the measurement. Before implementing the ANN modelling method as an engineering productivity measuring tool, the model needs to be tested in practice and further explored.

The lack of reliable data and time prevent the research to conduct practical testing. This makes the research purely theoretical and that reflects as disadvantage for the discovery and cannot prove to what extend the proposed measurement, modelling method and productivity framework would be efficient. For further research, a form of a collaboration with the bigger companies in the danish industry will help in achieving satisfactory results faster and help in validating the process. Afterwards the selection of a productivity framework can be financially evaluated and calculated of what would be the cost for such implementation.

11 Conclusion

Enhancing the engineering productivity in the design office can benefit the continuous improvement of the processes in an architectural or an engineering company. The academia has concluded that without monitoring the productivity in a company it will keep the same level of productiveness and will continue making the same choices and follow the same work patterns.

The research has established that there is no standard in Denmark when it comes to engineering productivity. The literature review has shown that there are many different methods for productivity measuring. Many conclude that they fail to incorporate the complexity of using CAD tools and programs. At the same time there are many factors that impact the productivity but are not considered adequately. Through the interviews it was found out that the companies measure productivity similarly based on an economical calculation that does not include any of the impacting factors.

By conducting a survey, the research revealed that there are different factors that are impacting the engineering productivity. An extensive statistical methodology was applied and concluded that there are 13 most likely impacting factors on the engineering productivity in Denmark, where the Management group of factors are considered most impacting based on the sample of 37 responses.

The use of the classical productivity definition of output over input in the form of Actual hours over Planned hours is found to be more suitable for calculating the engineering productivity. In this way the whole process can be taken into account together with the complexity of using CAD programs and tools without excluding the indirect hours.

For identifying the influence of the impacting factors four modelling approaches were considered: Expert systems, Simulation tools, Regression analysis and ANN. The research evaluation method has found ANN as the most suitable productivity modelling approach and excluded the rest, because of their irrelevance to the engineering productivity or the limitation of including all the influencing factors.

The three main steps of a successful framework are: 1) productivity measurement, 2) data collection and 3) productivity modelling. The productivity measurement will be applied for determining the productivity of all company's projects and will help in the formation of a company standard. It also includes the identification and evaluation of the impacting factors. The data collection is an essential part of having high productivity and it provides a solid base for the measurement. Productivity modelling will help in evaluating the influence of the impacting factors over the productivity and will help in improving the design process.

By enhancing the productivity measurement with the addition of the influence of the impacting factors, the industry can achieve a more reliable results that can be used for improving the design process. As a consequence of that, the construction productivity can benefit as well by receiving materials with better quality minimizing problems and errors occurrence during the construction process.

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13 Appendixes

13.1 Appendix A – Interviews

13.1.1 Questions

1. Introduce yourself, where do you work, what is your position in the company, how many years of experience do you have?
2. What is the main focus project your company has? What types of project does your company usually have? (residential, office, etc.)
3. Do you measure the productivity of your projects?
4. How would you define productivity?
5. What factors do you think affect the productivity?
6. How do you measure productivity and what processes do you have for that?
7. Is there a standard you follow, or is this your company's choice?
8. Do you think we need a standard for the whole industry?
9. Which factors do you take into account when measuring productivity?
10. How is the project scope defined and how it is relevant to the productivity?
11. According to research we've done, project size is considered as one of the main factors affecting the productivity, can you confirm this based on your experience?
12. In your experience, do you think a project that have more repetitions have higher productivity?
13. What about project type?
14. What about the complexity of a project, how do you define the complexity before the project starts?
15. How does the budget affect the project, the resources used, team members?
16. Do you plan extra budget for unforeseen problems?
17. What about team members personal experience, qualities and competences?
18. According to our research: ineffective management is concluded to be the biggest cause for low productivity on the building site. Do you consider this applicable during the design phase?

19. What about the planning and scheduling of the project? Do they affect the productivity?

20. What about information dependability, do you often wait for another discipline to deliver materials or information?

21. What about the quality of the materials?

22. What about changes, how do they affect the project and the productivity?

23. What about the different programs and tools used during the projects? Do you think the productivity can increase if there are better/different tools and programs available?

24. Do you collect productivity data for future project assessment?

25. What type of data?

26. What about working hours / labour cost / square meters?

27. Do you have any suggestion for improving the industry's productivity during the design phase?

13.1.2 Summaries

Person A

Person A is a **department manager** for the building construction department, **with 23 years of experience** in a big consulting engineering company.

Typical company projects are **middle and large projects**, varying from apartment buildings to offices, school, hospitals, etc.

The productivity is based on budget given for the project **and hours spent** with the **value-added measurement.**

To ensure **good productivity** having a **good start**, with **good time plan**, and **good plan for information coordination and exchange, having skilled and intelligent teams** that is **aware of the goals of the project**, is of a big importance. When **inefficient information exchange** is present, then **a lot more time is spent** on the project, which leads to **loss of productivity**.

Factors affecting productivity are **time plan**, how each **discipline is acting**, the ability to **solve problems quickly and efficiently**, rather than reaching a point of confrontation.

There is not a specific calculation for the productivity. Considering the project complexity, if the project is more squared or if it's made of weird shapes, or if the architect has good ideas, it's **hard to make a model for calculating the productivity.** An easier approach is used instead in the form of **collecting data from past projects about the complexity**, based on the shape of the building, into easy, medium or advanced category and an estimate on **how many hours are used per square meter** for the different categories. This makes it **easier to estimate how much can be the benefit from future projects.** Person A describes it as a **benchmarking based on historical data**, rather than doing a complicated calculation.

There is **no standard for productivity in Denmark**. A standard **will benefit the industry** but, according to the interviewee, **it is very difficult to make one**. It is also very hard to predict if you can make money on the project or not, because **the earnings are only a small percentage from the whole project value.** When talked about the possibility of comparison between different companies, Person A says that companies are often competing with one another based on a market price for the projects. If a company agrees with the price, they have a chance of winning the project, while if the company is more expensive, then the project is won by another, cheaper company.

The project scope is strongly connected with the project planning and good planning is essential for a successful project. Person A points out that no matter how good the company's plan is, **also very important it is the whole collaboration with the other companies involved.**

When it comes to project size, Person A says, **"it is easier to make more money on bigger projects",** which means that **the productivity is better since there are more hours for completing** the project and **more square meters to divide the earnings on and the hours spent.** When the project is small, then you have very high values of kr. per square meter.

When it comes to repetition, Person A agrees that **when more repletion or similarities are present, the productivity is also higher.** But at the same time **each project is unique to itself and it's very hard to reuse aspects from previous projects.**

Project type is strongly connected to the complexity. Example given by the interviewee is that **residential buildings are often less complex** that other types in terms that **they have more structural walls, which makes the stability easier to calculate and ensure.** At the same time, **residential projects have less monetary value and bigger competition.**

Budget size can affect choices made for the project. When the budget is low, there is need to be more creative in what has to be done by you and what not. **If something can be left out on contract bases, you can complete the project for less hours.**

There is always a percentage of the budget that is used for unforeseen problems.

It is **very important that the right team is assigned** for completing a certain project. **The team's experience also plays a key role**, for instance, **there cannot be too many new beginners on the same project.** It has to be a **mix of experienced people that can guide and help the new beginners.** The **team formation** inside the company is **based on the personal knowledge of the skills people poses, how they work with one another and who is available.** If someone is essential for a new project that is about to begin but is unavailable, adjustments are made for making him or her available. But that's a rare practice, since **the productivity and the project are much better if the same team members stay on a project all the way.**

Usually there are a lot of changes in a project. Often adjustments in the number of team members need to be done, considering that a lot changes from the initial phase of the project to the detail design phase.

Ineffective management is one of the essential factors that can contribute to low productivity. If the direction of the project is not well guided, then the productivity drops.

If a committed deadline approaches but the work is behind, more people need to be assigned to the project. But if the deadlines are possible to be prolonged, then that is better choice. It is always **better to have the same people in the team than to add new member** so close to the deadline.

Waiting for another party on the project **to deliver crucial information** for the completing of the project **happens often**. If you have to wait, then **the work stops**. **If information comes too late, it can be hard to be implemented** before the deadline.

It **often happens that the information or materials deliver by another party is not of a good quality or precis enough.** But **with good communication, this problem is easier to solve**.

Changes also affect the productivity. There are several stages on the project and some things should be locked when a stage ends but **the clients often come with changes**, especially when the project gets more and more visually complete. **These changes cost a lot of**

money but **also good relations with the client needs to be preserved**, which can lead to **change orders that are not paid extra.**

Sometimes **complex models can be used for making calculations** and **when errors occur**, it can be hard to identify why it occur, which can lead to **a lot of time spent on solving the problem**. **It is often easier to make more simple calculation** (with the use of Excel). **Revit** on the other hand **is the standard program** used for the creation of the model. **The choice of programs and tools** used on a project **is a choice of the lead team members**.

The level of detail for the models is decided at the beginning of the project. It is important that the client is aware of how much information is embedded in the models based on the different level of detail. **Sometimes a lot of information is asked to be implemented, but it can be something that the client does not really need.**

Data collected for future projects assessment **includes size in terms of square meters, project type, complexity, short description of negative or positive occurrences, time spent in terms of hours and level of detail.**

As a suggestion for improvement, Person A says that **change orders should be handled "less friendly" with the clients.**

The biggest problem for the productivity is the uniqueness of each project, which means that **each project starts from scratch**. Another problem is that **each project also starts with new teams, formed by people from different companies. Sometimes it's harder to find the symbiose and adjustments are needed along the way.**

Person B

Person B is **project manager with more than 20 years of experience** in a big consulting engineering company.

Typical company project is difficult to say, usually there are many residential projects, but there are hospital, offices.

Person B is always **checking the productivity by looking at the hours spent.**

Productivity is then defined by the scope that needs to be fulfilled and how many hours are used to fulfilled it and the budget, since different people have different cost based on their experience.

Many factors have effect over the productivity – **how does the Architect perform, the set up team**. **It is better to have a small team than bigger one**, when it comes to effectiveness.

Productivity estimation is based on hours spend and the time costs that are collected by a Enterprise Resource Planning program. Bigger projects have their own excel sheets for further tracking.

There is **no standard in Denmark** and Person B follows the company's standard. **A standard would be nice to have for creating a benchmark. It will make it easier to evaluate projects. Currently key figures are collected from projects, such as time spend and money spend. They are used for assessing future projects when entering a competition.**

The project scope gets defined by the client first. Once a project is won **some negotiation can be done before officially signing the contract. Any changes of the scope further on will be noted as change orders. The project scope is very relevant for the productivity. The whole scope is reviewed by the project team, to make them aware of what needs to be done or not done.**

Really big projects can be very complicated. But project from residential type with size of 15 000m2 or 20 000m^2, **Person B would prefer to work on the bigger one, because the work itself does not increase so much due to the repletion that exist in big projects.** And **repetition** in a project **means higher productivity.**

When there is a very big project with a lot of people with different skill sets, it can be very difficult, and a lot of time is spent to make it all together.

According to Person B **project type is not very relevant for the productivity. Some project types are more complex than others, but the productivity won't be affected so much** by the project type.

When a project starts, an analyse is made to evaluate what can be done better and easier in order to fulfil the scope. One example is to make sure that the architect on the project, **use the same programs and tools as the others, to ensure a smoother transfer of information.**

There is always a fixed percent from the whole budget for unforeseen problems.

The team and their experience are very important. If a project is more complex, it is very important that at the beginning to get the experts to make the planning based on the scope and to define what needs to be done. Once the project gets into developing, you can have less experience people with the experienced to work on the project.

A good project manager is very important. He has to guide the team during the process of work and make quick decisions when necessary.

Project planning can also have an effect over the productivity. Sometimes there can be a **very big schedule, more money is used. There can also be a compact schedule, where you have to team up more people and that is not good. The right time schedule is very important.**

A good track on the project schedule for checking the progress compared to the deadlines is important. If **the progress gets behind, changes need to be made as quick as possible. More people can be added to the project or the deadline can be pushed if agreed upon.**

Big chances coming from the client that are deviating from the project scope needs to be paid extra. These changes can have an effect over the productivity.

Meetings, with the different parties on the project, **for discussing and highlighting what information is needed will ensure less information delay and smoother communication.** Every time a **delay in the project progress is cause by the delay of information, the productivity drops. Information delays, however, do occur.**

Different programs and tools can also have an effect over the productivity. For example, if the Engineers are **modelling in Revit and** the Architects are **modelling in ArchiCAD**, **then every time a new model comes in, it needs to be adjusted**. The usual tools used for indoor climate estimation cannot be used directly. Sometimes it is hard to tell how difficult can be using two different software. **Different programs and tools are considered at the beginning** of each project.

Productivity data is collected from past project that can be used for future projects assessment. This data includes the **key figures – how much time and cost are spent.**

Some people on the same position as Person B do collect data from their project but it is not currently required from the top management.

One of the biggest problems for the productivity during the design phase is if changes in the team members during the project are necessary. If you can **keep the same team during the whole project, will ensure better productivity.** It happens often to make changes.

Person C

Person C is a **client advisor and a project manager** for a small consulting engineering company with **9 years of experience.**

A typical project for his company is residential building. They also do warehouse projects. **The size varies** from small renovation to big sport center.

The productivity is measured based on the economy of the project, the resources put into a project and the output.

Factors that affect the productivity is the social atmosphere in the company and the integrity of the project, if they are satisfied with what they are doing compared to a situation, where they are not pleased but they have to do it anyway. **"A little bit of time pressure also helps on the productivity".** If there is too much time or when there is too little time, the productivity drops.

A process for measuring productivity includes comparison with other projects when it comes to time spent, resources used and cost, as profit made.

There is no standard in Denmark, bur according to Person C, **most of the companies estimate the productivity the same way but by using different tools.**

Different companies have different ambitious, everyone wants to make profits, some want to make interesting project, visual landmarks and others are not so critical in their task. More complex buildings are often more expensive, and lack of experience can contribute to less profit earned. **So, a standard might not be the best thing to have.**

When **measuring the productivity, an estimation, based on personal experience, is made at the beginning of the project,** other project managers make an approval of it, and then this **becomes a baseline for the project**. At the end of the project**, a comparison between the initial estimation and a final estimation is made to establish the actual productivity**. Also, **when there are less experienced people on the project team, the project tempo changes** compared to a team with more experienced members.

The project scope plays a big role for the productivity. It will **affect the strategy that will be used**. Also, if two projects are to be compared, their scopes must be known.

The scope is defined by them for private clients. For competition, the scope is sent by the client.

Project size is important for the productivity. The more square meters you have, the cheaper it becomes for the things you can do compared to small projects. **No matter the size all project needs the basics.**

When there is **more repetition, the productivity increases. Bigger projects tend to have more repetitions.** It means that once you have solved one problem you can distribute the solution. In smaller project you have less work, but problems take more time to solve compared to the time schedule as well.

The project type does affect the productivity. Very technical projects, like hospital or such, **require a lot more consideration and the variety in the project can be very big. Hence, they also require more time.**

The complexity is very important. It is **defined at the beginning of a project** or if a competition is to be won, in terms of setting the price. The client always expects more.

The budget has some effect on the project and what resources are put in it. The choice of **the people on the project depends on their availability.** Some people are starting, finishing or a are in a project. It is never a good idea to change team members in the process of work.

There is always a small percentage of the budget for risk and unforeseen problems.

Team member experience is important. Someone fresh out of school compared to someone who has 20 years or experience – **they do not work with the same pace.**

Effective management is important for the productivity. Guiding the team to ensure that everyone is going in the same direction.

Planning and scheduling affect the productivity to some degree. The **main concern is the availability. Usually, people are working on a few projects at a time.** You need to make sure that they have enough time and that they do not have to work on two projects at the same time. Otherwise, **the stress factor** builds up and lead to unproductivity.

If you are falling behind with work – you can either ask for people to invest more time in the project or add more people, if possible. Sometimes the deadline can be pushed as well, but sometimes deadlines are connected to a sanction.

The amount of information delay depends on how good the planning is and how committed are all the parties involved on the project. Sometimes there can be a situation where you can be ahead, or you can be behind time schedule. **This definitely affects the productivity** as well.

The quality of information can also depend on if you are getting behind schedule.

Too many changes can cause an annoyance among teams. Sometimes change are connected to rework, sometimes they are connected to additional work.

Different programs can have some effect over the productivity. **Some program can be more demanding than others.** In his company there are not many diversities when it comes to doing the same calculation with different tools.

Productivity data is collected for future project assessment. This data includes **economic indicators such as project characteristic, time and cost spent; scope as in term of what has been made,** so similar projects can be assess. **Unforeseen aspect that has occurred during a project are also recorded** for knowledge sharing as well.

Good planning is always a plus and it will help avoiding information delays.

This biggest problem for the productivity is that it happens often to have too many projects happening at the same time.

13.2 Appendix B – Survey

13.2.1 Questions

Factors affecting the engineering (labour) productivity

1. What is your occupation? *

Mark only one oval.

- Top management position
- Project manager
- Engineer
- Architect
- Constructing architect
- Other:

2. How many years of experience do you have in the construction sector? *

Mark only one oval.

- 0-5 years
- 5-10 years
- 10 - 20
- years More
- than 20

Other:

3. According to previous studies there are five main groups of factors that affect the productivity on the building site, which of them do you find applicable for the productivity in the engineering office? *

Check all that apply.

- [ ] Project factors (project scope, location, complexity, financial capability and ect.)
- [ ] Labour factors (skills, motivation, experience and ect.)
- [ ] Management factors (planning and sequencing, competency of project manager, coordination and collaboration and ect.)
- [ ] Technical factors (tools/programs and equipment, technology and culture, design changes, incomplete specification or design and ect.)
- [ ] External factors (financial stability of the country, legislation and ect.)
- [ ] All of them
- [ ] None of them

Other: [ ] ______________________

Grade the groups of factors according to their significance for the engineering productivity.

4. Project factors (project scope, location, complexity, financial capability and ect.) *

Where 1 have the lowest impact and 5 the highest.

Mark only one oval.

	1	2	3	4	5	
Low	◯	◯	◯	◯	◯	High

5. Labour factors (skills, motivation, experience and ect.) *

Where 1 have the lowest impact and 5 the highest.

Mark only one oval.

	1	2	3	4	5	
Low	⬭	⬭	⬭	⬭	⬭	High

6. Management factors (planning and sequencing, competency of project manager, coordination and collaboration and ect.) *

Where 1 have the lowest impact and 5 the highest.

Mark only one oval.

	1	2	3	4	5	
Low	⬭	⬭	⬭	⬭	⬭	High

7. Technical factors (tools/programs and equipment, technology and culture, design changes, incomplete specification or design and ect.) *

Where 1 have the lowest impact and 5 the highest.

Mark only one oval.

	1	2	3	4	5	
Low	⬭	⬭	⬭	⬭	⬭	High

8. External factors (financial stability of the country, legislation and ect.) *

Where 1 have the lowest impact and 5 the highest.

Mark only one oval.

	1	2	3	4	5	
Low	⬭	⬭	⬭	⬭	⬭	High

Project factors

Grade the factors according to their significance for the engineering productivity. Where 1 have the lowest impact and 5 the highest.

9. Project scope *

Mark only one oval.

	1	2	3	4	5	
Low						High

10. Project location *

Mark only one oval.

	1	2	3	4	5	
Low						High

11. Project characteristics (size, buildability and ect.) *

Mark only one oval.

	1	2	3	4	5	
Low						High

12. Project complexity *

Mark only one oval.

	1	2	3	4	5	
Low						High

13. Rework and delays *

Mark only one oval.

	1	2	3			
Low						High

Labour factors

Grade the factors according to their significance for the engineering productivity. Where 1 have the lowest impact and 5 the highest.

14. Employee skills *

Mark only one oval.

	1	2	3	4	5	
Low						High

15. Employee availability *

Mark only one oval.

	1	2	3	4	5	
Low						High

16. Employee motivation *

Mark only one oval.

	1	2	3	4	5	
Low	⬭	⬭	⬭	⬭	⬭	High

17. Employee experience *

Mark only one oval.

	1	2	3			
Low	⬭	⬭	⬭	⬭	⬭	High

18. Labour work facilities and satisfaction *

Mark only one oval.

	1	2	3	4	5	
Low	⬭	⬭	⬭	⬭	⬭	High

19. Labour fatigue *

Mark only one oval.

	1	2	3	4	5	
Low	⬭	⬭	⬭	⬭	⬭	High

Management factors

Grade the factors according to their significance for the engineering productivity. Where 1 have the lowest impact and 5 the highest.

20. Supervision *

Mark only one oval.

	1	2	3	4	5	
Low	⬭	⬭	⬭	⬭	⬭	High

21. Planning and sequencing *

Mark only one oval.

	1	2	3			
Low	⬭	⬭	⬭	⬭	⬭	High

22. Competency of project manager *

Mark only one oval.

	1	2	3	4	5	
Low	⬭	⬭	⬭	⬭	⬭	High

23. Availability and quality of information *

Mark only one oval.

	1	2	3	4	5	
Low	⬭	⬭	⬭	⬭	⬭	High

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DENMARK

24. Coordination and collaboration *

Mark only one oval.

	1	2	3	4	5	
Low	◯	◯	◯	◯	◯	High

Technical factors

Grade the factors according to their significance for the engineering productivity. Where 1 have the lowest impact and 5 the highest.

25. Tools and programs *

Mark only one oval.

	1	2	3			
Low	◯	◯	◯	◯	◯	High

26. Techno changes *

Mark only one oval.

	1	2	3	4	5	
Low	◯	◯	◯	◯	◯	High

27. Design changes *

Mark only one oval.

	1	2	3	4	5	
Low	◯	◯	◯	◯	◯	High

28. Incomplete or unclear specification of the work *

Mark only one oval.

	1	2	3	4	5	
Low	◯	◯	◯	◯	◯	High

29. Client and consultants (client interference, approvals and disputes, decision making, competence) *

Mark only one oval.

	1	2	3	4	5	
Low	◯	◯	◯	◯	◯	High

External factors

Grade the factors according to their significance for the engineering productivity. Where 1 have the lowest impact and 5 the highest.

30. Financial stability (stability of country, inflation, cost of capital, financial crisis) *

Mark only one oval.

	1	2	3	4	5	
Low	◯	◯	◯	◯	◯	High

31. Permits *

Mark only one oval.

	1	2	3	4	5	
Low	◯	◯	◯	◯	◯	High

32. Legislation *

Mark only one oval.

	1	2	3	4	5	
Low	◯	◯	◯	◯	◯	High

33. Weather *

Mark only one oval.

	1	2	3	4	5	
Low	◯	◯	◯	◯	◯	High

Final conclusion

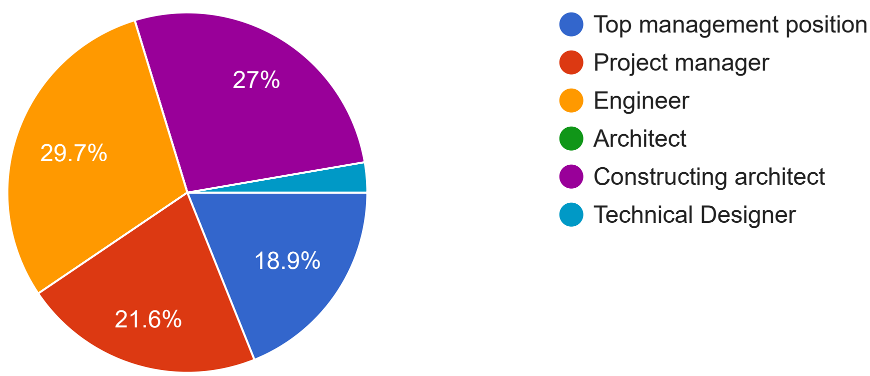
34. Based on your own experience which is the biggest problem for achieving high engineering productivity?

Factors a ecting the engineering (labor) productivity

37 responses

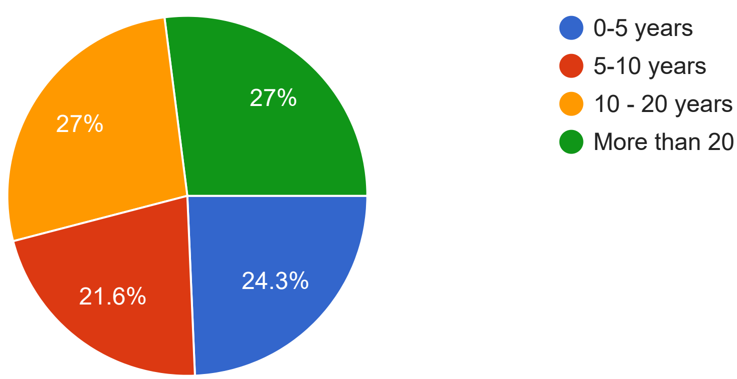
What is your occupation?

37 responses



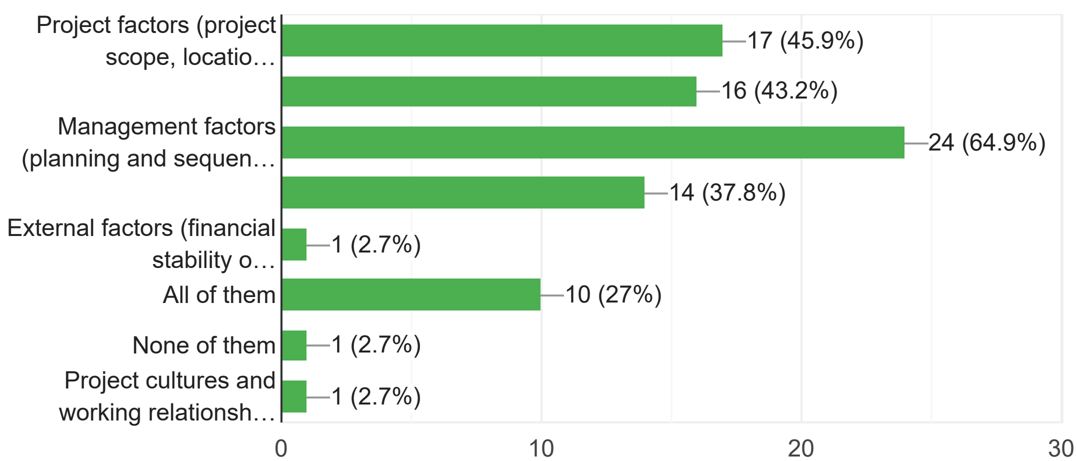
How many years of experience do you have in the construction sector?

37 responses



According to previous studies there are five main groups of factors that affect the productivity on the building site, which of them do you find applicable for the productivity in the engineering office?

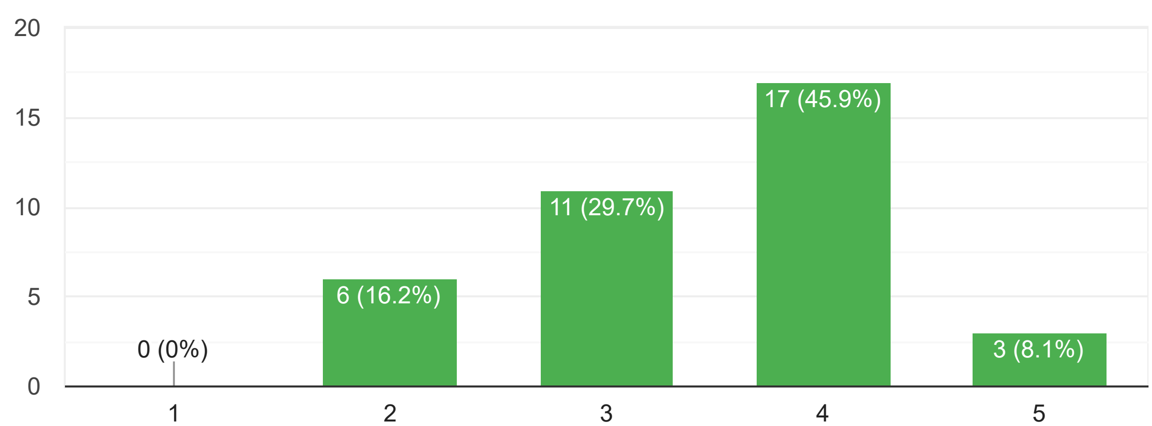
37 responses



Grade the groups of factors according to their significance for the engineering productivity.

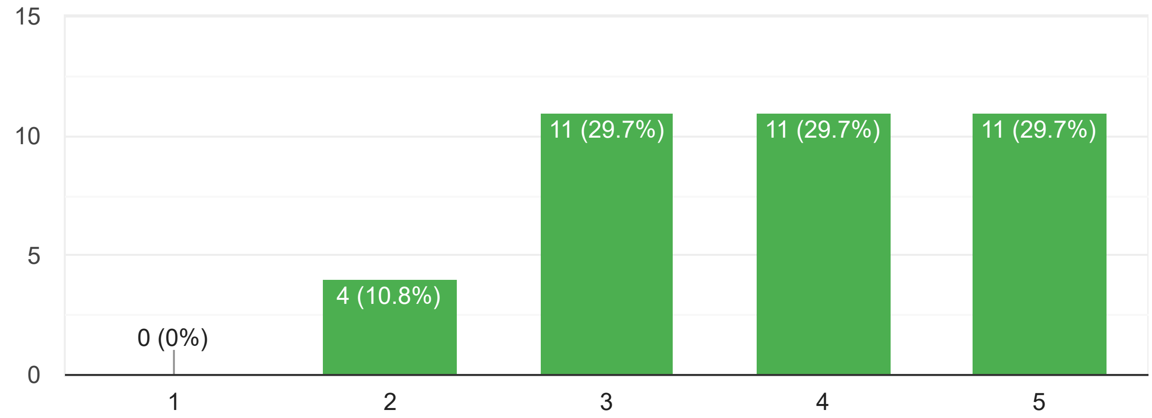
Project factors (project scope, location, complexity, financial capability and ect.)

37 responses



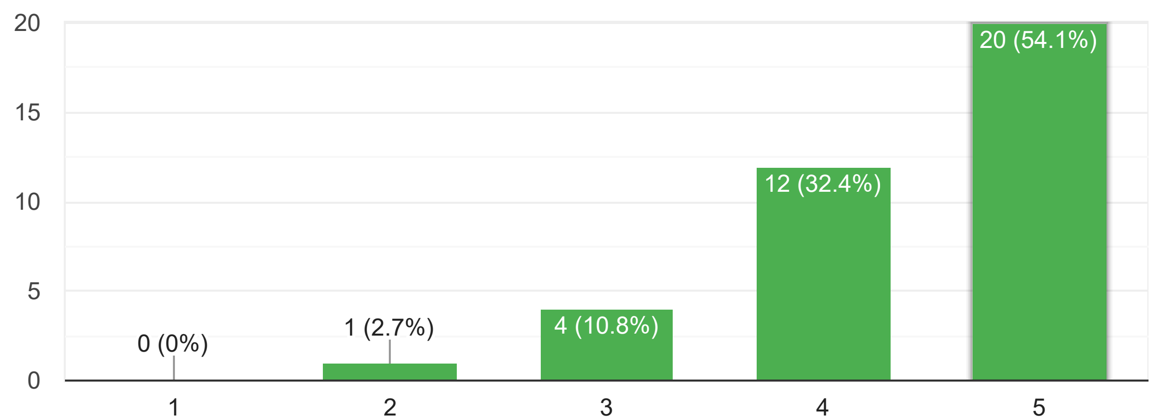
Labor factors (skills, motivation, experience and ect.)

37 responses



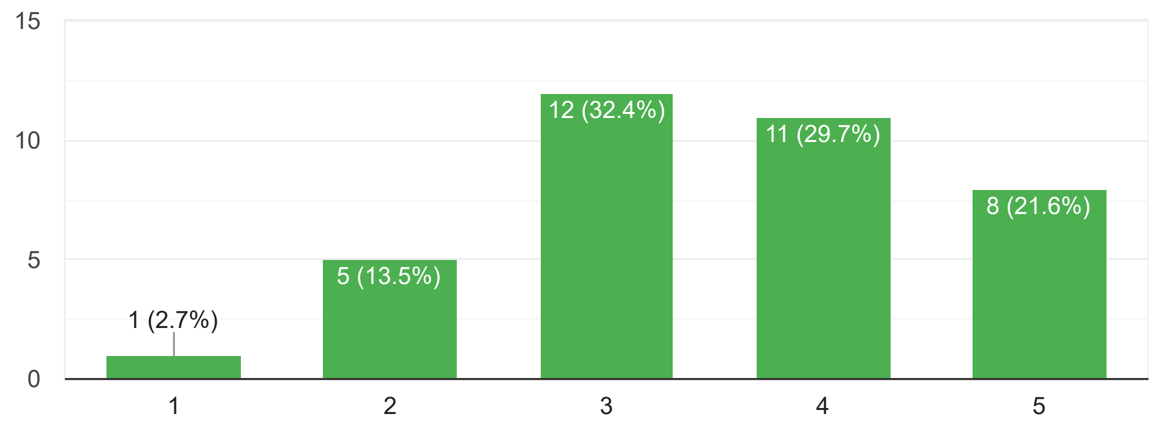
Management factors (planning and sequencing, competency of project manager, coordination and collaboration and ect.)

37 responses



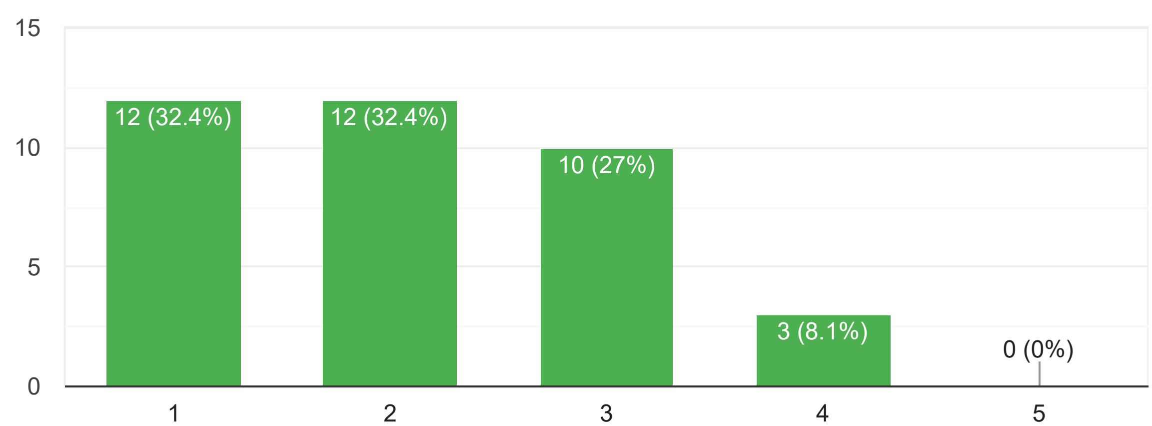
Technical factors (tools/programs and equipment, technology and culture, design changes, incomplete specification or design and ect.)

37 responses



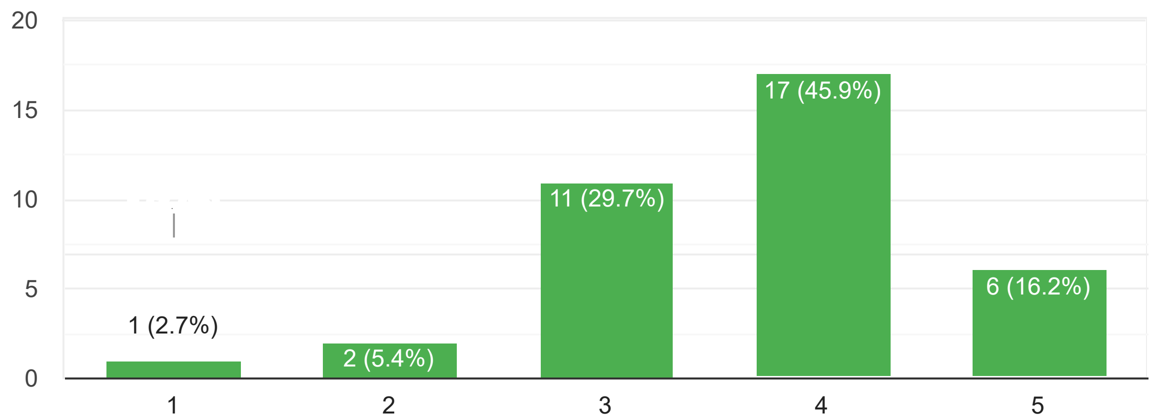
External factors (financial stability of the country, legislation and ect.)

37 responses



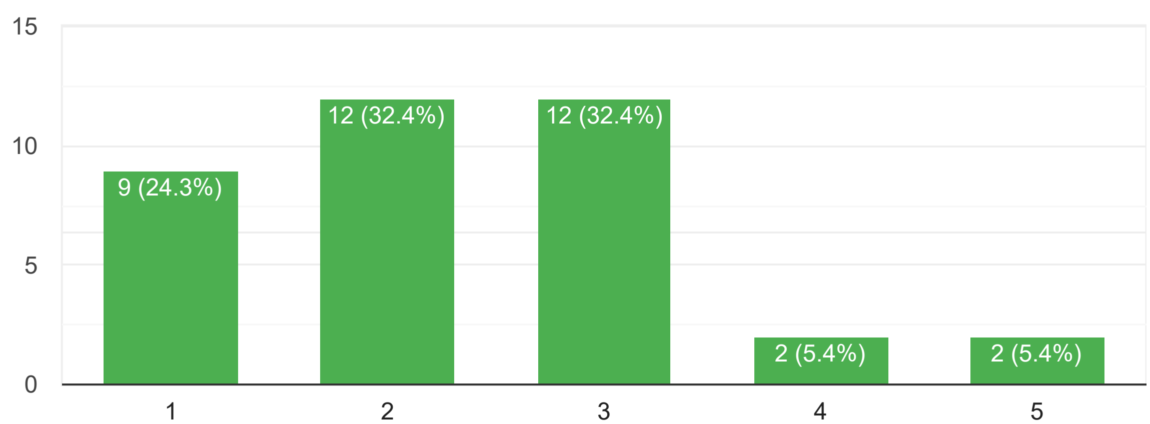
Project scope

37 responses



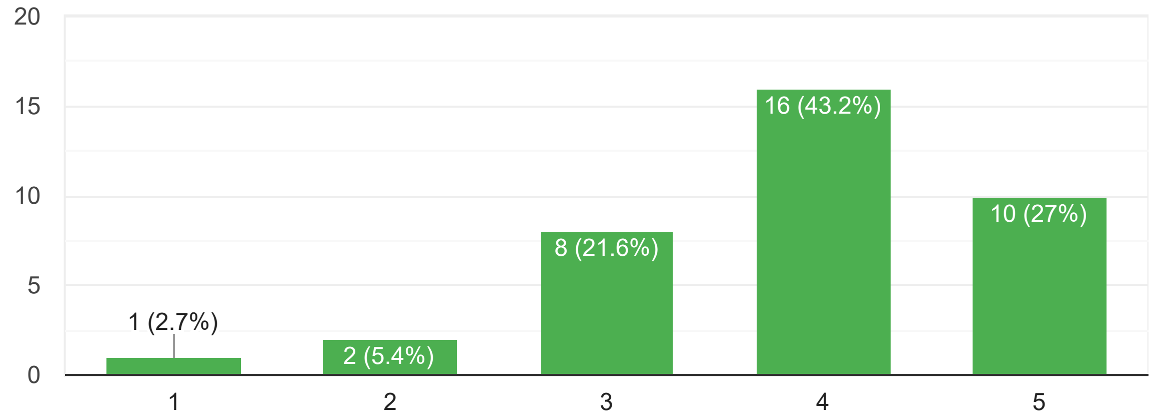
Project location

37 responses



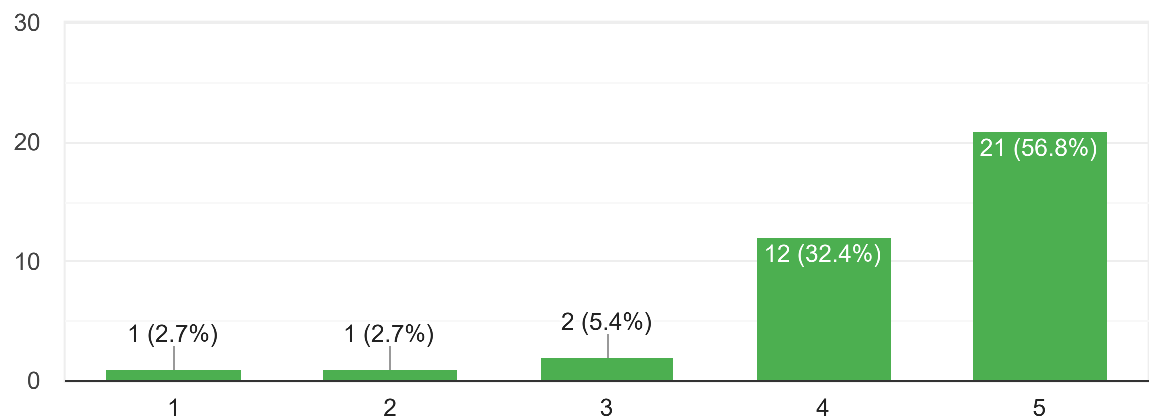
Project characteristics (size, buildability and ect.)

37 responses



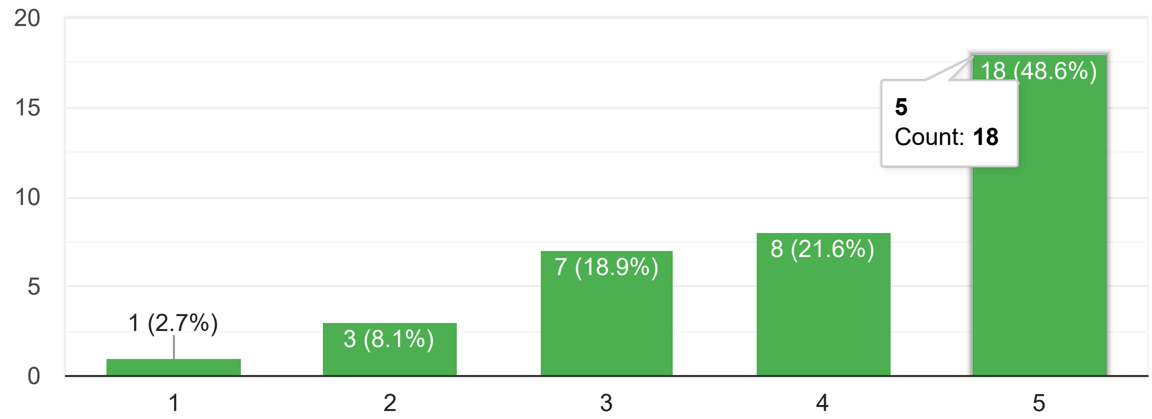
Project complexity

37 responses



Rework and delays

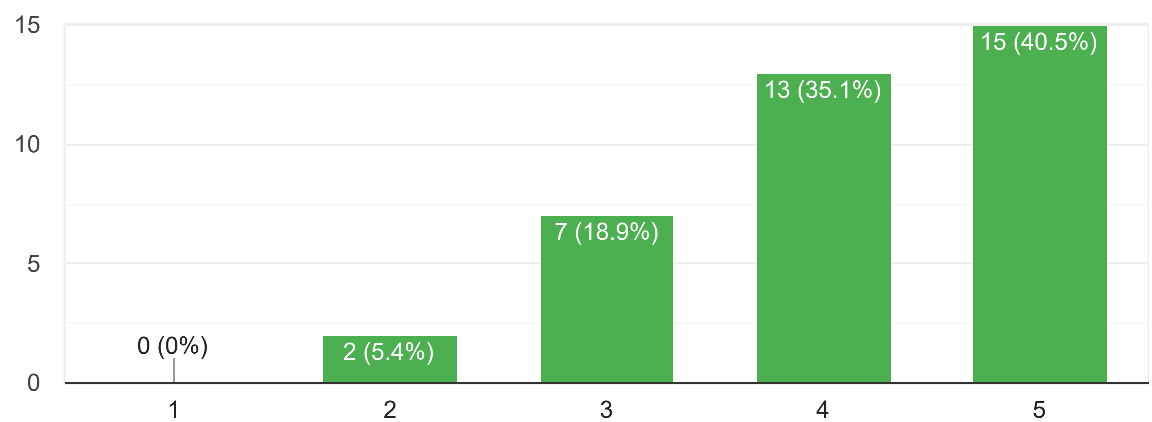
37 responses



Labor factors

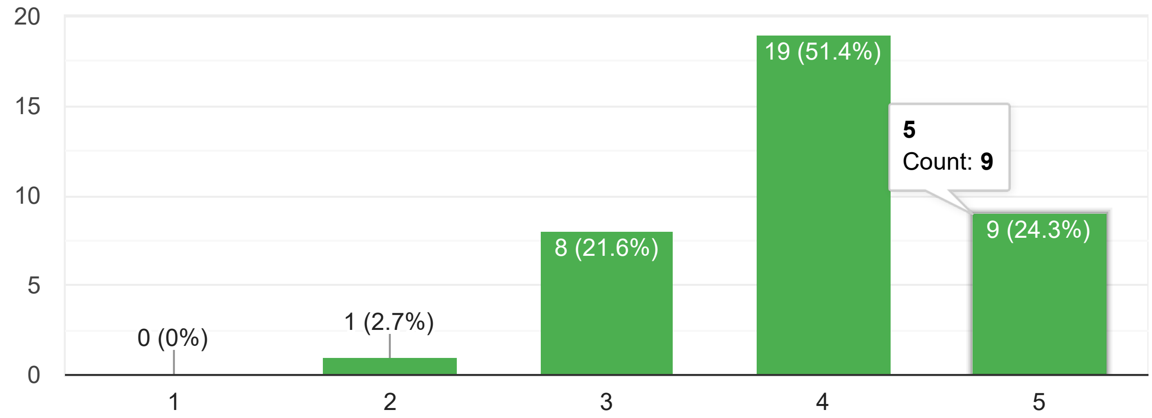
Employee skills

37 responses



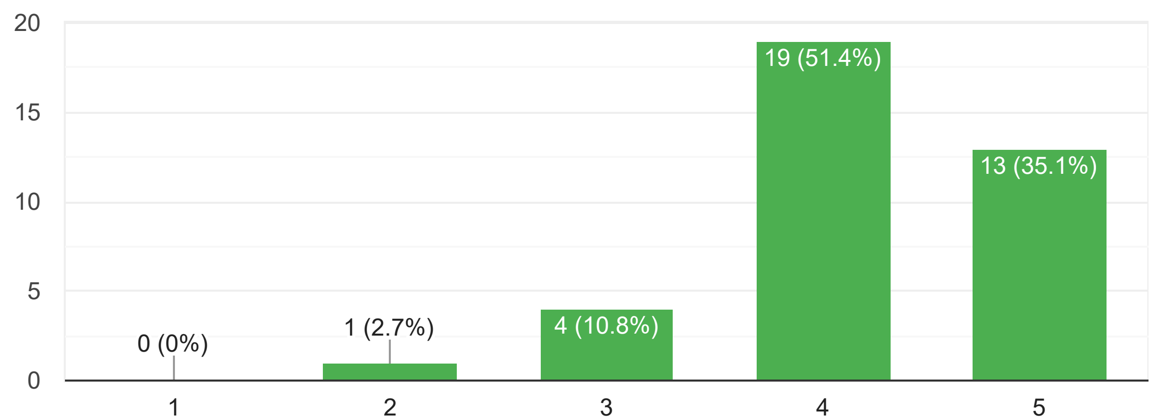
Employee availability

37 responses



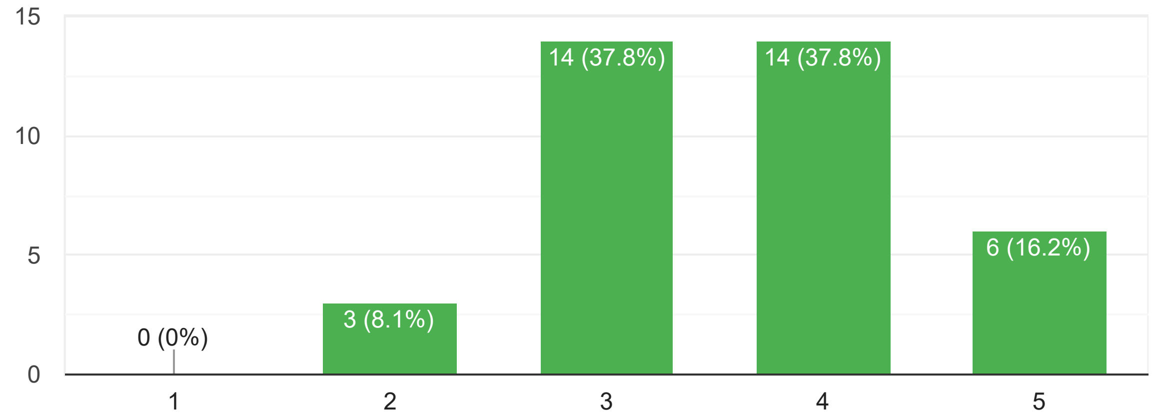
Employee motivation

37 responses



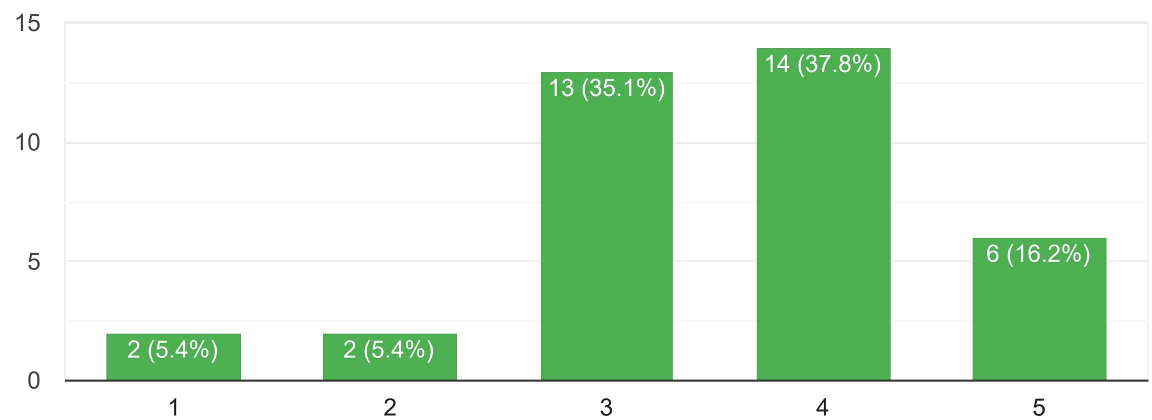
Employee experience

37 responses



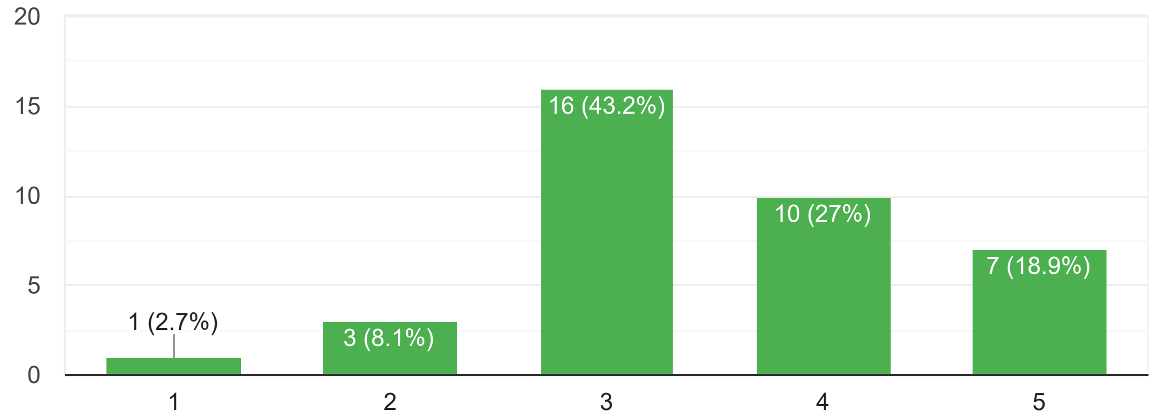
Labor work facilities and satisfaction

37 responses



Labor fatigue

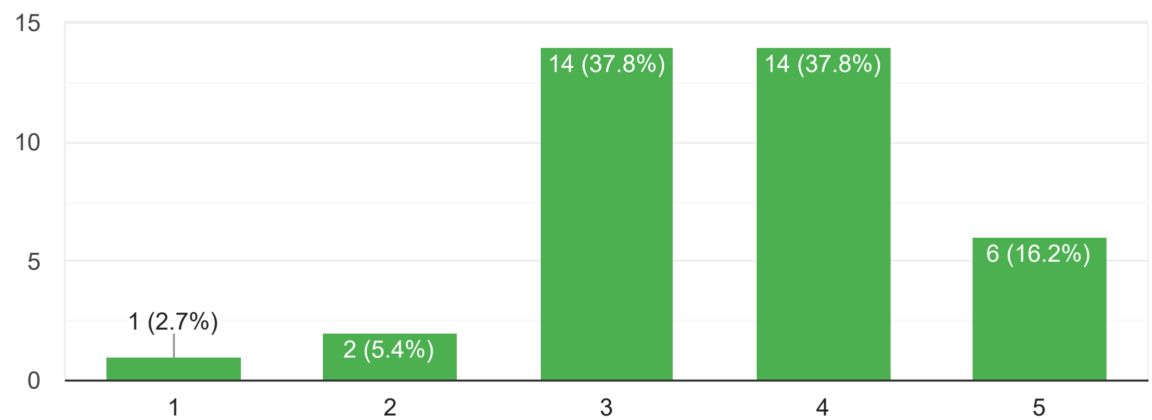
37 responses



Management factors

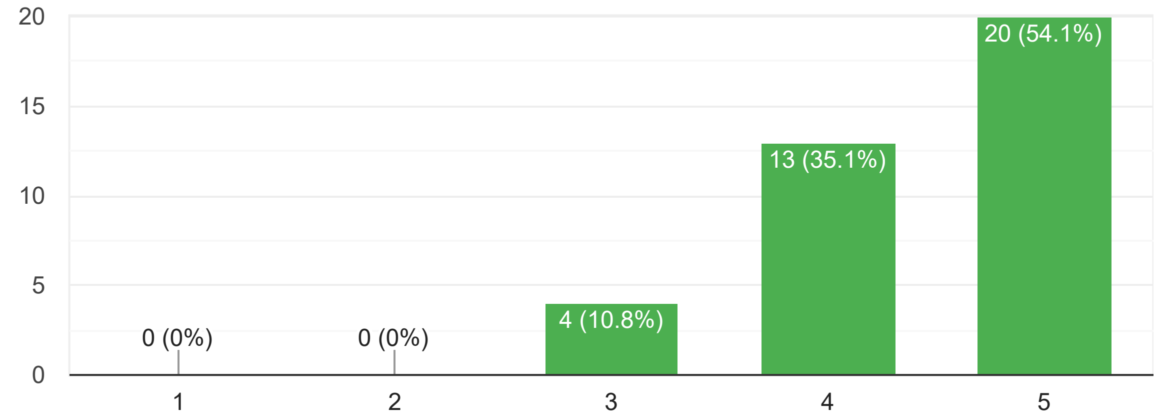
Supervision

37 responses



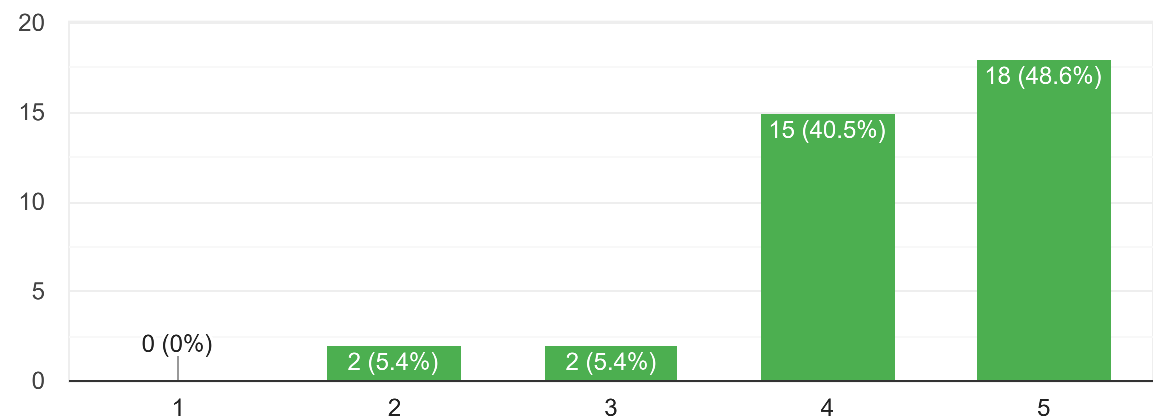
Planning and sequencing

37 responses



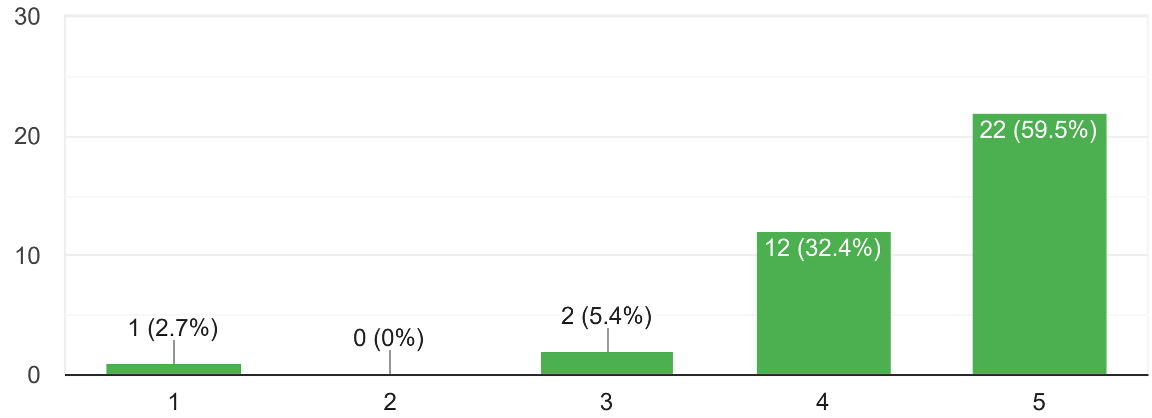
Competency of project manager

37 responses



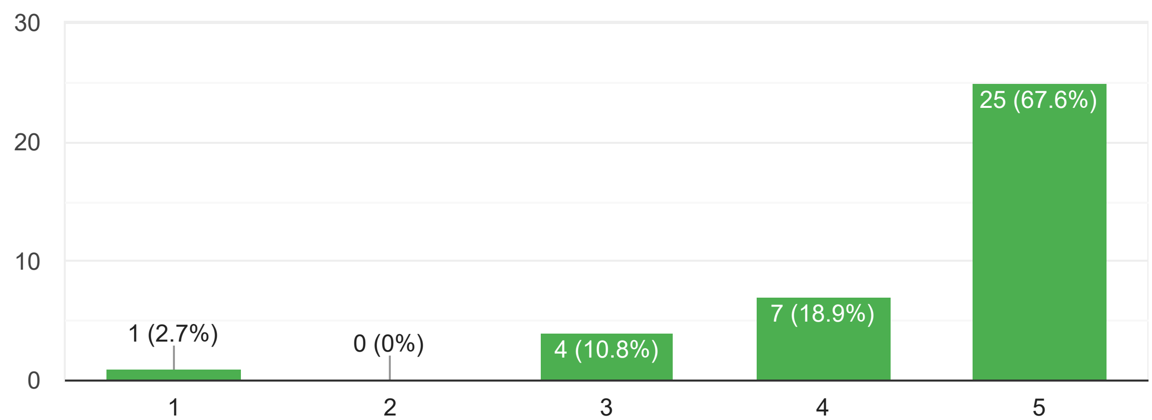
Availability and quality of information

37 responses



Coordination and collaboration

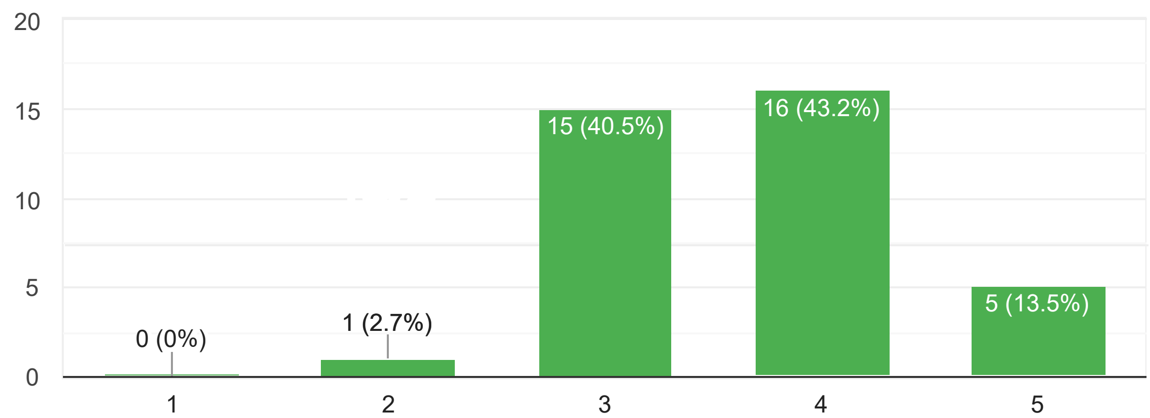
37 responses



Technical factors

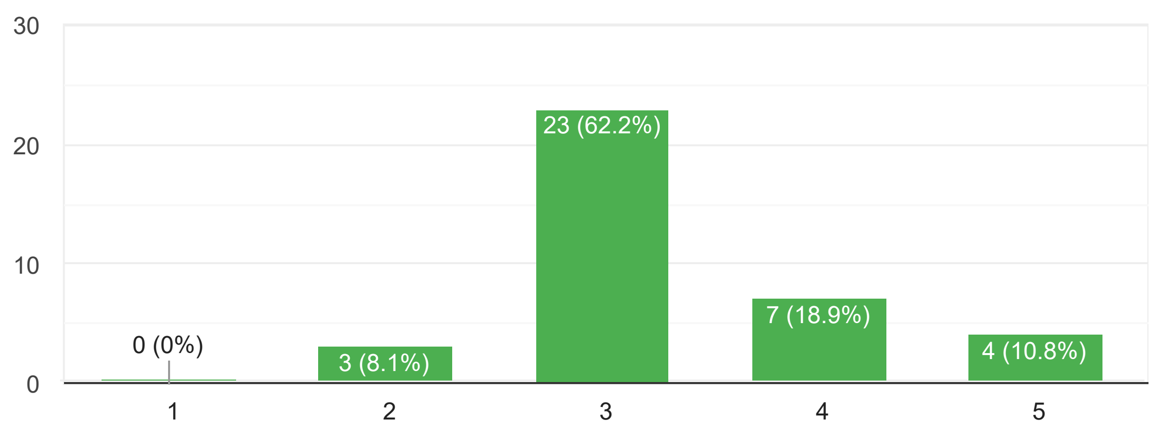
Tools and programs

37 responses



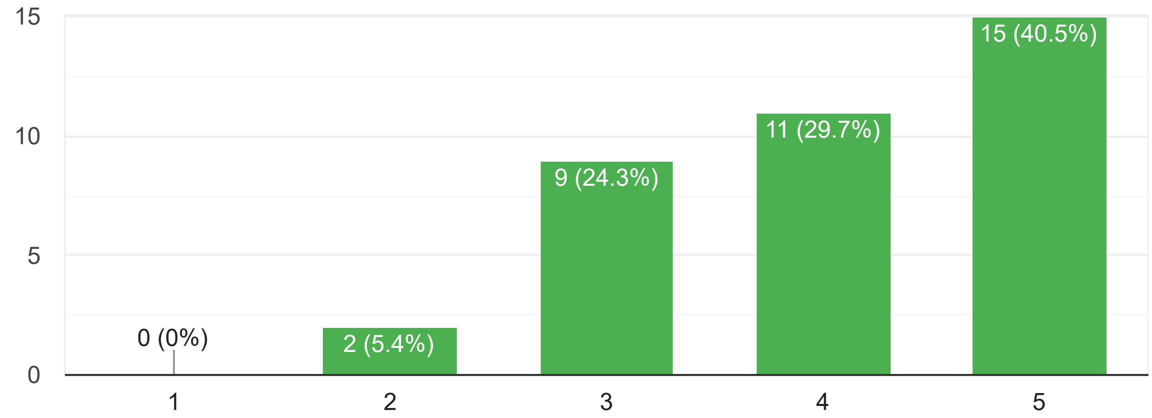
Techno changes

37 responses



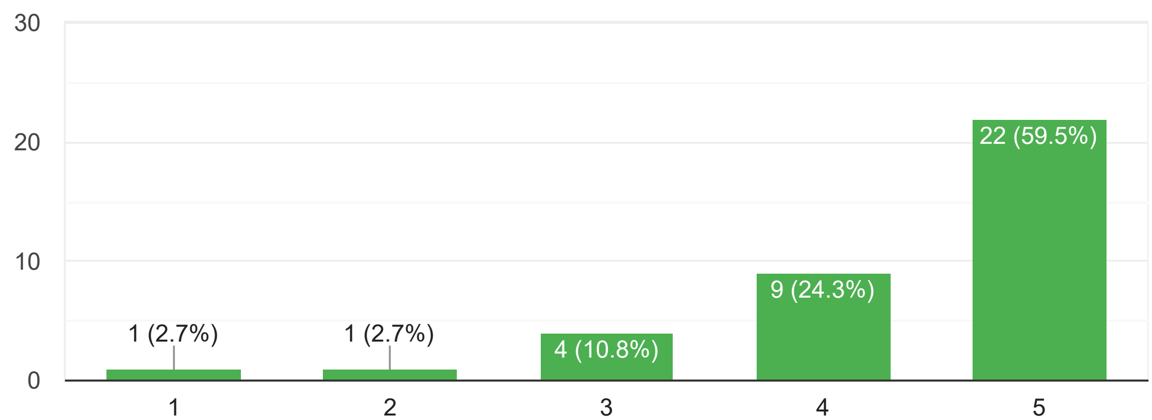
Design changes

37 responses



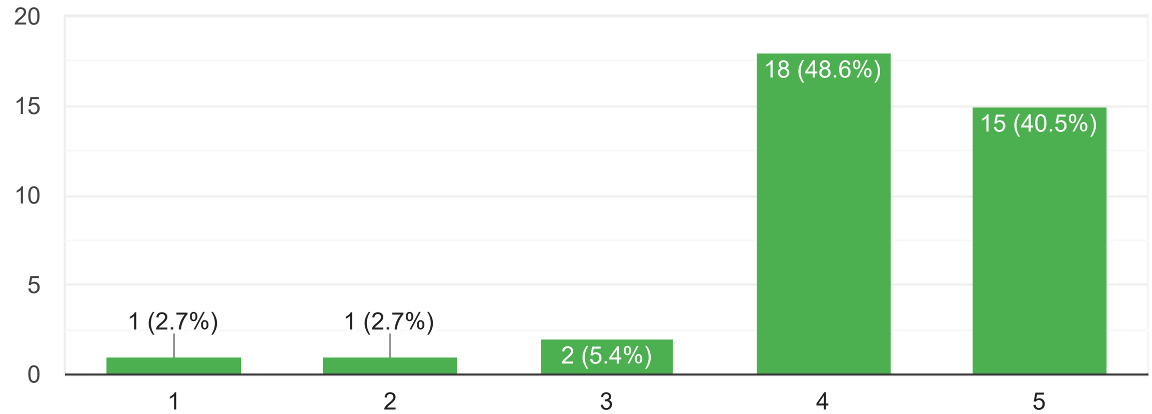
Incomplete or unclear specification of the work

37 responses



Client and consultants (client interference, approvals and disputes, decision making, competence)

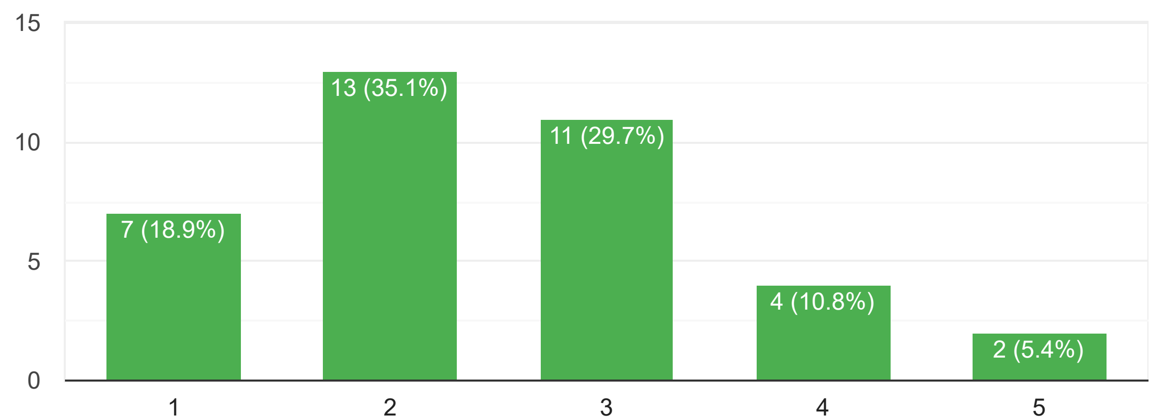
37 responses



External factors

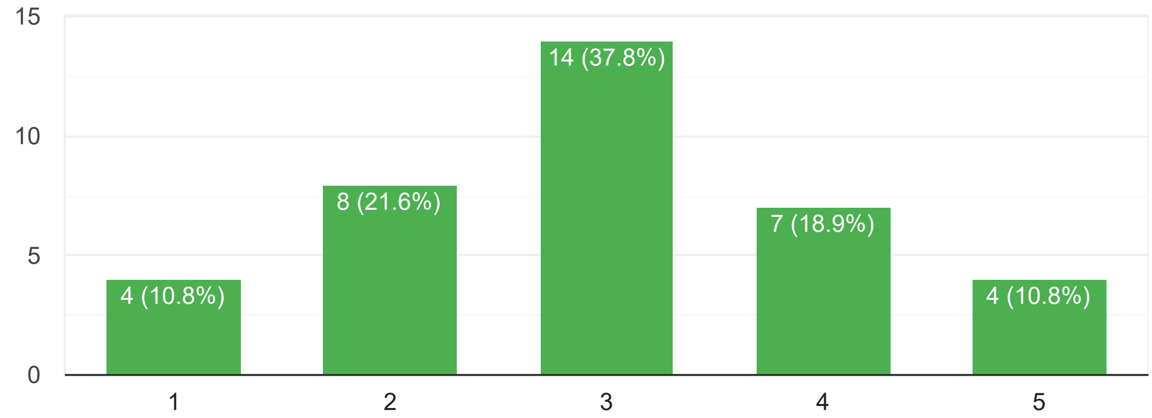
Financial stability (stability of country, inflation, cost of capital, financial crisis)

37 responses



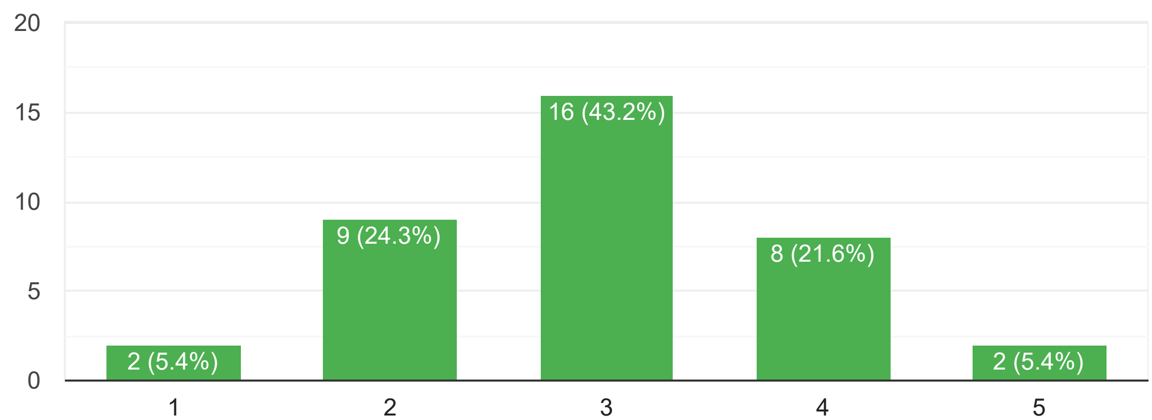
Permits

37 responses



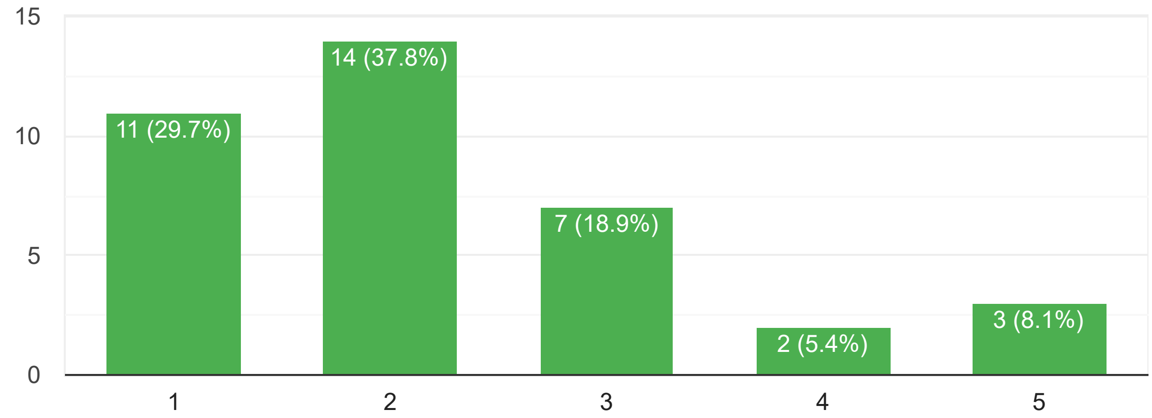
Legislation

37 responses



Weather

37 responses



Final conclusion

Based on your own experience which is the biggest problem for achieving high engineering productivity?

26 responses

Poor communication and manegement.

Unclear, unidentified calculation of the productivity

Constant changes and unclear project material.

Comuniacation in a language that the labor understsnds. Visible leadership in site. Shorten the chain of unnecessery managers.

coordination

Decision making by people who can, and have the power to make decisions, done at the right time.
Bese decisions on facts, not assumptions.
Plan and supervice the proces internal as well external.
Make time schedules for technally deliverence between the architect and the ingeneer.

13.3 Appendix C - Cronbach Alpha

```
GET DATA
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ductivity (Responses).xlsx'
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  /CELLRANGE=FULL
  /READNAMES=ON
  /DATATYPEMIN PERCENTAGE=95.0
  /HIDDEN IGNORE=YES.
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DATASET NAME DataSet4 WINDOW=FRONT.
RELIABILITY
  /VARIABLES=Projectfactorsprojectscopelocationcomplexityfinancialcapabilitya
    Laborfactorsskillsmotivationexperienceandect
    Managementfactorsplanningandsequencingcompetencyofprojectmanager
    Technicalfactorstoolsprogramsandequipmenttechnologyandculturedes
    Externalfactorsfinancialstabilityofthecountrylegislationandect Projectscope Projec
tlocation
    Projectcharacteristicssizebuildabilityandect Projectcomplexity Reworkanddelays Emp
loyeeskills
    Employeeavailability Employeemotivation Employeeexperience Laborworkfacilitiesands
atisfaction
    Laborfatigue Supervision Planningandsequencing Competencyofprojectmanager
    Availabilityandqualityofinformation Coordinationandcollaboration Toolsandprograms
Technochanges
    Designchanges Incompleteorunclearspecificationofthework
    Clientandconsultantsclientinterferenceapprovalsanddisputesdecisi
    Financialstabilitystabilityofcountryinflationcostofcapitalfinanc Permits Legislati
on Weather
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA
  /STATISTICS=DESCRIPTIVE SCALE
  /SUMMARY=TOTAL.
```

Reliability

[DataSet4]

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	37	100.0
	Excluded[a]	0	.0
	Total	37	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.865	30

Item Statistics

	Mean	Std. Deviation	N
Project factors (project scope, location, complexity, financial capability and ect.)	3.46	.869	37
Labor factors (skills, motivation, experience and ect.)	3.78	1.004	37
Management factors (planning and sequencing, competency of project manager, coordination and collaboration and ect.)	4.38	.794	37
Technical factors (tools/programs and equipment, technology and culture, design changes, incomplete specification or design and ect.)	3.54	1.070	37
External factors (financial stability of the country, legislation and ect.)	2.11	.966	37
Project scope	3.68	.915	37
Project location	2.35	1.086	37
Project characteristics (size, buildability and ect.)	3.86	.976	37
Project complexity	4.38	.924	37
Rework and delays	4.05	1.129	37
Employee skills	4.11	.906	37
Employee availability	3.97	.763	37
Employee motivation	4.19	.739	37
Employee experience	3.62	.861	37
Labor work facilities and satisfaction	3.54	1.016	37
Labor fatigue	3.51	.989	37
Supervision	3.59	.927	37
Planning and sequencing	4.43	.689	37

Item Statistics

	Mean	Std. Deviation	N
Competency of project manager	4.32	.818	37
Availability and quality of information	4.46	.836	37
Coordination and collaboration	4.49	.901	37
Tools and programs	3.68	.747	37
Techno changes	3.32	.784	37
Design changes	4.05	.941	37
Incomplete or unclear specification of the work	4.35	.978	37
Client and consultants (client interference, approvals and disputes, decision making, competence)	4.22	.886	37
Financial stability (stability of country, inflation, cost of capital, financial crisis)	2.49	1.096	37
Permits	2.97	1.142	37
Legislation	2.97	.957	37
Weather	2.24	1.188	37

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Project factors (project scope, location, complexity, financial capability and ect.)	106.68	159.447	.032	.869
Labor factors (skills, motivation, experience and ect.)	106.35	151.456	.341	.862
Management factors (planning and sequencing, competency of project manager, coordination and collaboration and ect.)	105.76	154.745	.280	.863
Technical factors (tools/programs and equipment, technology and culture, design changes, incomplete specification or design and ect.)	106.59	155.359	.165	.867
External factors (financial stability of the country, legislation and ect.)	108.03	154.527	.227	.865
Project scope	106.46	152.811	.321	.862
Project location	107.78	158.008	.063	.870
Project characteristics (size, buildability and ect.)	106.27	146.314	.577	.855
Project complexity	105.76	150.467	.423	.860
Rework and delays	106.08	142.632	.630	.853
Employee skills	106.03	150.138	.447	.859
Employee availability	106.16	152.473	.416	.860
Employee motivation	105.95	148.664	.648	.855
Employee experience	106.51	151.590	.404	.860
Labor work facilities and satisfaction	106.59	148.748	.448	.859
Labor fatigue	106.62	147.631	.511	.857
Supervision	106.54	148.644	.504	.858
Planning and sequencing	105.70	152.048	.493	.859
Competency of project manager	105.81	149.769	.522	.858
Availability and quality of information	105.68	151.725	.411	.860

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Coordination and collaboration	105.65	153.901	.277	.863
Tools and programs	106.46	152.755	.411	.860
Techno changes	106.81	149.380	.569	.857
Design changes	106.08	146.743	.582	.856
Incomplete or unclear specification of the work	105.78	147.230	.536	.857
Client and consultants (client interference, approvals and disputes, decision making, competence)	105.92	153.410	.305	.863
Financial stability (stability of country, inflation, cost of capital, financial crisis)	107.65	150.123	.356	.862
Permits	107.16	147.529	.435	.859
Legislation	107.16	149.306	.456	.859
Weather	107.89	153.988	.186	.868

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
110.14	160.898	12.685	30

13.4 Appendix D - Friedman's test

Respondent	Project factors	Labor factors	Management factors	Technical factors	External factors	Project scope	Project location	Project characteristics	Project complexity	Rework and delays	Employee skills	Employee availability	Employee motivation	Employee experience	Labor work facilities and satisfaction	Labor fatigue	Supervision	Planning and sequencing	Competency of project manager	Availability and quality of information	Coordination and collaboration	Tools and programs	Techno changes	Design changes	unclear specification of the work	Client and consultants	Financial stability	Permits	Legislation	Weather
1	5	4	5	3	2	5	1	5	5	5	5	4	4	3	3	4	5	5	5	5	5	4	4	5	5	4	3	3	4	1
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7	3	5	4	5	2	3	1	4	5	5	5	5	5	5	5	5	4	5	4	5	5	5	3	5	4	5	2	1	3	1
8	3	4	5	3	3	4	3	4	5	4	5	4	4	3	5	5	5	5	5	5	5	3	4	4	5	5	3	3	3	3
9	4	5	3	2	3	4	4	3	5	3	5	5	3	5	3	3	3	3	4	5	3	3	3	3	3	1	2	1	1	5
10	2	5	5	3	2	2	2	2	3	3	4	4	4	3	5	3	1	4	5	5	5	3	3	3	4	5	2	2	2	2
11	3	3	4	3	2	3	2	2	3	2	2	3	2	2	3	3	2	4	3	3	3	2	2	2	2	2	2	2	2	2
12	4	3	2	5	1	2	1	4	5	3	5	2	4	3	1	2	4	5	4	5	5	3	3	5	5	5	1	3	5	3
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16	4	2	5	2	1	4	1	3	4	5	3	4	4	4	4	4	3	5	5	5	5	3	2	4	5	5	2	3	2	1
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19	4	5	5	3	2	4	3	5	5	5	5	4	5	5	4	5	5	5	5	5	5	3	3	4	5	5	3	4	3	2
20	4	3	4	4	2	4	2	4	5	5	3	4	4	3	5	4	3	4	4	5	5	4	3	5	5	5	2	4	4	2
21	3	5	4	5	3	4	1	4	4	5	5	5	5	3	3	3	4	5	5	5	5	5	5	5	5	4	4	4	4	4
22	4	3	4	4	1	3	2	4	4	5	3	4	4	3	3	3	3	5	4	5	5	3	3	3	5	4	1	3	3	2
23	2	4	5	5	1	4	3	4	4	5	4	3	4	4	2	1	4	4	4	5	5	3	3	5	5	4	1	1	3	1
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25	4	5	5	5	3	4	3	4	4	5	4	5	5	3	4	4	3	5	5	5	5	3	4	5	5	4	3	4	3	2
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27	4	3	5	3	2	4	3	4	4	5	4	3	4	4	4	3	5	5	5	4	5	5	4	3	5	5	2	3	3	3
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33	5	5	5	4	3	5	2	5	5	5	5	5	4	4	4	5	3	5	5	4	5	4	3	5	5	5	3	4	4	2
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36	3	4	5	3	1	4	2	4	4	3	4	3	5	3	3	3	3	5	4	4	5	3	3	4	4	5	1	3	3	1
37	3	4	5	3	1	4	3	5	5	4	4	5	4	3	3	3	4	4	5	4	3	4	3	4	5	4	1	2	2	3

Respondent	Project factors	Labor factors	Management factors	Technical factors	External factors	Project scope	Project location	Project characteristics	Project complexity	Rework and delays	Employee skills	Employee availability	Employee motivation	Employee experience	Labor work facilities and satisfaction	Labor fatigue	Supervision	Planning and sequencing	Competency of project manager	Availability and quality of information	Coordination and collaboration	Tools and programs	Techno changes	Design changes	Incomplete or unclear specification of the work	Client and consultants	Financial stability	Permits	Legislation	Weather
1	23,5	12,5	23,5	6	3	23,5	1,5	23,5	23,5	23,5	23,5	12,5	12,5	6	6	12,5	23,5	23,5	23,5	23,5	23,5	12,5	12,5	23,5	23,5	12,5	6	6	12,5	1,5
2	24	14	24	29,5	4,5	24	4,5	24	24	4,5	14	14	24	4,5	14	4,5	14	14	24	14	29,5	24	4,5	14	14	14	4,5	14	24	4,5
3	7	11,5	11,5	3,5	3,5	11,5	3,5	3,5	3,5	11,5	23,5	23,5	23,5	23,5	23,5	11,5	11,5	11,5	23,5	23,5	3,5	23,5	23,5	23,5	16	23,5	23,5	23,5	11,5	23,5
4	1,5	16,5	26,5	16,5	6,5	6,5	1,5	16,5	16,5	26,5	16,5	16,5	26,5	16,5	6,5	6,5	16,5	26,5	26,5	26,5	26,5	16,5	6,5	16,5	26,5	6,5	6,5	16,5	16,5	6,5
5	13	24	24	6	6	24	6	24	24	24	24	13	13	13	13	24	24	24	24	24	24	6	13	13	13	13	2	2	6	2
6	2,5	4,5	4,5	2,5	1	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
7	7,5	22,5	12	22,5	4,5	7,5	2	12	22,5	22,5	22,5	22,5	22,5	22,5	22,5	22,5	12	22,5	12	22,5	22,5	22,5	7,5	22,5	12	22,5	4,5	2	7,5	2
8	5,5	14,5	24,5	5,5	5,5	14,5	5,5	14,5	24,5	14,5	24,5	14,5	14,5	5,5	24,5	24,5	24,5	24,5	24,5	24,5	24,5	5,5	14,5	14,5	24,5	24,5	5,5	5,5	5,5	5,5
9	21,5	27	12,5	4,5	12,5	21,5	21,5	12,5	27	12,5	27	27	12,5	27	12,5	12,5	12,5	12,5	21,5	27	12,5	12,5	12,5	12,5	12,5	2	4,5	2	2	27
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11	23	23	29,5	23	9	23	9	9	23	9	9	23	9	9	23	23	9	29,5	23	23	23	9	9	9	9	9	9	9	9	9
12	18	12	6,5	25,5	2,5	6,5	2,5	18	25,5	12	25,5	6,5	18	12	2,5	6,5	18	25,5	18	25,5	25,5	12	12	25,5	25,5	25,5	2,5	12	25,5	12
13	20	20	20	20	7,5	7,5	7,5	29,5	29,5	20	20	20	20	20	20	20	7,5	20	20	20	20	7,5	7,5	7,5	20	20	7,5	2	2	2
14	27,5	21,5	15,5	9,5	3,5	27,5	21,5	15,5	9,5	3,5	27,5	21,5	15,5	9,5	3,5	27,5	21,5	15,5	9,5	3,5	27,5	21,5	15,5	9,5	3,5	27,5	21,5	15,5	9,5	3,5
15	24,5	12	24,5	24,5	12	12	12	12	24,5	24,5	12	12	12	12	24,5	3	3	24,5	3	24,5	24,5	24,5	12	12	24,5	24,5	12	3	12	3
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19	11,5	22,5	22,5	5,5	1,5	11,5	5,5	22,5	22,5	22,5	22,5	11,5	22,5	22,5	11,5	22,5	22,5	22,5	22,5	22,5	22,5	5,5	5,5	11,5	22,5	22,5	5,5	11,5	5,5	1,5
20	16	7	16	16	2,5	16	2,5	16	26,5	26,5	7	16	16	7	26,5	16	7	16	16	26,5	26,5	16	7	26,5	26,5	26,5	2,5	16	16	2,5
21	4	23,5	11,5	23,5	4	11,5	1	11,5	11,5	23,5	23,5	23,5	23,5	4	4	4	11,5	23,5	23,5	23,5	23,5	23,5	23,5	23,5	23,5	11,5	11,5	11,5	11,5	11,5
22	21	10,5	21	21	1,5	10,5	3,5	21	21	28	10,5	21	21	10,5	10,5	10,5	10,5	28	21	28	28	10,5	10,5	10,5	28	21	1,5	10,5	10,5	3,5
23	6,5	18	27	27	3	18	10	18	18	27	18	10	18	18	6,5	3	18	18	18	27	27	10	10	27	27	18	3	3	10	3
24	17,5	4	27	4	17,5	17,5	4	17,5	27	27	17,5	17,5	17,5	17,5	9	9	9	27	27	27	27	17,5	9	9	17,5	17,5	17,5	4	4	1
25	13,5	24,5	24,5	24,5	5	13,5	5	13,5	13,5	24,5	13,5	24,5	24,5	5	13,5	13,5	5	24,5	24,5	24,5	24,5	5	13,5	24,5	24,5	13,5	5	13,5	5	1
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36	10,5	21	28	10,5	2	21	4	21	21	10,5	21	10,5	28	10,5	10,5	10,5	10,5	28	21	21	28	10,5	10,5	21	21	28	2	10,5	10,5	2
37	9	19	27,5	9	1,5	19	9	27,5	27,5	19	19	27,5	19	9	9	9	19	19	27,5	19	9	19	9	19	27,5	19	1,5	3,5	3,5	9
Sum	***506,5***	***599,5***	***788***	***544,5***	***194,5***	***558,5***	***246***	***622,5***	***812***	***697***	***676,5***	***641***	***716***	***521***	***520,5***	***504***	***520,5***	***809***	***765***	***810***	***824,5***	***543,5***	***430,5***	***671,5***	***778,5***	***719***	***250,5***	***368,5***	***346***	***220***
Mean rank	***13,69***	***16,20***	***21,30***	***14,72***	***5,26***	***15,09***	***6,65***	***16,82***	***21,95***	***18,84***	***18,28***	***17,32***	***19,35***	***14,08***	***14,07***	***13,62***	***14,07***	***21,86***	***20,68***	***21,89***	***22,28***	***14,69***	***11,64***	***18,15***	***21,04***	***19,43***	***6,77***	***9,96***	***9,35***	***5,95***
Sum Rank ^2	***256542,25***	***359400,25***	***620944***	***296480,25***	***37830,25***	***311922,25***	***60516***	***387506,25***	***659344***	***485809***	***457652,25***	***410881***	***512656***	***271441***	***270920,25***	***254016***	***270920,25***	***654481***	***585225***	***656100***	***679800,25***	***295392,25***	***185330,25***	***450912,25***	***606062,25***	***516961***	***62750,25***	***135792,25***	***119716***	***48400***

Min sum of ranks for 1 factor	***37***
Max sum of ranks for 1 factor	***1110***
Sum of all ranks for all factors	***17205***
Sum of all squares for all factors	***10921704***
Expected sum for 1 factor, H0	***573,5***

			Rank
General groups	Project factors	***13,69***	4
	Labour factors	***16,20***	2
	Management factors	***21,30***	1
	Technical factors	***14,72***	3
	External factors	***5,26***	5
Project factors	Project scope	***15,09***	***14***
	Project location	***6,65***	***24***
	Project characteristics (size, buildability and ect.)	***16,82***	***13***
	Project complexity	***21,95***	***2***
	Rework and delays	***18,84***	***9***
Labour factors	Employee skills	***18,28***	***10***
	Employee availability	***17,32***	***12***
	Employee motivation	***19,35***	***8***
	Employee experience	***14,08***	***16***
	Labour work facilities and satisfaction	***14,07***	***17***
	Labour fatigue	***13,62***	***19***
Management factors	Supervision	***14,07***	***17***
	Planning and sequencing	***21,86***	***4***
	Competency of project manager	***20,68***	***6***
	Availability and quality of information	***21,89***	***3***
	Coordination and collaboration	***22,28***	***1***
Technical factors	Tools and programs	***14,69***	***15***
	Techno changes	***11,64***	***20***
	Design changes	***18,15***	***11***
	Incomplete or unclear specification of the work	***21,04***	***5***
	Client and consultants	***19,43***	***7***
External factors	Financial stability	***6,77***	***23***
	Permits	***9,96***	***21***
	Legislation	***9,35***	***22***
	Weather	***5,95***	***25***

Mean Frequency rank **15,754**

*Ranking of factors with colour:

(green)	most likely low impact from 15,754 below
(red)	most likely high impact above 15,754

Blocks (n)	*37*
Treatments (p)	*30*
Part 1	*0,00035*
Part 2	*10921704*
Part 3	*3441*
alpha	*0,05*
${X^2}_r$	*367,79*
Critical value chi-square X^2	*42,56*
p-value	*0,00*
Reject Null?	***Yes***

$$ {X^2}_r = \left[\frac{12}{n(p)(p+1)} \sum_{j=1}^{p} r_j^2 \right] - 3n(p+1) $$

$p=$ number of treatments

$n=$ the number of blocks

r_j^2 = the squared sum of the ranks for sample treatment (column) j

13.5 Appendix E - Wilcoxon test

13.5.1 Groups of factors

```
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>The LOCALE subcommand of the SET command has an invalid parameter.  It could
>not be mapped to a valid backend locale.

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  /FILE='C:\Kameliya\Appendix\Factors affecting the engineering (labor) productivity (
Responses).xlsx'
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  /CELLRANGE=FULL
  /READNAMES=ON
  /DATATYPEMIN PERCENTAGE=95.0
  /HIDDEN IGNORE=YES.
EXECUTE.
DATASET NAME DataSet1 WINDOW=FRONT.
NPAR TESTS
  /WILCOXON=Projectfactorsprojectscopelocationcomplexityfinancialcapabilitya WITH
    Laborfactorsskillsmotivationexperienceandect (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

```
[DataSet1]
```

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Labor factors (skills, motivation, experience and ect.) - Project factors (project scope, location, complexity, financial capability and ect.)	Negative Ranks	13[a]	13.85	180.00
	Positive Ranks	18[b]	17.56	316.00
	Ties	6[c]		
	Total	37		

a. Labor factors (skills, motivation, experience and ect.) < Project factors (project scope, location, complexity, financial capability and ect.)

b. Labor factors (skills, motivation, experience and ect.) > Project factors (project scope, location, complexity, financial capability and ect.)

c. Labor factors (skills, motivation, experience and ect.) = Project factors (project scope, location, complexity, financial capability and ect.)

Test Statistics[a]

	Labor factors (skills, motivation, experience and ect.) - Project factors (project scope, location, complexity, financial capability and ect.)
Z	-1.382[b]
Asymp. Sig. (2-tailed)	.167

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectfactorsprojectscopelocationcomplexityfinancialcapabilitya WITH
    Managementfactorsplanningandsequencingcompetencyofprojectmanager (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Management factors (planning and sequencing, competency of project manager, coordination and collaboration and ect.) - Project factors (project scope, location, complexity, financial capability and ect.)	Negative Ranks	4[a]	14.75	59.00
	Positive Ranks	25[b]	15.04	376.00
	Ties	8[c]		
	Total	37		

a. Management factors (planning and sequencing, competency of project manager, coordination and collaboration and ect.) < Project factors (project scope, location, complexity, financial capability and ect.)

b. Management factors (planning and sequencing, competency of project manager, coordination and collaboration and ect.) > Project factors (project scope, location, complexity, financial capability and ect.)

c. Management factors (planning and sequencing, competency of project manager, coordination and collaboration and ect.) = Project factors (project scope, location, complexity, financial capability and ect.)

Test Statistics[a]

	Management factors (planning and sequencing, competency of project manager, coordination and collaboration and ect.) - Project factors (project scope, location, complexity, financial capability and ect.)
Z	-3.511[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectfactorsprojectscopelocationcomplexityfinancialcapabilitya WITH
    Technicalfactorstoolsprogramsandequipmenttechnologyandculturedes (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Technical factors (tools/programs and equipment, technology and culture, design changes, incomplete specification or design and ect.) - Project factors (project scope, location, complexity, financial capability and ect.)	Negative Ranks	11[a]	13.68	150.50
	Positive Ranks	14[b]	12.46	174.50
	Ties	12[c]		
	Total	37		

a. Technical factors (tools/programs and equipment, technology and culture, design changes, incomplete specification or design and ect.) < Project factors (project scope, location, complexity, financial capability and ect.)

b. Technical factors (tools/programs and equipment, technology and culture, design changes, incomplete specification or design and ect.) > Project factors (project scope, location, complexity, financial capability and ect.)

c. Technical factors (tools/programs and equipment, technology and culture, design changes, incomplete specification or design and ect.) = Project factors (project scope, location, complexity, financial capability and ect.)

Test Statistics[a]

	Technical factors (tools/programs and equipment, technology and culture, design changes, incomplete specification or design and ect.) - Project factors (project scope, location, complexity, financial capability and ect.)
Z	-.333[b]
Asymp. Sig. (2-tailed)	.739

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

NPAR TESTS

```
  /WILCOXON=Projectfactorsprojectscopelocationcomplexityfinancialcapabilitya WITH
    Externalfactorsfinancialstabilityofthecountrylegislationandect (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
External factors (financial stability of the country, legislation and ect.) - Project factors (project scope, location, complexity, financial capability and ect.)	Negative Ranks	29[a]	15.78	457.50
	Positive Ranks	1[b]	7.50	7.50
	Ties	7[c]		
	Total	37		

a. External factors (financial stability of the country, legislation and ect.) < Project factors (project scope, location, complexity, financial capability and ect.)

b. External factors (financial stability of the country, legislation and ect.) > Project factors (project scope, location, complexity, financial capability and ect.)

c. External factors (financial stability of the country, legislation and ect.) = Project factors (project scope, location, complexity, financial capability and ect.)

Test Statistics[a]

	External factors (financial stability of the country, legislation and ect.) - Project factors (project scope, location, complexity, financial capability and ect.)
Z	-4.714[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Laborfactorsskillsmotivationexperienceandect WITH
    Managementfactorsplanningandsequencingcompetencyofprojectmanager (PAIRED)
```

```
/MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Management factors (planning and sequencing, competency of project manager, coordination and collaboration and ect.) - Labor factors (skills, motivation, experience and ect.)	Negative Ranks	6[a]	11.92	71.50
	Positive Ranks	20[b]	13.98	279.50
	Ties	11[c]		
	Total	37		

a. Management factors (planning and sequencing, competency of project manager, coordination and collaboration and ect.) < Labor factors (skills, motivation, experience and ect.)

b. Management factors (planning and sequencing, competency of project manager, coordination and collaboration and ect.) > Labor factors (skills, motivation, experience and ect.)

c. Management factors (planning and sequencing, competency of project manager, coordination and collaboration and ect.) = Labor factors (skills, motivation, experience and ect.)

Test Statistics[a]

	Management factors (planning and sequencing, competency of project manager, coordination and collaboration and ect.) - Labor factors (skills, motivation, experience and ect.)
Z	-2.774[b]
Asymp. Sig. (2-tailed)	.006

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
```

```
/WILCOXON=Laborfactorsskillsmotivationexperienceandect WITH
  Technicalfactorstoolsprogramsandequipmenttechnologyandculturedes (PAIRED)
/MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Technical factors (tools/programs and equipment, technology and culture, design changes, incomplete specification or design and ect.) - Labor factors (skills, motivation, experience and ect.)	Negative Ranks	15[a]	12.27	184.00
	Positive Ranks	9[b]	12.89	116.00
	Ties	13[c]		
	Total	37		

a. Technical factors (tools/programs and equipment, technology and culture, design changes, incomplete specification or design and ect.) < Labor factors (skills, motivation, experience and ect.)

b. Technical factors (tools/programs and equipment, technology and culture, design changes, incomplete specification or design and ect.) > Labor factors (skills, motivation, experience and ect.)

c. Technical factors (tools/programs and equipment, technology and culture, design changes, incomplete specification or design and ect.) = Labor factors (skills, motivation, experience and ect.)

Test Statistics[a]

	Technical factors (tools/programs and equipment, technology and culture, design changes, incomplete specification or design and ect.) - Labor factors (skills, motivation, experience and ect.)
Z	-.998[b]
Asymp. Sig. (2-tailed)	.319

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Laborfactorsskillsmotivationexperienceandect WITH
    Externalfactorsfinancialstabilityofthecountrylegislationandect (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
External factors (financial stability of the country, legislation and ect.) - Labor factors (skills, motivation, experience and ect.)	Negative Ranks	33[a]	17.97	593.00
	Positive Ranks	2[b]	18.50	37.00
	Ties	2[c]		
	Total	37		

a. External factors (financial stability of the country, legislation and ect.) < Labor factors (skills, motivation, experience and ect.)

b. External factors (financial stability of the country, legislation and ect.) > Labor factors (skills, motivation, experience and ect.)

c. External factors (financial stability of the country, legislation and ect.) = Labor factors (skills, motivation, experience and ect.)

Test Statistics[a]

	External factors (financial stability of the country, legislation and ect.) - Labor factors (skills, motivation, experience and ect.)
Z	-4.615[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Managementfactorsplanningandsequencingcompetencyofprojectmanager WITH
    Technicalfactorstoolsprogramsandequipmenttechnologyandculturedes (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Technical factors (tools/programs and equipment, technology and culture, design changes, incomplete specification or design and ect.) - Management factors (planning and sequencing, competency of project manager, coordination and collaboration and ect.)	Negative Ranks	23[a]	15.17	349.00
	Positive Ranks	5[b]	11.40	57.00
	Ties	9[c]		
	Total	37		

a. Technical factors (tools/programs and equipment, technology and culture, design changes, incomplete specification or design and ect.) < Management factors (planning and sequencing, competency of project manager, coordination and collaboration and ect.)

b. Technical factors (tools/programs and equipment, technology and culture, design changes, incomplete specification or design and ect.) > Management factors (planning and sequencing, competency of project manager, coordination and collaboration and ect.)

c. Technical factors (tools/programs and equipment, technology and culture, design changes, incomplete specification or design and ect.) = Management factors (planning and sequencing, competency of project manager, coordination and collaboration and ect.)

Test Statistics[a]

	Technical factors (tools/programs and equipment, technology and culture, design changes, incomplete specification or design and ect.) - Management factors (planning and sequencing, competency of project manager, coordination and collaboration and ect.)
Z	-3.400[b]
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Managementfactorsplanningandsequencingcompetencyofprojectmanager WITH
    Externalfactorsfinancialstabilityofthecountrylegislationandect (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
External factors (financial stability of the country, legislation and ect.) - Management factors (planning and sequencing, competency of project manager, coordination and collaboration and ect.)	Negative Ranks	34[a]	18.43	626.50
	Positive Ranks	1[b]	3.50	3.50
	Ties	2[c]		
	Total	37		

a. External factors (financial stability of the country, legislation and ect.) < Management factors (planning and sequencing, competency of project manager, coordination and collaboration and ect.)

b. External factors (financial stability of the country, legislation and ect.) > Management factors (planning and sequencing, competency of project manager, coordination and collaboration and ect.)

c. External factors (financial stability of the country, legislation and ect.) = Management factors (planning and sequencing, competency of project manager, coordination and collaboration and ect.)

Test Statistics[a]

	External factors (financial stability of the country, legislation and ect.) - Management factors (planning and sequencing, competency of project manager, coordination and collaboration and ect.)
Z	-5.157[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Technicalfactorstoolsprogramsandequipmenttechnologyandculturedes WITH
    Externalfactorsfinancialstabilityofthecountrylegislationandect (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
External factors (financial stability of the country, legislation and ect.) - Technical factors (tools/programs and equipment, technology and culture, design changes, incomplete specification or design and ect.)	Negative Ranks	30[a]	16.65	499.50
	Positive Ranks	2[b]	14.25	28.50
	Ties	5[c]		
	Total	37		

a. External factors (financial stability of the country, legislation and ect.) < Technical factors (tools/programs and equipment, technology and culture, design changes, incomplete specification or design and ect.)

b. External factors (financial stability of the country, legislation and ect.) > Technical factors (tools/programs and equipment, technology and culture, design changes, incomplete specification or design and ect.)

c. External factors (financial stability of the country, legislation and ect.) = Technical factors (tools/programs and equipment, technology and culture, design changes, incomplete specification or design and ect.)

Test Statistics[a]

	External factors (financial stability of the country, legislation and ect.) - Technical factors (tools/programs and equipment, technology and culture, design changes, incomplete specification or design and ect.)
Z	-4.482[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

13.5.2 All factors

```
NPAR TESTS
  /WILCOXON=Projectscope WITH Projectlocation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Project location - Project scope	Negative Ranks	29[a]	15.34	445.00
	Positive Ranks	1[b]	20.00	20.00
	Ties	7[c]		
	Total	37		

a. Project location < Project scope

b. Project location > Project scope

c. Project location = Project scope

Test Statistics[a]

	Project location - Project scope
Z	-4.452[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectscope WITH Projectcharacteristicssizebuildabilityandect (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Project characteristics (size, buildability and ect.) - Project scope	Negative Ranks	7[a]	9.71	68.00
	Positive Ranks	12[b]	10.17	122.00
	Ties	18[c]		
	Total	37		

a. Project characteristics (size, buildability and ect.) < Project scope

b. Project characteristics (size, buildability and ect.) > Project scope

c. Project characteristics (size, buildability and ect.) = Project scope

Test Statistics[a]

	Project characteristics (size, buildability and ect.) - Project scope
Z	-1.133[b]
Asymp. Sig. (2-tailed)	.257

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectscope WITH Projectcomplexity (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Project complexity - Project scope	Negative Ranks	2[a]	18.25	36.50
	Positive Ranks	20[b]	10.83	216.50
	Ties	15[c]		
	Total	37		

a. Project complexity < Project scope

b. Project complexity > Project scope

c. Project complexity = Project scope

Test Statistics[a]

	Project complexity - Project scope
Z	-2.990[b]
Asymp. Sig. (2-tailed)	.003

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectscope WITH Reworkanddelays (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Rework and delays - Project scope	Negative Ranks	8[a]	16.63	133.00
	Positive Ranks	21[b]	14.38	302.00
	Ties	8[c]		
	Total	37		

a. Rework and delays < Project scope

b. Rework and delays > Project scope

c. Rework and delays = Project scope

Test Statistics[a]

	Rework and delays - Project scope
Z	-1.918[b]
Asymp. Sig. (2-tailed)	.055

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectscope WITH Employeeskills (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee skills - Project scope	Negative Ranks	7[a]	10.50	73.50
	Positive Ranks	16[b]	12.66	202.50
	Ties	14[c]		
	Total	37		

a. Employee skills < Project scope

b. Employee skills > Project scope

c. Employee skills = Project scope

Test Statistics[a]

	Employee skills - Project scope
Z	-2.063[b]
Asymp. Sig. (2-tailed)	.039

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectscope WITH Employeeavailability (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee availability - Project scope	Negative Ranks	9[a]	9.50	85.50
	Positive Ranks	14[b]	13.61	190.50
	Ties	14[c]		
	Total	37		

a. Employee availability < Project scope

b. Employee availability > Project scope

c. Employee availability = Project scope

Test Statistics[a]

	Employee availability - Project scope
Z	-1.696[b]
Asymp. Sig. (2-tailed)	.090

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectscope WITH Employeemotivation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee motivation - Project scope	Negative Ranks	8[a]	10.06	80.50
	Positive Ranks	18[b]	15.03	270.50
	Ties	11[c]		
	Total	37		

a. Employee motivation < Project scope

b. Employee motivation > Project scope

c. Employee motivation = Project scope

Test Statistics[a]

	Employee motivation - Project scope
Z	-2.495[b]
Asymp. Sig. (2-tailed)	.013

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectscope WITH Employeeexperience (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee experience - Project scope	Negative Ranks	15[a]	13.23	198.50
	Positive Ranks	12[b]	14.96	179.50
	Ties	10[c]		
	Total	37		

a. Employee experience < Project scope

b. Employee experience > Project scope

c. Employee experience = Project scope

Test Statistics[a]

	Employee experience - Project scope
Z	-.240[b]
Asymp. Sig. (2-tailed)	.810

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectscope WITH Laborworkfacilitiesandsatisfaction (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Labor work facilities and satisfaction - Project scope	Negative Ranks	15[a]	14.10	211.50
	Positive Ranks	12[b]	13.88	166.50
	Ties	10[c]		
	Total	37		

a. Labor work facilities and satisfaction < Project scope

b. Labor work facilities and satisfaction > Project scope

c. Labor work facilities and satisfaction = Project scope

Ranks

		N	Mean Rank	Sum of Ranks
Employee experience - Project scope	Negative Ranks	15[a]	13.23	198.50
	Positive Ranks	12[b]	14.96	179.50
	Ties	10[c]		
	Total	37		

a. Employee experience < Project scope

b. Employee experience > Project scope

c. Employee experience = Project scope

Test Statistics[a]

	Employee experience - Project scope
Z	-.240[b]
Asymp. Sig. (2-tailed)	.810

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectscope WITH Laborworkfacilitiesandsatisfaction (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Labor work facilities and satisfaction - Project scope	Negative Ranks	15[a]	14.10	211.50
	Positive Ranks	12[b]	13.88	166.50
	Ties	10[c]		
	Total	37		

a. Labor work facilities and satisfaction < Project scope

b. Labor work facilities and satisfaction > Project scope

c. Labor work facilities and satisfaction = Project scope

Test Statistics[a]

	Labor work facilities and satisfaction - Project scope
Z	-.569[b]
Asymp. Sig. (2-tailed)	.569

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectscope WITH Laborfatigue (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Labor fatigue - Project scope	Negative Ranks	13[a]	11.62	151.00
	Positive Ranks	9[b]	11.33	102.00
	Ties	15[c]		
	Total	37		

a. Labor fatigue < Project scope

b. Labor fatigue > Project scope

c. Labor fatigue = Project scope

Test Statistics[a]

	Labor fatigue - Project scope
Z	-.843[b]
Asymp. Sig. (2-tailed)	.399

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectscope WITH Supervision (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Supervision - Project scope	Negative Ranks	14[a]	12.14	170.00
	Positive Ranks	10[b]	13.00	130.00
	Ties	13[c]		
	Total	37		

a. Supervision < Project scope

b. Supervision > Project scope

c. Supervision = Project scope

Test Statistics[a]

	Supervision - Project scope
Z	-.615[b]
Asymp. Sig. (2-tailed)	.539

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectscope WITH Planningandsequencing (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Planning and sequencing - Project scope	Negative Ranks	4[a]	12.00	48.00
	Positive Ranks	22[b]	13.77	303.00
	Ties	11[c]		
	Total	37		

a. Planning and sequencing < Project scope

b. Planning and sequencing > Project scope

c. Planning and sequencing = Project scope

Test Statistics[a]

	Planning and sequencing - Project scope
Z	-3.358[b]
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectscope WITH Competencyofprojectmanager (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Competency of project manager - Project scope	Negative Ranks	3[a]	12.67	38.00
	Positive Ranks	20[b]	11.90	238.00
	Ties	14[c]		
	Total	37		

a. Competency of project manager < Project scope

b. Competency of project manager > Project scope

c. Competency of project manager = Project scope

Test Statistics[a]

	Competency of project manager - Project scope
Z	-3.150[b]
Asymp. Sig. (2-tailed)	.002

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectscope WITH Availabilityandqualityofinformation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Availability and quality of information - Project scope	Negative Ranks	4[a]	14.13	56.50
	Positive Ranks	24[b]	14.56	349.50
	Ties	9[c]		
	Total	37		

a. Availability and quality of information < Project scope

b. Availability and quality of information > Project scope

c. Availability and quality of information = Project scope

Test Statistics[a]

	Availability and quality of information - Project scope
Z	-3.451[b]
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectscope WITH Coordinationandcollaboration (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Coordination and collaboration - Project scope	Negative Ranks	4[a]	13.13	52.50
	Positive Ranks	24[b]	14.73	353.50
	Ties	9[c]		
	Total	37		

a. Coordination and collaboration < Project scope

b. Coordination and collaboration > Project scope

c. Coordination and collaboration = Project scope

Test Statistics[a]

	Coordination and collaboration - Project scope
Z	-3.566[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectscope WITH Toolsandprograms (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Tools and programs - Project scope	Negative Ranks	14[a]	12.43	174.00
	Positive Ranks	12[b]	14.75	177.00
	Ties	11[c]		
	Total	37		

a. Tools and programs < Project scope

b. Tools and programs > Project scope

c. Tools and programs = Project scope

Test Statistics[a]

	Tools and programs - Project scope
Z	-.041[b]
Asymp. Sig. (2-tailed)	.967

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectscope WITH Technochanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Techno changes - Project scope	Negative Ranks	17[a]	12.53	213.00
	Positive Ranks	7[b]	12.43	87.00
	Ties	13[c]		
	Total	37		

a. Techno changes < Project scope

b. Techno changes > Project scope

c. Techno changes = Project scope

Test Statistics[a]

	Techno changes - Project scope
Z	-1.886[b]
Asymp. Sig. (2-tailed)	.059

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectscope WITH Designchanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Design changes - Project scope	Negative Ranks	9[a]	11.06	99.50
	Positive Ranks	16[b]	14.09	225.50
	Ties	12[c]		
	Total	37		

a. Design changes < Project scope

b. Design changes > Project scope

c. Design changes = Project scope

Test Statistics[a]

	Design changes - Project scope
Z	-1.776[b]
Asymp. Sig. (2-tailed)	.076

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectscope WITH Incompleteoruncleartspecificationofthework (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Incomplete or unclear specification of the work - Project scope	Negative Ranks	6[a]	14.50	87.00
	Positive Ranks	24[b]	15.75	378.00
	Ties	7[c]		
	Total	37		

a. Incomplete or unclear specification of the work < Project scope

b. Incomplete or unclear specification of the work > Project scope

c. Incomplete or unclear specification of the work = Project scope

Test Statistics[a]

	Incomplete or unclear specification of the work - Project scope
Z	-3.145[b]
Asymp. Sig. (2-tailed)	.002

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectscope WITH Clientandconsultantsclientinterferenceapprovalsanddisput
esdecisi
    (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Client and consultants (client interference, approvals and disputes, decision making, competence) - Project scope	Negative Ranks	5[a]	11.10	55.50
	Positive Ranks	18[b]	12.25	220.50
	Ties	14[c]		
	Total	37		

a. Client and consultants (client interference, approvals and disputes, decision making, competence) < Project scope

b. Client and consultants (client interference, approvals and disputes, decision making, competence) > Project scope

c. Client and consultants (client interference, approvals and disputes, decision making, competence) = Project scope

Test Statistics[a]

	Client and consultants (client interference, approvals and disputes, decision making, competence) - Project scope
Z	-2.616[b]
Asymp. Sig. (2-tailed)	.009

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectscope WITH Financialstabilitystabilityofcountryinflationcostofcapit
alfinanc
    (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Financial stability (stability of country, inflation, cost of capital, financial crisis) - Project scope	Negative Ranks	25[a]	14.24	356.00
	Positive Ranks	2[b]	11.00	22.00
	Ties	10[c]		
	Total	37		

a. Financial stability (stability of country, inflation, cost of capital, financial crisis) < Project scope

b. Financial stability (stability of country, inflation, cost of capital, financial crisis) > Project scope

c. Financial stability (stability of country, inflation, cost of capital, financial crisis) = Project scope

Test Statistics[a]

	Financial stability (stability of country, inflation, cost of capital, financial crisis) - Project scope
Z	-4.081[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectscope WITH Permits (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Permits - Project scope	Negative Ranks	21[a]	14.48	304.00
	Positive Ranks	6[b]	12.33	74.00
	Ties	10[c]		
	Total	37		

a. Permits < Project scope

b. Permits > Project scope

c. Permits = Project scope

Test Statistics[a]

	Permits - Project scope
Z	-2.840[b]
Asymp. Sig. (2-tailed)	.005

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectscope WITH Legislation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Legislation - Project scope	Negative Ranks	20[a]	12.00	240.00
	Positive Ranks	3[b]	12.00	36.00
	Ties	14[c]		
	Total	37		

a. Legislation < Project scope

b. Legislation > Project scope

c. Legislation = Project scope

Test Statistics[a]

	Legislation - Project scope
Z	-3.181[b]
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectscope WITH Weather (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Weather - Project scope	Negative Ranks	26[a]	16.65	433.00
	Positive Ranks	4[b]	8.00	32.00
	Ties	7[c]		
	Total	37		

a. Weather < Project scope

b. Weather > Project scope

c. Weather = Project scope

Test Statistics[a]

	Weather - Project scope
Z	-4.167[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectlocation WITH Projectcharacteristicssizebuildabilityandect (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Project characteristics (size, buildability and ect.) - Project location	Negative Ranks	3[a]	8.83	26.50
	Positive Ranks	28[b]	16.77	469.50
	Ties	6[c]		
	Total	37		

a. Project characteristics (size, buildability and ect.) < Project location

b. Project characteristics (size, buildability and ect.) > Project location

c. Project characteristics (size, buildability and ect.) = Project location

Test Statistics[a]

	Project characteristics (size, buildability and ect.) - Project location
Z	-4.404[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectlocation WITH Projectcomplexity (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Project complexity - Project location	Negative Ranks	1[a]	15.00	15.00
	Positive Ranks	33[b]	17.58	580.00
	Ties	3[c]		
	Total	37		

a. Project complexity < Project location

b. Project complexity > Project location

c. Project complexity = Project location

Test Statistics[a]

	Project complexity - Project location
Z	-4.878[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectlocation WITH Reworkanddelays (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Rework and delays - Project location	Negative Ranks	3[a]	18.50	55.50
	Positive Ranks	31[b]	17.40	539.50
	Ties	3[c]		
	Total	37		

a. Rework and delays < Project location

b. Rework and delays > Project location

c. Rework and delays = Project location

Test Statistics[a]

	Rework and delays - Project location
Z	-4.173[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectlocation WITH Employeeskills (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee skills - Project location	Negative Ranks	1[a]	17.00	17.00
	Positive Ranks	31[b]	16.48	511.00
	Ties	5[c]		
	Total	37		

a. Employee skills < Project location

b. Employee skills > Project location

c. Employee skills = Project location

Test Statistics[a]

	Employee skills - Project location
Z	-4.668[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectlocation WITH Employeeavailability (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee availability - Project location	Negative Ranks	1[a]	7.50	7.50
	Positive Ranks	31[b]	16.79	520.50
	Ties	5[c]		
	Total	37		

a. Employee availability < Project location

b. Employee availability > Project location

c. Employee availability = Project location

Test Statistics[a]

	Employee availability - Project location
Z	-4.862[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectlocation WITH Employeemotivation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee motivation - Project location	Negative Ranks	2[a]	4.50	9.00
	Positive Ranks	30[b]	17.30	519.00
	Ties	5[c]		
	Total	37		

a. Employee motivation < Project location

b. Employee motivation > Project location

c. Employee motivation = Project location

Test Statistics[a]

	Employee motivation - Project location
Z	-4.818[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectlocation WITH Employeeexperience (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee experience - Project location	Negative Ranks	1[a]	15.00	15.00
	Positive Ranks	25[b]	13.44	336.00
	Ties	11[c]		
	Total	37		

a. Employee experience < Project location

b. Employee experience > Project location

c. Employee experience = Project location

Test Statistics[a]

	Employee experience - Project location
Z	-4.135[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectlocation WITH Laborworkfacilitiesandsatisfaction (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Labor work facilities and satisfaction - Project location	Negative Ranks	4[a]	14.75	59.00
	Positive Ranks	29[b]	17.31	502.00
	Ties	4[c]		
	Total	37		

a. Labor work facilities and satisfaction < Project location

b. Labor work facilities and satisfaction > Project location

c. Labor work facilities and satisfaction = Project location

Test Statistics[a]

	Labor work facilities and satisfaction - Project location
Z	-4.057[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectlocation WITH Laborfatigue (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Labor fatigue - Project location	Negative Ranks	4[a]	12.38	49.50
	Positive Ranks	28[b]	17.09	478.50
	Ties	5[c]		
	Total	37		

a. Labor fatigue < Project location

b. Labor fatigue > Project location

c. Labor fatigue = Project location

Test Statistics[a]

	Labor fatigue - Project location
Z	-4.101[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectlocation WITH Supervision (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Supervision - Project location	Negative Ranks	4[a]	8.00	32.00
	Positive Ranks	27[b]	17.19	464.00
	Ties	6[c]		
	Total	37		

a. Supervision < Project location

b. Supervision > Project location

c. Supervision = Project location

Test Statistics[a]

	Supervision - Project location
Z	-4.311[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectlocation WITH Planningandsequencing (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Planning and sequencing - Project location	Negative Ranks	3[a]	5.50	16.50
	Positive Ranks	33[b]	19.68	649.50
	Ties	1[c]		
	Total	37		

a. Planning and sequencing < Project location

b. Planning and sequencing > Project location

c. Planning and sequencing = Project location

Test Statistics[a]

	Planning and sequencing - Project location
Z	-5.016[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectlocation WITH Competencyofprojectmanager (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Competency of project manager - Project location	Negative Ranks	3[a]	10.33	31.00
	Positive Ranks	32[b]	18.72	599.00
	Ties	2[c]		
	Total	37		

a. Competency of project manager < Project location

b. Competency of project manager > Project location

c. Competency of project manager = Project location

Test Statistics[a]

	Competency of project manager - Project location
Z	-4.727[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectlocation WITH Availabilityandqualityofinformation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Availability and quality of information - Project location	Negative Ranks	2[a]	15.00	30.00
	Positive Ranks	34[b]	18.71	636.00
	Ties	1[c]		
	Total	37		

a. Availability and quality of information < Project location

b. Availability and quality of information > Project location

c. Availability and quality of information = Project location

Test Statistics[a]

	Availability and quality of information - Project location
Z	-4.800[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectlocation WITH Coordinationandcollaboration (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Coordination and collaboration - Project location	Negative Ranks	2[a]	8.00	16.00
	Positive Ranks	32[b]	18.09	579.00
	Ties	3[c]		
	Total	37		

a. Coordination and collaboration < Project location

b. Coordination and collaboration > Project location

c. Coordination and collaboration = Project location

Test Statistics[a]

	Coordination and collaboration - Project location
Z	-4.857[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectlocation WITH Toolsandprograms (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Tools and programs - Project location	Negative Ranks	2[a]	4.50	9.00
	Positive Ranks	24[b]	14.25	342.00
	Ties	11[c]		
	Total	37		

a. Tools and programs < Project location

b. Tools and programs > Project location

c. Tools and programs = Project location

Test Statistics[a]

	Tools and programs - Project location
Z	-4.295[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectlocation WITH Technochanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Techno changes - Project location	Negative Ranks	3[a]	12.33	37.00
	Positive Ranks	24[b]	14.21	341.00
	Ties	10[c]		
	Total	37		

a. Techno changes < Project location

b. Techno changes > Project location

c. Techno changes = Project location

Test Statistics[a]

	Techno changes - Project location
Z	-3.753[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectlocation WITH Designchanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Design changes - Project location	Negative Ranks	3[a]	9.00	27.00
	Positive Ranks	28[b]	16.75	469.00
	Ties	6[c]		
	Total	37		

a. Design changes < Project location

b. Design changes > Project location

c. Design changes = Project location

Test Statistics[a]

	Design changes - Project location
Z	-4.369[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectlocation WITH Incompleteorunclearspecificationofthework (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Incomplete or unclear specification of the work - Project location	Negative Ranks	3[a]	12.67	38.00
	Positive Ranks	31[b]	17.97	557.00
	Ties	3[c]		
	Total	37		

a. Incomplete or unclear specification of the work < Project location

b. Incomplete or unclear specification of the work > Project location

c. Incomplete or unclear specification of the work = Project location

Test Statistics[a]

	Incomplete or unclear specification of the work - Project location
Z	-4.483[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectlocation WITH Clientandconsultantsclientinterferenceapprovalsanddis
putesdecisi
    (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Client and consultants (client interference, approvals and disputes, decision making, competence) - Project location	Negative Ranks	2[a]	16.25	32.50
	Positive Ranks	33[b]	18.11	597.50
	Ties	2[c]		
	Total	37		

a. Client and consultants (client interference, approvals and disputes, decision making, competence) < Project location

b. Client and consultants (client interference, approvals and disputes, decision making, competence) > Project location

c. Client and consultants (client interference, approvals and disputes, decision making, competence) = Project location

Test Statistics[a]

	Client and consultants (client interference, approvals and disputes, decision making, competence) - Project location
Z	-4.672[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectlocation WITH Financialstabilitystabilityofcountryinflationcostofca
pitalfinanc
    (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Financial stability (stability of country, inflation, cost of capital, financial crisis) - Project location	Negative Ranks	11[a]	10.23	112.50
	Positive Ranks	11[b]	12.77	140.50
	Ties	15[c]		
	Total	37		

a. Financial stability (stability of country, inflation, cost of capital, financial crisis) < Project location

b. Financial stability (stability of country, inflation, cost of capital, financial crisis) > Project location

c. Financial stability (stability of country, inflation, cost of capital, financial crisis) = Project location

Test Statistics[a]

	Financial stability (stability of country, inflation, cost of capital, financial crisis) - Project location
Z	-.470[b]
Asymp. Sig. (2-tailed)	.638

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectlocation WITH Permits (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Permits - Project location	Negative Ranks	8[a]	11.50	92.00
	Positive Ranks	19[b]	15.05	286.00
	Ties	10[c]		
	Total	37		

a. Permits < Project location

b. Permits > Project location

c. Permits = Project location

Test Statistics[a]

	Permits - Project location
Z	-2.387[b]
Asymp. Sig. (2-tailed)	.017

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectlocation WITH Legislation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Legislation - Project location	Negative Ranks	6[a]	11.58	69.50
	Positive Ranks	18[b]	12.81	230.50
	Ties	13[c]		
	Total	37		

a. Legislation < Project location

b. Legislation > Project location

c. Legislation = Project location

Test Statistics[a]

	Legislation - Project location
Z	-2.340[b]
Asymp. Sig. (2-tailed)	.019

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectlocation WITH Weather (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Weather - Project location	Negative Ranks	13[a]	9.38	122.00
	Positive Ranks	7[b]	12.57	88.00
	Ties	17[c]		
	Total	37		

a. Weather < Project location

b. Weather > Project location

c. Weather = Project location

Test Statistics[a]

	Weather - Project location
Z	-.652[b]
Asymp. Sig. (2-tailed)	.514

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcharacteristicssizebuildabilityandect WITH Projectcomplexity (PAIRE
D)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Project complexity - Project characteristics (size, buildability and ect.)	Negative Ranks	1[a]	8.00	8.00
	Positive Ranks	17[b]	9.59	163.00
	Ties	19[c]		
	Total	37		

a. Project complexity < Project characteristics (size, buildability and ect.)

b. Project complexity > Project characteristics (size, buildability and ect.)

c. Project complexity = Project characteristics (size, buildability and ect.)

Test Statistics[a]

	Project complexity - Project characteristics (size, buildability and ect.)
Z	-3.626[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectcharacteristicssizebuildabilityandect WITH Reworkanddelays (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Rework and delays - Project characteristics (size, buildability and ect.)	Negative Ranks	8[a]	14.50	116.00
	Positive Ranks	16[b]	11.50	184.00
	Ties	13[c]		
	Total	37		

a. Rework and delays < Project characteristics (size, buildability and ect.)

b. Rework and delays > Project characteristics (size, buildability and ect.)

c. Rework and delays = Project characteristics (size, buildability and ect.)

Test Statistics[a]

	Rework and delays - Project characteristics (size, buildability and ect.)
Z	-1.035[b]
Asymp. Sig. (2-tailed)	.301

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectcharacteristicssizebuildabilityandect WITH Employeeskills (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee skills - Project characteristics (size, buildability and ect.)	Negative Ranks	8[a]	7.00	56.00
	Positive Ranks	10[b]	11.50	115.00
	Ties	19[c]		
	Total	37		

a. Employee skills < Project characteristics (size, buildability and ect.)

b. Employee skills > Project characteristics (size, buildability and ect.)

c. Employee skills = Project characteristics (size, buildability and ect.)

Test Statistics[a]

	Employee skills - Project characteristics (size, buildability and ect.)
Z	-1.346[b]
Asymp. Sig. (2-tailed)	.178

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectcharacteristicssizebuildabilityandect WITH Employeeavailability (PA
IRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee availability - Project characteristics (size, buildability and ect.)	Negative Ranks	13[a]	12.46	162.00
	Positive Ranks	13[b]	14.54	189.00
	Ties	11[c]		
	Total	37		

a. Employee availability < Project characteristics (size, buildability and ect.)

b. Employee availability > Project characteristics (size, buildability and ect.)

c. Employee availability = Project characteristics (size, buildability and ect.)

Test Statistics[a]

	Employee availability - Project characteristics (size, buildability and ect.)
Z	-.370[b]
Asymp. Sig. (2-tailed)	.711

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectcharacteristicssizebuildabilityandect WITH Employeemotivation (PAIR
ED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee motivation - Project characteristics (size, buildability and ect.)	Negative Ranks	7[a]	9.50	66.50
	Positive Ranks	14[b]	11.75	164.50
	Ties	16[c]		
	Total	37		

a. Employee motivation < Project characteristics (size, buildability and ect.)

b. Employee motivation > Project characteristics (size, buildability and ect.)

c. Employee motivation = Project characteristics (size, buildability and ect.)

Test Statistics[a]

	Employee motivation - Project characteristics (size, buildability and ect.)
Z	-1.843[b]
Asymp. Sig. (2-tailed)	.065

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectcharacteristicssizebuildabilityandect WITH Employeeexperience (PAIR
ED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee experience - Project characteristics (size, buildability and ect.)	Negative Ranks	19[a]	13.05	248.00
	Positive Ranks	8[b]	16.25	130.00
	Ties	10[c]		
	Total	37		

a. Employee experience < Project characteristics (size, buildability and ect.)

b. Employee experience > Project characteristics (size, buildability and ect.)

c. Employee experience = Project characteristics (size, buildability and ect.)

Test Statistics[a]

	Employee experience - Project characteristics (size, buildability and ect.)
Z	-1.505[b]
Asymp. Sig. (2-tailed)	.132

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcharacteristicssizebuildabilityandect WITH Laborworkfacilitiesandsa
tisfaction
     (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Labor work facilities and satisfaction - Project characteristics (size, buildability and ect.)	Negative Ranks	19[a]	14.63	278.00
	Positive Ranks	9[b]	14.22	128.00
	Ties	9[c]		
	Total	37		

a. Labor work facilities and satisfaction < Project characteristics (size, buildability and ect.)

b. Labor work facilities and satisfaction > Project characteristics (size, buildability and ect.)

c. Labor work facilities and satisfaction = Project characteristics (size, buildability and ect.)

Test Statistics[a]

	Labor work facilities and satisfaction - Project characteristics (size, buildability and ect.)
Z	-1.788[b]
Asymp. Sig. (2-tailed)	.074

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcharacteristicssizebuildabilityandect WITH Laborfatigue (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Labor fatigue - Project characteristics (size, buildability and ect.)	Negative Ranks	17[a]	13.24	225.00
	Positive Ranks	8[b]	12.50	100.00
	Ties	12[c]		
	Total	37		

a. Labor fatigue < Project characteristics (size, buildability and ect.)

b. Labor fatigue > Project characteristics (size, buildability and ect.)

c. Labor fatigue = Project characteristics (size, buildability and ect.)

Test Statistics[a]

	Labor fatigue - Project characteristics (size, buildability and ect.)
Z	-1.764[b]
Asymp. Sig. (2-tailed)	.078

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcharacteristicssizebuildabilityandect WITH Supervision (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Supervision - Project characteristics (size, buildability and ect.)	Negative Ranks	16[a]	12.75	204.00
	Positive Ranks	8[b]	12.00	96.00
	Ties	13[c]		
	Total	37		

a. Supervision < Project characteristics (size, buildability and ect.)

b. Supervision > Project characteristics (size, buildability and ect.)

c. Supervision = Project characteristics (size, buildability and ect.)

Test Statistics[a]

	Supervision - Project characteristics (size, buildability and ect.)
Z	-1.661[b]
Asymp. Sig. (2-tailed)	.097

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcharacteristicssizebuildabilityandect WITH Planningandsequencing (P
AIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Planning and sequencing - Project characteristics (size, buildability and ect.)	Negative Ranks	5[a]	11.00	55.00
	Positive Ranks	21[b]	14.10	296.00
	Ties	11[c]		
	Total	37		

a. Planning and sequencing < Project characteristics (size, buildability and ect.)

b. Planning and sequencing > Project characteristics (size, buildability and ect.)

c. Planning and sequencing = Project characteristics (size, buildability and ect.)

Test Statistics[a]

	Planning and sequencing - Project characteristics (size, buildability and ect.)
Z	-3.273[b]
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectcharacteristicssizebuildabilityandect WITH Competencyofprojectmanag
er (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Competency of project manager - Project characteristics (size, buildability and ect.)	Negative Ranks	5[a]	8.50	42.50
	Positive Ranks	15[b]	11.17	167.50
	Ties	17[c]		
	Total	37		

a. Competency of project manager < Project characteristics (size, buildability and ect.)

b. Competency of project manager > Project characteristics (size, buildability and ect.)

c. Competency of project manager = Project characteristics (size, buildability and ect.)

Test Statistics[a]

	Competency of project manager - Project characteristics (size, buildability and ect.)
Z	-2.485[b]
Asymp. Sig. (2-tailed)	.013

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectcharacteristicssizebuildabilityandect WITH Availabilityandqualityof
information
    (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Availability and quality of information - Project characteristics (size, buildability and ect.)	Negative Ranks	8[a]	13.75	110.00
	Positive Ranks	22[b]	16.14	355.00
	Ties	7[c]		
	Total	37		

a. Availability and quality of information < Project characteristics (size, buildability and ect.)

b. Availability and quality of information > Project characteristics (size, buildability and ect.)

c. Availability and quality of information = Project characteristics (size, buildability and ect.)

Test Statistics[a]

	Availability and quality of information - Project characteristics (size, buildability and ect.)
Z	-2.668[b]
Asymp. Sig. (2-tailed)	.008

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectcharacteristicssizebuildabilityandect WITH Coordinationandcollabora
tion (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Coordination and collaboration - Project characteristics (size, buildability and ect.)	Negative Ranks	3[a]	14.50	43.50
	Positive Ranks	22[b]	12.80	281.50
	Ties	12[c]		
	Total	37		

a. Coordination and collaboration < Project characteristics (size, buildability and ect.)

b. Coordination and collaboration > Project characteristics (size, buildability and ect.)

c. Coordination and collaboration = Project characteristics (size, buildability and ect.)

Test Statistics[a]

	Coordination and collaboration - Project characteristics (size, buildability and ect.)
Z	-3.416[b]
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectcharacteristicssizebuildabilityandect WITH Toolsandprograms (PAIRED
)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Tools and programs - Project characteristics (size, buildability and ect.)	Negative Ranks	16[a]	13.25	212.00
	Positive Ranks	9[b]	12.56	113.00
	Ties	12[c]		
	Total	37		

a. Tools and programs < Project characteristics (size, buildability and ect.)

b. Tools and programs > Project characteristics (size, buildability and ect.)

c. Tools and programs = Project characteristics (size, buildability and ect.)

Test Statistics[a]

	Tools and programs - Project characteristics (size, buildability and ect.)
Z	-1.436[b]
Asymp. Sig. (2-tailed)	.151

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcharacteristicssizebuildabilityandect WITH Technochanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Techno changes - Project characteristics (size, buildability and ect.)	Negative Ranks	20[a]	12.53	250.50
	Positive Ranks	4[b]	12.38	49.50
	Ties	13[c]		
	Total	37		

a. Techno changes < Project characteristics (size, buildability and ect.)

b. Techno changes > Project characteristics (size, buildability and ect.)

c. Techno changes = Project characteristics (size, buildability and ect.)

Test Statistics[a]

	Techno changes - Project characteristics (size, buildability and ect.)
Z	-2.986[b]
Asymp. Sig. (2-tailed)	.003

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcharacteristicssizebuildabilityandect WITH Designchanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Design changes - Project characteristics (size, buildability and ect.)	Negative Ranks	10[a]	12.15	121.50
	Positive Ranks	14[b]	12.75	178.50
	Ties	13[c]		
	Total	37		

a. Design changes < Project characteristics (size, buildability and ect.)

b. Design changes > Project characteristics (size, buildability and ect.)

c. Design changes = Project characteristics (size, buildability and ect.)

Test Statistics[a]

	Design changes - Project characteristics (size, buildability and ect.)
Z	-.887[b]
Asymp. Sig. (2-tailed)	.375

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectcharacteristicssizebuildabilityandect WITH
    Incompleteorunclearspecificationofthework (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Incomplete or unclear specification of the work - Project characteristics (size, buildability and ect.)	Negative Ranks	4[a]	10.50	42.00
	Positive Ranks	17[b]	11.12	189.00
	Ties	16[c]		
	Total	37		

a. Incomplete or unclear specification of the work < Project characteristics (size, buildability and ect.)

b. Incomplete or unclear specification of the work > Project characteristics (size, buildability and ect.)

c. Incomplete or unclear specification of the work = Project characteristics (size, buildability and ect.)

Test Statistics[a]

	Incomplete or unclear specification of the work - Project characteristics (size, buildability and ect.)
Z	-2.674[b]
Asymp. Sig. (2-tailed)	.007

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectcharacteristicssizebuildabilityandect WITH
    Clientandconsultantsclientinterferenceapprovalsanddisputesdecisi (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Client and consultants (client interference, approvals and disputes, decision making, competence) - Project characteristics (size, buildability and ect.)	Negative Ranks	8[a]	10.81	86.50
	Positive Ranks	15[b]	12.63	189.50
	Ties	14[c]		
	Total	37		

a. Client and consultants (client interference, approvals and disputes, decision making, competence) < Project characteristics (size, buildability and ect.)

b. Client and consultants (client interference, approvals and disputes, decision making, competence) > Project characteristics (size, buildability and ect.)

c. Client and consultants (client interference, approvals and disputes, decision making, competence) = Project characteristics (size, buildability and ect.)

Test Statistics[a]

	Client and consultants (client interference, approvals and disputes, decision making, competence) - Project characteristics (size, buildability and ect.)
Z	-1.663[b]
Asymp. Sig. (2-tailed)	.096

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectcharacteristicssizebuildabilityandect WITH
    Financialstabilitystabilityofcountryinflationcostofcapitalfinanc (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Financial stability (stability of country, inflation, cost of capital, financial crisis) - Project characteristics (size, buildability and ect.)	Negative Ranks	28[a]	16.25	455.00
	Positive Ranks	3[b]	13.67	41.00
	Ties	6[c]		
	Total	37		

a. Financial stability (stability of country, inflation, cost of capital, financial crisis) < Project characteristics (size, buildability and ect.)

b. Financial stability (stability of country, inflation, cost of capital, financial crisis) > Project characteristics (size, buildability and ect.)

c. Financial stability (stability of country, inflation, cost of capital, financial crisis) = Project characteristics (size, buildability and ect.)

Test Statistics[a]

	Financial stability (stability of country, inflation, cost of capital, financial crisis) - Project characteristics (size, buildability and ect.)
Z	-4.111[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcharacteristicssizebuildabilityandect WITH Permits (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Permits - Project characteristics (size, buildability and ect.)	Negative Ranks	22[a]	13.00	286.00
	Positive Ranks	3[b]	13.00	39.00
	Ties	12[c]		
	Total	37		

a. Permits < Project characteristics (size, buildability and ect.)

b. Permits > Project characteristics (size, buildability and ect.)

c. Permits = Project characteristics (size, buildability and ect.)

Test Statistics[a]

	Permits - Project characteristics (size, buildability and ect.)
Z	-3.388[b]
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcharacteristicssizebuildabilityandect WITH Legislation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Legislation - Project characteristics (size, buildability and ect.)	Negative Ranks	23[a]	13.00	299.00
	Positive Ranks	2[b]	13.00	26.00
	Ties	12[c]		
	Total	37		

a. Legislation < Project characteristics (size, buildability and ect.)

b. Legislation > Project characteristics (size, buildability and ect.)

c. Legislation = Project characteristics (size, buildability and ect.)

Test Statistics[a]

	Legislation - Project characteristics (size, buildability and ect.)
Z	-3.767[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcharacteristicssizebuildabilityandect WITH Weather (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Weather - Project characteristics (size, buildability and ect.)	Negative Ranks	30[a]	16.98	509.50
	Positive Ranks	3[b]	17.17	51.50
	Ties	4[c]		
	Total	37		

a. Weather < Project characteristics (size, buildability and ect.)

b. Weather > Project characteristics (size, buildability and ect.)

c. Weather = Project characteristics (size, buildability and ect.)

Test Statistics[a]

	Weather - Project characteristics (size, buildability and ect.)
Z	-4.134[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
```

```
  /WILCOXON=Projectcomplexity WITH Reworkanddelays (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcox

Ranks

		N	Mean Rank	Sum of Ranks
Rework and delays - Project complexity	Negative Ranks	15[a]	12.87	193.00
	Positive Ranks	8[b]	10.38	83.00
	Ties	14[c]		
	Total	37		

a. Rework and delays < Project complexity

b. Rework and delays > Project complexity

c. Rework and delays = Project complexity

Test Statistics[a]

	Rework and delays - Project complexity
Z	-1.760[b]
Asymp. Sig. (2-tailed)	.078

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcomplexity WITH Employeeskills (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

```
  /WILCOXON=Projectcomplexity WITH Reworkanddelays (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcox

Ranks

		N	Mean Rank	Sum of Ranks
Rework and delays - Project complexity	Negative Ranks	15[a]	12.87	193.00
	Positive Ranks	8[b]	10.38	83.00
	Ties	14[c]		
	Total	37		

a. Rework and delays < Project complexity

b. Rework and delays > Project complexity

c. Rework and delays = Project complexity

Test Statistics[a]

	Rework and delays - Project complexity
Z	-1.760[b]
Asymp. Sig. (2-tailed)	.078

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcomplexity WITH Employeeskills (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee skills - Project complexity	Negative Ranks	16[a]	9.69	155.00
	Positive Ranks	4[b]	13.75	55.00
	Ties	17[c]		
	Total	37		

a. Employee skills < Project complexity

b. Employee skills > Project complexity

c. Employee skills = Project complexity

Test Statistics[a]

	Employee skills - Project complexity
Z	-1.966[b]
Asymp. Sig. (2-tailed)	.049

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcomplexity WITH Employeeavailability (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee availability - Project complexity	Negative Ranks	21[a]	12.71	267.00
	Positive Ranks	5[b]	16.80	84.00
	Ties	11[c]		
	Total	37		

a. Employee availability < Project complexity

b. Employee availability > Project complexity

c. Employee availability = Project complexity

Test Statistics[a]

	Employee availability - Project complexity
Z	-2.510[b]
Asymp. Sig. (2-tailed)	.012

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcomplexity WITH Employeemotivation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee motivation - Project complexity	Negative Ranks	16[a]	11.69	187.00
	Positive Ranks	7[b]	12.71	89.00
	Ties	14[c]		
	Total	37		

a. Employee motivation < Project complexity

b. Employee motivation > Project complexity

c. Employee motivation = Project complexity

Test Statistics[a]

	Employee motivation - Project complexity
Z	-1.644[b]
Asymp. Sig. (2-tailed)	.100

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcomplexity WITH Employeeexperience (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee experience - Project complexity	Negative Ranks	24[a]	12.50	300.00
	Positive Ranks	1[b]	25.00	25.00
	Ties	12[c]		
	Total	37		

a. Employee experience < Project complexity

b. Employee experience > Project complexity

c. Employee experience = Project complexity

Test Statistics[a]

	Employee experience - Project complexity
Z	-3.835[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcomplexity WITH Laborworkfacilitiesandsatisfaction (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Labor work facilities and satisfaction - Project complexity	Negative Ranks	26[a]	13.71	356.50
	Positive Ranks	2[b]	24.75	49.50
	Ties	9[c]		
	Total	37		

a. Labor work facilities and satisfaction < Project complexity

b. Labor work facilities and satisfaction > Project complexity

c. Labor work facilities and satisfaction = Project complexity

Test Statistics[a]

	Labor work facilities and satisfaction - Project complexity
Z	-3.618[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcomplexity WITH Laborfatigue (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Labor fatigue - Project complexity	Negative Ranks	25[a]	13.28	332.00
	Positive Ranks	2[b]	23.00	46.00
	Ties	10[c]		
	Total	37		

a. Labor fatigue < Project complexity

b. Labor fatigue > Project complexity

c. Labor fatigue = Project complexity

Test Statistics[a]

	Labor fatigue - Project complexity
Z	-3.524[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcomplexity WITH Supervision (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Supervision - Project complexity	Negative Ranks	24[a]	13.63	327.00
	Positive Ranks	3[b]	17.00	51.00
	Ties	10[c]		
	Total	37		

a. Supervision < Project complexity

b. Supervision > Project complexity

c. Supervision = Project complexity

Test Statistics[a]

	Supervision - Project complexity
Z	-3.422[b]
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcomplexity WITH Planningandsequencing (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Planning and sequencing - Project complexity	Negative Ranks	9[a]	10.61	95.50
	Positive Ranks	11[b]	10.41	114.50
	Ties	17[c]		
	Total	37		

a. Planning and sequencing < Project complexity

b. Planning and sequencing > Project complexity

c. Planning and sequencing = Project complexity

Test Statistics[a]

	Planning and sequencing - Project complexity
Z	-.389[b]
Asymp. Sig. (2-tailed)	.697

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectcomplexity WITH Competencyofprojectmanager (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Competency of project manager - Project complexity	Negative Ranks	12[a]	10.08	121.00
	Positive Ranks	8[b]	11.13	89.00
	Ties	17[c]		
	Total	37		

a. Competency of project manager < Project complexity

b. Competency of project manager > Project complexity

c. Competency of project manager = Project complexity

Test Statistics[a]

	Competency of project manager - Project complexity
Z	-.636[b]
Asymp. Sig. (2-tailed)	.524

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcomplexity WITH Availabilityandqualityofinformation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Availability and quality of information - Project complexity	Negative Ranks	11[a]	10.00	110.00
	Positive Ranks	10[b]	12.10	121.00
	Ties	16[c]		
	Total	37		

a. Availability and quality of information < Project complexity

b. Availability and quality of information > Project complexity

c. Availability and quality of information = Project complexity

Test Statistics[a]

	Availability and quality of information - Project complexity
Z	-.210[b]
Asymp. Sig. (2-tailed)	.834

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectcomplexity WITH Coordinationandcollaboration (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Coordination and collaboration - Project complexity	Negative Ranks	8[a]	11.56	92.50
	Positive Ranks	12[b]	9.79	117.50
	Ties	17[c]		
	Total	37		

a. Coordination and collaboration < Project complexity

b. Coordination and collaboration > Project complexity

c. Coordination and collaboration = Project complexity

Test Statistics[a]

	Coordination and collaboration - Project complexity
Z	-.492[b]
Asymp. Sig. (2-tailed)	.623

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Projectcomplexity WITH Toolsandprograms (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Tools and programs - Project complexity	Negative Ranks	26[a]	14.96	389.00
	Positive Ranks	4[b]	19.00	76.00
	Ties	7[c]		
	Total	37		

a. Tools and programs < Project complexity

b. Tools and programs > Project complexity

c. Tools and programs = Project complexity

Test Statistics[a]

	Tools and programs - Project complexity
Z	-3.350[b]
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcomplexity WITH Technochanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Techno changes - Project complexity	Negative Ranks	28[a]	16.11	451.00
	Positive Ranks	3[b]	15.00	45.00
	Ties	6[c]		
	Total	37		

a. Techno changes < Project complexity

b. Techno changes > Project complexity

c. Techno changes = Project complexity

Test Statistics[a]

	Techno changes - Project complexity
Z	-4.096[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcomplexity WITH Designchanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Design changes - Project complexity	Negative Ranks	16[a]	10.28	164.50
	Positive Ranks	4[b]	11.38	45.50
	Ties	17[c]		
	Total	37		

a. Design changes < Project complexity

b. Design changes > Project complexity

c. Design changes = Project complexity

Test Statistics[a]

	Design changes - Project complexity
Z	-2.367[b]
Asymp. Sig. (2-tailed)	.018

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcomplexity WITH Incompleteoruncleardspecificationofthework (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Incomplete or unclear specification of the work - Project complexity	Negative Ranks	11[a]	11.32	124.50
	Positive Ranks	10[b]	10.65	106.50
	Ties	16[c]		
	Total	37		

a. Incomplete or unclear specification of the work < Project complexity

b. Incomplete or unclear specification of the work > Project complexity

c. Incomplete or unclear specification of the work = Project complexity

Test Statistics[a]

	Incomplete or unclear specification of the work - Project complexity
Z	-.339[b]
Asymp. Sig. (2-tailed)	.735

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcomplexity WITH Clientandconsultantsclientinterferenceapprovalsandd
isputesdecisi
    (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Client and consultants (client interference, approvals and disputes, decision making, competence) - Project complexity	Negative Ranks	15[a]	9.77	146.50
	Positive Ranks	6[b]	14.08	84.50
	Ties	16[c]		
	Total	37		

a. Client and consultants (client interference, approvals and disputes, decision making, competence) < Project complexity

b. Client and consultants (client interference, approvals and disputes, decision making, competence) > Project complexity

c. Client and consultants (client interference, approvals and disputes, decision making, competence) = Project complexity

Test Statistics[a]

	Client and consultants (client interference, approvals and disputes, decision making, competence) - Project complexity
Z	-1.151[b]
Asymp. Sig. (2-tailed)	.250

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcomplexity WITH Financialstabilitystabilityofcountryinflationcostof
capitalfinanc
    (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Financial stability (stability of country, inflation, cost of capital, financial crisis) - Project complexity	Negative Ranks	33[a]	17.65	582.50
	Positive Ranks	2[b]	23.75	47.50
	Ties	2[c]		
	Total	37		

a. Financial stability (stability of country, inflation, cost of capital, financial crisis) < Project complexity

b. Financial stability (stability of country, inflation, cost of capital, financial crisis) > Project complexity

c. Financial stability (stability of country, inflation, cost of capital, financial crisis) = Project complexity

Test Statistics[a]

	Financial stability (stability of country, inflation, cost of capital, financial crisis) - Project complexity
Z	-4.430[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcomplexity WITH Permits (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Permits - Project complexity	Negative Ranks	29[a]	15.83	459.00
	Positive Ranks	2[b]	18.50	37.00
	Ties	6[c]		
	Total	37		

a. Permits < Project complexity

b. Permits > Project complexity

c. Permits = Project complexity

Test Statistics[a]

	Permits - Project complexity
Z	-4.191[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcomplexity WITH Legislation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Legislation - Project complexity	Negative Ranks	30[a]	15.87	476.00
	Positive Ranks	1[b]	20.00	20.00
	Ties	6[c]		
	Total	37		

a. Legislation < Project complexity

b. Legislation > Project complexity

c. Legislation = Project complexity

Test Statistics[a]

	Legislation - Project complexity
Z	-4.543[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Projectcomplexity WITH Weather (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Weather - Project complexity	Negative Ranks	33[a]	17.11	564.50
	Positive Ranks	1[b]	30.50	30.50
	Ties	3[c]		
	Total	37		

a. Weather < Project complexity

b. Weather > Project complexity

c. Weather = Project complexity

Test Statistics[a]

	Weather - Project complexity
Z	-4.604[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Reworkanddelays WITH Employeeskills (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee skills - Rework and delays	Negative Ranks	12[a]	11.25	135.00
	Positive Ranks	11[b]	12.82	141.00
	Ties	14[c]		
	Total	37		

a. Employee skills < Rework and delays

b. Employee skills > Rework and delays

c. Employee skills = Rework and delays

Test Statistics[a]

	Employee skills - Rework and delays
Z	-.095[b]
Asymp. Sig. (2-tailed)	.924

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Reworkanddelays WITH Employeeavailability (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee availability - Rework and delays	Negative Ranks	16[a]	12.06	193.00
	Positive Ranks	10[b]	15.80	158.00
	Ties	11[c]		
	Total	37		

a. Employee availability < Rework and delays

b. Employee availability > Rework and delays

c. Employee availability = Rework and delays

Test Statistics[a]

	Employee availability - Rework and delays
Z	-.471[b]
Asymp. Sig. (2-tailed)	.638

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Reworkanddelays WITH Employeemotivation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee motivation - Rework and delays	Negative Ranks	12[a]	9.50	114.00
	Positive Ranks	11[b]	14.73	162.00
	Ties	14[c]		
	Total	37		

a. Employee motivation < Rework and delays

b. Employee motivation > Rework and delays

c. Employee motivation = Rework and delays

Test Statistics[a]

	Employee motivation - Rework and delays
Z	-.775[b]
Asymp. Sig. (2-tailed)	.438

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Reworkanddelays WITH Employeeexperience (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee experience - Rework and delays	Negative Ranks	20[a]	12.75	255.00
	Positive Ranks	6[b]	16.00	96.00
	Ties	11[c]		
	Total	37		

a. Employee experience < Rework and delays

b. Employee experience > Rework and delays

c. Employee experience = Rework and delays

Test Statistics[a]

	Employee experience - Rework and delays
Z	-2.097[b]
Asymp. Sig. (2-tailed)	.036

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Reworkanddelays WITH Laborworkfacilitiesandsatisfaction (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Labor work facilities and satisfaction - Rework and delays	Negative Ranks	19[a]	12.84	244.00
	Positive Ranks	6[b]	13.50	81.00
	Ties	12[c]		
	Total	37		

a. Labor work facilities and satisfaction < Rework and delays

b. Labor work facilities and satisfaction > Rework and delays

c. Labor work facilities and satisfaction = Rework and delays

Test Statistics[a]

	Labor work facilities and satisfaction - Rework and delays
Z	-2.257[b]
Asymp. Sig. (2-tailed)	.024

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Reworkanddelays WITH Laborfatigue (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Labor fatigue - Rework and delays	Negative Ranks	19[a]	11.61	220.50
	Positive Ranks	4[b]	13.88	55.50
	Ties	14[c]		
	Total	37		

a. Labor fatigue < Rework and delays

b. Labor fatigue > Rework and delays

c. Labor fatigue = Rework and delays

Test Statistics[a]

	Labor fatigue - Rework and delays
Z	-2.587[b]
Asymp. Sig. (2-tailed)	.010

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Reworkanddelays WITH Supervision (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Supervision - Rework and delays	Negative Ranks	17[a]	12.32	209.50
	Positive Ranks	6[b]	11.08	66.50
	Ties	14[c]		
	Total	37		

a. Supervision < Rework and delays

b. Supervision > Rework and delays

c. Supervision = Rework and delays

Test Statistics[a]

	Supervision - Rework and delays
Z	-2.234[b]
Asymp. Sig. (2-tailed)	.026

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Reworkanddelays WITH Planningandsequencing (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Planning and sequencing - Rework and delays	Negative Ranks	3[a]	5.50	16.50
	Positive Ranks	12[b]	8.63	103.50
	Ties	22[c]		
	Total	37		

a. Planning and sequencing < Rework and delays

b. Planning and sequencing > Rework and delays

c. Planning and sequencing = Rework and delays

Test Statistics[a]

	Planning and sequencing - Rework and delays
Z	-2.568[b]
Asymp. Sig. (2-tailed)	.010

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Reworkanddelays WITH Competencyofprojectmanager (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Competency of project manager - Rework and delays	Negative Ranks	7[a]	11.07	77.50
	Positive Ranks	15[b]	11.70	175.50
	Ties	15[c]		
	Total	37		

a. Competency of project manager < Rework and delays

b. Competency of project manager > Rework and delays

c. Competency of project manager = Rework and delays

Test Statistics[a]

	Competency of project manager - Rework and delays
Z	-1.705[b]
Asymp. Sig. (2-tailed)	.088

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Reworkanddelays WITH Availabilityandqualityofinformation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Availability and quality of information - Rework and delays	Negative Ranks	5[a]	7.00	35.00
	Positive Ranks	14[b]	11.07	155.00
	Ties	18[c]		
	Total	37		

a. Availability and quality of information < Rework and delays

b. Availability and quality of information > Rework and delays

c. Availability and quality of information = Rework and delays

Test Statistics[a]

	Availability and quality of information - Rework and delays
Z	-2.518[b]
Asymp. Sig. (2-tailed)	.012

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Reworkanddelays WITH Coordinationandcollaboration (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Coordination and collaboration - Rework and delays	Negative Ranks	3[a]	7.17	21.50
	Positive Ranks	12[b]	8.21	98.50
	Ties	22[c]		
	Total	37		

a. Coordination and collaboration < Rework and delays

b. Coordination and collaboration > Rework and delays

c. Coordination and collaboration = Rework and delays

Test Statistics[a]

	Coordination and collaboration - Rework and delays
Z	-2.246[b]
Asymp. Sig. (2-tailed)	.025

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Reworkanddelays WITH Toolsandprograms (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Tools and programs - Rework and delays	Negative Ranks	19[a]	11.79	224.00
	Positive Ranks	6[b]	16.83	101.00
	Ties	12[c]		
	Total	37		

a. Tools and programs < Rework and delays

b. Tools and programs > Rework and delays

c. Tools and programs = Rework and delays

Test Statistics[a]

	Tools and programs - Rework and delays
Z	-1.708[b]
Asymp. Sig. (2-tailed)	.088

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Reworkanddelays WITH Technochanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Techno changes - Rework and delays	Negative Ranks	21[a]	13.10	275.00
	Positive Ranks	4[b]	12.50	50.00
	Ties	12[c]		
	Total	37		

a. Techno changes < Rework and delays

b. Techno changes > Rework and delays

c. Techno changes = Rework and delays

Test Statistics[a]

	Techno changes - Rework and delays
Z	-3.109[b]
Asymp. Sig. (2-tailed)	.002

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Reworkanddelays WITH Designchanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Design changes - Rework and delays	Negative Ranks	10[a]	10.50	105.00
	Positive Ranks	10[b]	10.50	105.00
	Ties	17[c]		
	Total	37		

a. Design changes < Rework and delays

b. Design changes > Rework and delays

c. Design changes = Rework and delays

Test Statistics[a]

	Design changes - Rework and delays
Z	.000[b]
Asymp. Sig. (2-tailed)	1.000

a. Wilcoxon Signed Ranks Test

b. The sum of negative ranks equals the sum of positive ranks.

```
NPAR TESTS
  /WILCOXON=Reworkanddelays WITH Incompleteoruncleararspecificationofthework (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Incomplete or unclear specification of the work - Rework and delays	Negative Ranks	4[a]	7.00	28.00
	Positive Ranks	12[b]	9.00	108.00
	Ties	21[c]		
	Total	37		

a. Incomplete or unclear specification of the work < Rework and delays

b. Incomplete or unclear specification of the work > Rework and delays

c. Incomplete or unclear specification of the work = Rework and delays

Test Statistics[a]

	Incomplete or unclear specification of the work - Rework and delays
Z	-2.209[b]
Asymp. Sig. (2-tailed)	.027

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Reworkanddelays WITH Clientandconsultantsclientinterferenceapprovalsanddis
putesdecisi
    (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Client and consultants (client interference, approvals and disputes, decision making, competence) - Rework and delays	Negative Ranks	11[a]	8.32	91.50
	Positive Ranks	10[b]	13.95	139.50
	Ties	16[c]		
	Total	37		

a. Client and consultants (client interference, approvals and disputes, decision making, competence) < Rework and delays

b. Client and consultants (client interference, approvals and disputes, decision making, competence) > Rework and delays

c. Client and consultants (client interference, approvals and disputes, decision making, competence) = Rework and delays

Test Statistics[a]

	Client and consultants (client interference, approvals and disputes, decision making, competence) - Rework and delays
Z	-.859[b]
Asymp. Sig. (2-tailed)	.391

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Reworkanddelays WITH Financialstabilitystabilityofcountryinflationcostofca
pitalfinanc
    (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Financial stability (stability of country, inflation, cost of capital, financial crisis) - Rework and delays	Negative Ranks	31[a]	17.23	534.00
	Positive Ranks	3[b]	20.33	61.00
	Ties	3[c]		
	Total	37		

a. Financial stability (stability of country, inflation, cost of capital, financial crisis) < Rework and delays

b. Financial stability (stability of country, inflation, cost of capital, financial crisis) > Rework and delays

c. Financial stability (stability of country, inflation, cost of capital, financial crisis) = Rework and delays

Test Statistics[a]

	Financial stability (stability of country, inflation, cost of capital, financial crisis) - Rework and delays
Z	-4.096[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Reworkanddelays WITH Permits (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Permits - Rework and delays	Negative Ranks	26[a]	15.37	399.50
	Positive Ranks	4[b]	16.38	65.50
	Ties	7[c]		
	Total	37		

a. Permits < Rework and delays

b. Permits > Rework and delays

c. Permits = Rework and delays

Test Statistics[a]

	Permits - Rework and delays
Z	-3.496[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Reworkanddelays WITH Legislation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Legislation - Rework and delays	Negative Ranks	26[a]	15.88	413.00
	Positive Ranks	4[b]	13.00	52.00
	Ties	7[c]		
	Total	37		

a. Legislation < Rework and delays

b. Legislation > Rework and delays

c. Legislation = Rework and delays

Test Statistics[a]

	Legislation - Rework and delays
Z	-3.789[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Reworkanddelays WITH Weather (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Weather - Rework and delays	Negative Ranks	29[a]	16.97	492.00
	Positive Ranks	3[b]	12.00	36.00
	Ties	5[c]		
	Total	37		

a. Weather < Rework and delays

b. Weather > Rework and delays

c. Weather = Rework and delays

Test Statistics[a]

	Weather - Rework and delays
Z	-4.302[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeskills WITH Employeeavailability (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee availability - Employee skills	Negative Ranks	13[a]	12.38	161.00
	Positive Ranks	10[b]	11.50	115.00
	Ties	14[c]		
	Total	37		

a. Employee availability < Employee skills

b. Employee availability > Employee skills

c. Employee availability = Employee skills

Test Statistics[a]

	Employee availability - Employee skills
Z	-.784[b]
Asymp. Sig. (2-tailed)	.433

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeskills WITH Employeemotivation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee motivation - Employee skills	Negative Ranks	8[a]	10.38	83.00
	Positive Ranks	11[b]	9.73	107.00
	Ties	18[c]		
	Total	37		

a. Employee motivation < Employee skills

b. Employee motivation > Employee skills

c. Employee motivation = Employee skills

Test Statistics[a]

	Employee motivation - Employee skills
Z	-.513[b]
Asymp. Sig. (2-tailed)	.608

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeeskills WITH Employeeexperience (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee experience - Employee skills	Negative Ranks	16[a]	9.63	154.00
	Positive Ranks	3[b]	12.00	36.00
	Ties	18[c]		
	Total	37		

a. Employee experience < Employee skills

b. Employee experience > Employee skills

c. Employee experience = Employee skills

Test Statistics[a]

	Employee experience - Employee skills
Z	-2.444[b]
Asymp. Sig. (2-tailed)	.015

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeskills WITH Laborworkfacilitiesandsatisfaction (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Labor work facilities and satisfaction - Employee skills	Negative Ranks	17[a]	13.53	230.00
	Positive Ranks	7[b]	10.00	70.00
	Ties	13[c]		
	Total	37		

a. Labor work facilities and satisfaction < Employee skills

b. Labor work facilities and satisfaction > Employee skills

c. Labor work facilities and satisfaction = Employee skills

Test Statistics[a]

	Labor work facilities and satisfaction - Employee skills
Z	-2.372[b]
Asymp. Sig. (2-tailed)	.018

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeskills WITH Laborfatigue (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Labor fatigue - Employee skills	Negative Ranks	19[a]	13.29	252.50
	Positive Ranks	5[b]	9.50	47.50
	Ties	13[c]		
	Total	37		

a. Labor fatigue < Employee skills

b. Labor fatigue > Employee skills

c. Labor fatigue = Employee skills

Test Statistics[a]

	Labor fatigue - Employee skills
Z	-3.087[b]
Asymp. Sig. (2-tailed)	.002

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeskills WITH Supervision (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Supervision - Employee skills	Negative Ranks	18[a]	11.58	208.50
	Positive Ranks	4[b]	11.13	44.50
	Ties	15[c]		
	Total	37		

a. Supervision < Employee skills

b. Supervision > Employee skills

c. Supervision = Employee skills

Test Statistics[a]

	Supervision - Employee skills
Z	-2.794[b]
Asymp. Sig. (2-tailed)	.005

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeskills WITH Planningandsequencing (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Planning and sequencing - Employee skills	Negative Ranks	4[a]	13.63	54.50
	Positive Ranks	15[b]	9.03	135.50
	Ties	18[c]		
	Total	37		

a. Planning and sequencing < Employee skills

b. Planning and sequencing > Employee skills

c. Planning and sequencing = Employee skills

Test Statistics[a]

	Planning and sequencing - Employee skills
Z	-1.689[b]
Asymp. Sig. (2-tailed)	.091

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeeskills WITH Competencyofprojectmanager (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Competency of project manager - Employee skills	Negative Ranks	8[a]	11.63	93.00
	Positive Ranks	15[b]	12.20	183.00
	Ties	14[c]		
	Total	37		

a. Competency of project manager < Employee skills

b. Competency of project manager > Employee skills

c. Competency of project manager = Employee skills

Test Statistics[a]

	Competency of project manager - Employee skills
Z	-1.469[b]
Asymp. Sig. (2-tailed)	.142

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeeskills WITH Availabilityandqualityofinformation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Availability and quality of information - Employee skills	Negative Ranks	5[a]	10.00	50.00
	Positive Ranks	15[b]	10.67	160.00
	Ties	17[c]		
	Total	37		

a. Availability and quality of information < Employee skills

b. Availability and quality of information > Employee skills

c. Availability and quality of information = Employee skills

Test Statistics[a]

	Availability and quality of information - Employee skills
Z	-2.142[b]
Asymp. Sig. (2-tailed)	.032

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeeskills WITH Coordinationandcollaboration (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Coordination and collaboration - Employee skills	Negative Ranks	5[a]	12.50	62.50
	Positive Ranks	17[b]	11.21	190.50
	Ties	15[c]		
	Total	37		

a. Coordination and collaboration < Employee skills

b. Coordination and collaboration > Employee skills

c. Coordination and collaboration = Employee skills

Test Statistics[a]

	Coordination and collaboration - Employee skills
Z	-2.151[b]
Asymp. Sig. (2-tailed)	.031

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeeskills WITH Toolsandprograms (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Tools and programs - Employee skills	Negative Ranks	17[a]	12.56	213.50
	Positive Ranks	6[b]	10.42	62.50
	Ties	14[c]		
	Total	37		

a. Tools and programs < Employee skills

b. Tools and programs > Employee skills

c. Tools and programs = Employee skills

Test Statistics[a]

	Tools and programs - Employee skills
Z	-2.401[b]
Asymp. Sig. (2-tailed)	.016

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeskills WITH Technochanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Techno changes - Employee skills	Negative Ranks	23[a]	12.17	280.00
	Positive Ranks	1[b]	20.00	20.00
	Ties	13[c]		
	Total	37		

a. Techno changes < Employee skills

b. Techno changes > Employee skills

c. Techno changes = Employee skills

Test Statistics[a]

	Techno changes - Employee skills
Z	-3.850[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeskills WITH Designchanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Design changes - Employee skills	Negative Ranks	9[a]	9.00	81.00
	Positive Ranks	8[b]	9.00	72.00
	Ties	20[c]		
	Total	37		

a. Design changes < Employee skills

b. Design changes > Employee skills

c. Design changes = Employee skills

Test Statistics[a]

	Design changes - Employee skills
Z	-.225[b]
Asymp. Sig. (2-tailed)	.822

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeskills WITH Incompleteorunclearspecificationofthework (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Incomplete or unclear specification of the work - Employee skills	Negative Ranks	5[a]	10.40	52.00
	Positive Ranks	13[b]	9.15	119.00
	Ties	19[c]		
	Total	37		

a. Incomplete or unclear specification of the work < Employee skills

b. Incomplete or unclear specification of the work > Employee skills

c. Incomplete or unclear specification of the work = Employee skills

Test Statistics[a]

	Incomplete or unclear specification of the work - Employee skills
Z	-1.513[b]
Asymp. Sig. (2-tailed)	.130

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeeskills WITH Clientandconsultantsclientinterferenceapprovalsanddisp
utesdecisi
    (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Client and consultants (client interference, approvals and disputes, decision making, competence) - Employee skills	Negative Ranks	8[a]	9.94	79.50
	Positive Ranks	12[b]	10.88	130.50
	Ties	17[c]		
	Total	37		

a. Client and consultants (client interference, approvals and disputes, decision making, competence) < Employee skills

b. Client and consultants (client interference, approvals and disputes, decision making, competence) > Employee skills

c. Client and consultants (client interference, approvals and disputes, decision making, competence) = Employee skills

Test Statistics[a]

	Client and consultants (client interference, approvals and disputes, decision making, competence) - Employee skills
Z	-1.014[b]
Asymp. Sig. (2-tailed)	.310

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeeskills WITH Financialstabilitystabilityofcountryinflationcostofcap
italfinanc
     (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Financial stability (stability of country, inflation, cost of capital, financial crisis) - Employee skills	Negative Ranks	30[a]	16.32	489.50
	Positive Ranks	1[b]	6.50	6.50
	Ties	6[c]		
	Total	37		

a. Financial stability (stability of country, inflation, cost of capital, financial crisis) < Employee skills

b. Financial stability (stability of country, inflation, cost of capital, financial crisis) > Employee skills

c. Financial stability (stability of country, inflation, cost of capital, financial crisis) = Employee skills

Test Statistics[a]

	Financial stability (stability of country, inflation, cost of capital, financial crisis) - Employee skills
Z	-4.789[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeskills WITH Permits (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Permits - Employee skills	Negative Ranks	23[a]	15.30	352.00
	Positive Ranks	4[b]	6.50	26.00
	Ties	10[c]		
	Total	37		

a. Permits < Employee skills

b. Permits > Employee skills

c. Permits = Employee skills

Test Statistics[a]

	Permits - Employee skills
Z	-3.982[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeskills WITH Legislation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Legislation - Employee skills	Negative Ranks	26[a]	15.75	409.50
	Positive Ranks	3[b]	8.50	25.50
	Ties	8[c]		
	Total	37		

a. Legislation < Employee skills

b. Legislation > Employee skills

c. Legislation = Employee skills

Test Statistics[a]

	Legislation - Employee skills
Z	-4.253[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeskills WITH Weather (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Weather - Employee skills	Negative Ranks	31[a]	16.82	521.50
	Positive Ranks	1[b]	6.50	6.50
	Ties	5[c]		
	Total	37		

a. Weather < Employee skills

b. Weather > Employee skills

c. Weather = Employee skills

Test Statistics[a]

	Weather - Employee skills
Z	-4.864[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeavailability WITH Employeemotivation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee motivation - Employee availability	Negative Ranks	6[a]	9.00	54.00
	Positive Ranks	12[b]	9.75	117.00
	Ties	19[c]		
	Total	37		

a. Employee motivation < Employee availability

b. Employee motivation > Employee availability

c. Employee motivation = Employee availability

Test Statistics[a]

	Employee motivation - Employee availability
Z	-1.454[b]
Asymp. Sig. (2-tailed)	.146

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeeavailability WITH Employeeexperience (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee experience - Employee availability	Negative Ranks	15[a]	12.67	190.00
	Positive Ranks	7[b]	9.00	63.00
	Ties	15[c]		
	Total	37		

a. Employee experience < Employee availability

b. Employee experience > Employee availability

c. Employee experience = Employee availability

Test Statistics[a]

	Employee experience - Employee availability
Z	-2.185[b]
Asymp. Sig. (2-tailed)	.029

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeavailability WITH Laborworkfacilitiesandsatisfaction (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Labor work facilities and satisfaction - Employee availability	Negative Ranks	16[a]	12.44	199.00
	Positive Ranks	6[b]	9.00	54.00
	Ties	15[c]		
	Total	37		

a. Labor work facilities and satisfaction < Employee availability

b. Labor work facilities and satisfaction > Employee availability

c. Labor work facilities and satisfaction = Employee availability

Test Statistics[a]

	Labor work facilities and satisfaction - Employee availability
Z	-2.493[b]
Asymp. Sig. (2-tailed)	.013

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeavailability WITH Laborfatigue (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Labor fatigue - Employee availability	Negative Ranks	16[a]	11.13	178.00
	Positive Ranks	4[b]	8.00	32.00
	Ties	17[c]		
	Total	37		

a. Labor fatigue < Employee availability

b. Labor fatigue > Employee availability

c. Labor fatigue = Employee availability

Test Statistics[a]

	Labor fatigue - Employee availability
Z	-2.874[b]
Asymp. Sig. (2-tailed)	.004

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeavailability WITH Supervision (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Supervision - Employee availability	Negative Ranks	18[a]	13.67	246.00
	Positive Ranks	8[b]	13.13	105.00
	Ties	11[c]		
	Total	37		

a. Supervision < Employee availability

b. Supervision > Employee availability

c. Supervision = Employee availability

Test Statistics[a]

	Supervision - Employee availability
Z	-1.882[b]
Asymp. Sig. (2-tailed)	.060

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeavailability WITH Planningandsequencing (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Planning and sequencing - Employee availability	Negative Ranks	5[a]	14.10	70.50
	Positive Ranks	19[b]	12.08	229.50
	Ties	13[c]		
	Total	37		

a. Planning and sequencing < Employee availability

b. Planning and sequencing > Employee availability

c. Planning and sequencing = Employee availability

Test Statistics[a]

	Planning and sequencing - Employee availability
Z	-2.396[b]
Asymp. Sig. (2-tailed)	.017

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeeavailability WITH Competencyofprojectmanager (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Competency of project manager - Employee availability	Negative Ranks	5[a]	12.20	61.00
	Positive Ranks	17[b]	11.29	192.00
	Ties	15[c]		
	Total	37		

a. Competency of project manager < Employee availability

b. Competency of project manager > Employee availability

c. Competency of project manager = Employee availability

Test Statistics[a]

	Competency of project manager - Employee availability
Z	-2.307[b]
Asymp. Sig. (2-tailed)	.021

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeeavailability WITH Availabilityandqualityofinformation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Availability and quality of information - Employee availability	Negative Ranks	3[a]	12.50	37.50
	Positive Ranks	18[b]	10.75	193.50
	Ties	16[c]		
	Total	37		

a. Availability and quality of information < Employee availability

b. Availability and quality of information > Employee availability

c. Availability and quality of information = Employee availability

Test Statistics[a]

	Availability and quality of information - Employee availability
Z	-2.863[b]
Asymp. Sig. (2-tailed)	.004

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeeavailability WITH Coordinationandcollaboration (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Coordination and collaboration - Employee availability	Negative Ranks	5[a]	18.00	90.00
	Positive Ranks	22[b]	13.09	288.00
	Ties	10[c]		
	Total	37		

a. Coordination and collaboration < Employee availability

b. Coordination and collaboration > Employee availability

c. Coordination and collaboration = Employee availability

Test Statistics[a]

	Coordination and collaboration - Employee availability
Z	-2.472[b]
Asymp. Sig. (2-tailed)	.013

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeeavailability WITH Toolsandprograms (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Tools and programs - Employee availability	Negative Ranks	15[a]	11.10	166.50
	Positive Ranks	6[b]	10.75	64.50
	Ties	16[c]		
	Total	37		

a. Tools and programs < Employee availability

b. Tools and programs > Employee availability

c. Tools and programs = Employee availability

Test Statistics[a]

	Tools and programs - Employee availability
Z	-1.895[b]
Asymp. Sig. (2-tailed)	.058

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeavailability WITH Technochanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Techno changes - Employee availability	Negative Ranks	23[a]	14.43	332.00
	Positive Ranks	4[b]	11.50	46.00
	Ties	10[c]		
	Total	37		

a. Techno changes < Employee availability

b. Techno changes > Employee availability

c. Techno changes = Employee availability

Test Statistics[a]

	Techno changes - Employee availability
Z	-3.682[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeavailability WITH Designchanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Design changes - Employee availability	Negative Ranks	10[a]	10.50	105.00
	Positive Ranks	11[b]	11.45	126.00
	Ties	16[c]		
	Total	37		

a. Design changes < Employee availability

b. Design changes > Employee availability

c. Design changes = Employee availability

Test Statistics[a]

	Design changes - Employee availability
Z	-.386[b]
Asymp. Sig. (2-tailed)	.700

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeeavailability WITH Incompleteorunclearspecificationofthework (PAIRE
D)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Incomplete or unclear specification of the work - Employee availability	Negative Ranks	7[a]	14.36	100.50
	Positive Ranks	19[b]	13.18	250.50
	Ties	11[c]		
	Total	37		

a. Incomplete or unclear specification of the work < Employee availability

b. Incomplete or unclear specification of the work > Employee availability

c. Incomplete or unclear specification of the work = Employee availability

Test Statistics[a]

	Incomplete or unclear specification of the work - Employee availability
Z	-2.017[b]
Asymp. Sig. (2-tailed)	.044

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeeavailability WITH
    Clientandconsultantsclientinterferenceapprovalsanddisputesdecisi (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Client and consultants (client interference, approvals and disputes, decision making, competence) - Employee availability	Negative Ranks	7[a]	11.29	79.00
	Positive Ranks	15[b]	11.60	174.00
	Ties	15[c]		
	Total	37		

a. Client and consultants (client interference, approvals and disputes, decision making, competence) < Employee availability

b. Client and consultants (client interference, approvals and disputes, decision making, competence) > Employee availability

c. Client and consultants (client interference, approvals and disputes, decision making, competence) = Employee availability

Test Statistics[a]

	Client and consultants (client interference, approvals and disputes, decision making, competence) - Employee availability
Z	-1.651[b]
Asymp. Sig. (2-tailed)	.099

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeeavailability WITH
    Financialstabilitystabilityofcountryinflationcostofcapitalfinanc (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Financial stability (stability of country, inflation, cost of capital, financial crisis) - Employee availability	Negative Ranks	30[a]	15.50	465.00
	Positive Ranks	0[b]	.00	.00
	Ties	7[c]		
	Total	37		

a. Financial stability (stability of country, inflation, cost of capital, financial crisis) < Employee availability

b. Financial stability (stability of country, inflation, cost of capital, financial crisis) > Employee availability

c. Financial stability (stability of country, inflation, cost of capital, financial crisis) = Employee availability

Test Statistics[a]

	Financial stability (stability of country, inflation, cost of capital, financial crisis) - Employee availability
Z	-4.855[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeavailability WITH Permits (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Permits - Employee availability	Negative Ranks	23[a]	14.22	327.00
	Positive Ranks	3[b]	8.00	24.00
	Ties	11[c]		
	Total	37		

a. Permits < Employee availability

b. Permits > Employee availability

c. Permits = Employee availability

Test Statistics[a]

	Permits - Employee availability
Z	-3.947[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeavailability WITH Legislation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Legislation - Employee availability	Negative Ranks	24[a]	13.35	320.50
	Positive Ranks	2[b]	15.25	30.50
	Ties	11[c]		
	Total	37		

a. Legislation < Employee availability

b. Legislation > Employee availability

c. Legislation = Employee availability

Test Statistics[a]

	Legislation - Employee availability
Z	-3.752[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeavailability WITH Weather (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Weather - Employee availability	Negative Ranks	30[a]	16.37	491.00
	Positive Ranks	1[b]	5.00	5.00
	Ties	6[c]		
	Total	37		

a. Weather < Employee availability

b. Weather > Employee availability

c. Weather = Employee availability

Test Statistics[a]

	Weather - Employee availability
Z	-4.816[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeemotivation WITH Employeeexperience (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Employee experience - Employee motivation	Negative Ranks	17[a]	9.18	156.00
	Positive Ranks	1[b]	15.00	15.00
	Ties	19[c]		
	Total	37		

a. Employee experience < Employee motivation

b. Employee experience > Employee motivation

c. Employee experience = Employee motivation

Test Statistics[a]

	Employee experience - Employee motivation
Z	-3.176[b]
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeemotivation WITH Laborworkfacilitiesandsatisfaction (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Labor work facilities and satisfaction - Employee motivation	Negative Ranks	21[a]	14.33	301.00
	Positive Ranks	5[b]	10.00	50.00
	Ties	11[c]		
	Total	37		

a. Labor work facilities and satisfaction < Employee motivation

b. Labor work facilities and satisfaction > Employee motivation

c. Labor work facilities and satisfaction = Employee motivation

Test Statistics[a]

	Labor work facilities and satisfaction - Employee motivation
Z	-3.350[b]
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeemotivation WITH Laborfatigue (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Labor fatigue - Employee motivation	Negative Ranks	22[a]	14.43	317.50
	Positive Ranks	5[b]	12.10	60.50
	Ties	10[c]		
	Total	37		

a. Labor fatigue < Employee motivation

b. Labor fatigue > Employee motivation

c. Labor fatigue = Employee motivation

Test Statistics[a]

	Labor fatigue - Employee motivation
Z	-3.212[b]
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeemotivation WITH Supervision (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Supervision - Employee motivation	Negative Ranks	21[a]	14.86	312.00
	Positive Ranks	6[b]	11.00	66.00
	Ties	10[c]		
	Total	37		

a. Supervision < Employee motivation

b. Supervision > Employee motivation

c. Supervision = Employee motivation

Test Statistics[a]

	Supervision - Employee motivation
Z	-3.137[b]
Asymp. Sig. (2-tailed)	.002

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeemotivation WITH Planningandsequencing (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Planning and sequencing - Employee motivation	Negative Ranks	5[a]	10.90	54.50
	Positive Ranks	14[b]	9.68	135.50
	Ties	18[c]		
	Total	37		

a. Planning and sequencing < Employee motivation

b. Planning and sequencing > Employee motivation

c. Planning and sequencing = Employee motivation

Test Statistics[a]

	Planning and sequencing - Employee motivation
Z	-1.784[b]
Asymp. Sig. (2-tailed)	.074

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeemotivation WITH Competencyofprojectmanager (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Competency of project manager - Employee motivation	Negative Ranks	8[a]	11.31	90.50
	Positive Ranks	13[b]	10.81	140.50
	Ties	16[c]		
	Total	37		

a. Competency of project manager < Employee motivation

b. Competency of project manager > Employee motivation

c. Competency of project manager = Employee motivation

Test Statistics[a]

	Competency of project manager - Employee motivation
Z	-.955[b]
Asymp. Sig. (2-tailed)	.340

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeemotivation WITH Availabilityandqualityofinformation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Availability and quality of information - Employee motivation	Negative Ranks	6[a]	11.25	67.50
	Positive Ranks	15[b]	10.90	163.50
	Ties	16[c]		
	Total	37		

a. Availability and quality of information < Employee motivation

b. Availability and quality of information > Employee motivation

c. Availability and quality of information = Employee motivation

Test Statistics[a]

	Availability and quality of information - Employee motivation
Z	-1.806[b]
Asymp. Sig. (2-tailed)	.071

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeemotivation WITH Coordinationandcollaboration (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Coordination and collaboration - Employee motivation	Negative Ranks	5[a]	14.80	74.00
	Positive Ranks	18[b]	11.22	202.00
	Ties	14[c]		
	Total	37		

a. Coordination and collaboration < Employee motivation

b. Coordination and collaboration > Employee motivation

c. Coordination and collaboration = Employee motivation

Test Statistics[a]

	Coordination and collaboration - Employee motivation
Z	-2.090[b]
Asymp. Sig. (2-tailed)	.037

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeemotivation WITH Toolsandprograms (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Tools and programs - Employee motivation	Negative Ranks	18[a]	11.33	204.00
	Positive Ranks	3[b]	9.00	27.00
	Ties	16[c]		
	Total	37		

a. Tools and programs < Employee motivation

b. Tools and programs > Employee motivation

c. Tools and programs = Employee motivation

Test Statistics[a]

	Tools and programs - Employee motivation
Z	-3.288[b]
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeemotivation WITH Technochanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Techno changes - Employee motivation	Negative Ranks	23[a]	12.00	276.00
	Positive Ranks	0[b]	.00	.00
	Ties	14[c]		
	Total	37		

a. Techno changes < Employee motivation

b. Techno changes > Employee motivation

c. Techno changes = Employee motivation

Test Statistics[a]

	Techno changes - Employee motivation
Z	-4.344[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeemotivation WITH Designchanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Design changes - Employee motivation	Negative Ranks	12[a]	10.00	120.00
	Positive Ranks	7[b]	10.00	70.00
	Ties	18[c]		
	Total	37		

a. Design changes < Employee motivation

b. Design changes > Employee motivation

c. Design changes = Employee motivation

Test Statistics[a]

	Design changes - Employee motivation
Z	-1.147[b]
Asymp. Sig. (2-tailed)	.251

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeemotivation WITH Incompleteorunclearspecificationofthework (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Incomplete or unclear specification of the work - Employee motivation	Negative Ranks	7[a]	13.64	95.50
	Positive Ranks	15[b]	10.50	157.50
	Ties	15[c]		
	Total	37		

a. Incomplete or unclear specification of the work < Employee motivation

b. Incomplete or unclear specification of the work > Employee motivation

c. Incomplete or unclear specification of the work = Employee motivation

Test Statistics[a]

	Incomplete or unclear specification of the work - Employee motivation
Z	-1.108[b]
Asymp. Sig. (2-tailed)	.268

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeemotivation WITH
    Clientandconsultantsclientinterferenceapprovalsanddisputesdecisi (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Client and consultants (client interference, approvals and disputes, decision making, competence) - Employee motivation	Negative Ranks	10[a]	12.20	122.00
	Positive Ranks	12[b]	10.92	131.00
	Ties	15[c]		
	Total	37		

a. Client and consultants (client interference, approvals and disputes, decision making, competence) < Employee motivation

b. Client and consultants (client interference, approvals and disputes, decision making, competence) > Employee motivation

c. Client and consultants (client interference, approvals and disputes, decision making, competence) = Employee motivation

Test Statistics[a]

	Client and consultants (client interference, approvals and disputes, decision making, competence) - Employee motivation
Z	-.159[b]
Asymp. Sig. (2-tailed)	.874

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeemotivation WITH
    Financialstabilitystabilityofcountryinflationcostofcapitalfinanc (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Financial stability (stability of country, inflation, cost of capital, financial crisis) - Employee motivation	Negative Ranks	31[a]	16.85	522.50
	Positive Ranks	1[b]	5.50	5.50
	Ties	5[c]		
	Total	37		

a. Financial stability (stability of country, inflation, cost of capital, financial crisis) < Employee motivation

b. Financial stability (stability of country, inflation, cost of capital, financial crisis) > Employee motivation

c. Financial stability (stability of country, inflation, cost of capital, financial crisis) = Employee motivation

Test Statistics[a]

	Financial stability (stability of country, inflation, cost of capital, financial crisis) - Employee motivation
Z	-4.895[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeemotivation WITH Permits (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Permits - Employee motivation	Negative Ranks	28[a]	15.25	427.00
	Positive Ranks	1[b]	8.00	8.00
	Ties	8[c]		
	Total	37		

a. Permits < Employee motivation

b. Permits > Employee motivation

c. Permits = Employee motivation

Test Statistics[a]

	Permits - Employee motivation
Z	-4.637[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeemotivation WITH Legislation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Legislation - Employee motivation	Negative Ranks	29[a]	15.76	457.00
	Positive Ranks	1[b]	8.00	8.00
	Ties	7[c]		
	Total	37		

a. Legislation < Employee motivation

b. Legislation > Employee motivation

c. Legislation = Employee motivation

Test Statistics[a]

	Legislation - Employee motivation
Z	-4.735[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeemotivation WITH Weather (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Weather - Employee motivation	Negative Ranks	33[a]	17.56	579.50
	Positive Ranks	1[b]	15.50	15.50
	Ties	3[c]		
	Total	37		

a. Weather < Employee motivation

b. Weather > Employee motivation

c. Weather = Employee motivation

Test Statistics[a]

	Weather - Employee motivation
Z	-4.869[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeexperience WITH Laborworkfacilitiesandsatisfaction (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Labor work facilities and satisfaction - Employee experience	Negative Ranks	11[a]	10.64	117.00
	Positive Ranks	9[b]	10.33	93.00
	Ties	17[c]		
	Total	37		

a. Labor work facilities and satisfaction < Employee experience

b. Labor work facilities and satisfaction > Employee experience

c. Labor work facilities and satisfaction = Employee experience

Test Statistics[a]

	Labor work facilities and satisfaction - Employee experience
Z	-.465[b]
Asymp. Sig. (2-tailed)	.642

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeexperience WITH Laborfatigue (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Labor fatigue - Employee experience	Negative Ranks	13[a]	12.12	157.50
	Positive Ranks	10[b]	11.85	118.50
	Ties	14[c]		
	Total	37		

a. Labor fatigue < Employee experience

b. Labor fatigue > Employee experience

c. Labor fatigue = Employee experience

Test Statistics[a]

	Labor fatigue - Employee experience
Z	-.630[b]
Asymp. Sig. (2-tailed)	.529

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeexperience WITH Supervision (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Supervision - Employee experience	Negative Ranks	12[a]	11.88	142.50
	Positive Ranks	11[b]	12.14	133.50
	Ties	14[c]		
	Total	37		

a. Supervision < Employee experience

b. Supervision > Employee experience

c. Supervision = Employee experience

Test Statistics[a]

	Supervision - Employee experience
Z	-.144[b]
Asymp. Sig. (2-tailed)	.885

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeexperience WITH Planningandsequencing (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Planning and sequencing - Employee experience	Negative Ranks	3[a]	19.17	57.50
	Positive Ranks	26[b]	14.52	377.50
	Ties	8[c]		
	Total	37		

a. Planning and sequencing < Employee experience

b. Planning and sequencing > Employee experience

c. Planning and sequencing = Employee experience

Test Statistics[a]

	Planning and sequencing - Employee experience
Z	-3.587[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeeexperience WITH Competencyofprojectmanager (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Competency of project manager - Employee experience	Negative Ranks	4[a]	11.75	47.00
	Positive Ranks	22[b]	13.82	304.00
	Ties	11[c]		
	Total	37		

a. Competency of project manager < Employee experience

b. Competency of project manager > Employee experience

c. Competency of project manager = Employee experience

Test Statistics[a]

	Competency of project manager - Employee experience
Z	-3.381[b]
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeeexperience WITH Availabilityandqualityofinformation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Availability and quality of information - Employee experience	Negative Ranks	2[a]	8.00	16.00
	Positive Ranks	23[b]	13.43	309.00
	Ties	12[c]		
	Total	37		

a. Availability and quality of information < Employee experience

b. Availability and quality of information > Employee experience

c. Availability and quality of information = Employee experience

Test Statistics[a]

	Availability and quality of information - Employee experience
Z	-4.078[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeeexperience WITH Coordinationandcollaboration (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Coordination and collaboration - Employee experience	Negative Ranks	3[a]	23.33	70.00
	Positive Ranks	26[b]	14.04	365.00
	Ties	8[c]		
	Total	37		

a. Coordination and collaboration < Employee experience

b. Coordination and collaboration > Employee experience

c. Coordination and collaboration = Employee experience

Test Statistics[a]

	Coordination and collaboration - Employee experience
Z	-3.261[b]
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeeexperience WITH Toolsandprograms (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Tools and programs - Employee experience	Negative Ranks	8[a]	8.63	69.00
	Positive Ranks	9[b]	9.33	84.00
	Ties	20[c]		
	Total	37		

a. Tools and programs < Employee experience

b. Tools and programs > Employee experience

c. Tools and programs = Employee experience

Test Statistics[a]

	Tools and programs - Employee experience
Z	-.371[b]
Asymp. Sig. (2-tailed)	.710

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeeexperience WITH Technochanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Techno changes - Employee experience	Negative Ranks	14[a]	11.75	164.50
	Positive Ranks	7[b]	9.50	66.50
	Ties	16[c]		
	Total	37		

a. Techno changes < Employee experience

b. Techno changes > Employee experience

c. Techno changes = Employee experience

Test Statistics[a]

	Techno changes - Employee experience
Z	-1.785[b]
Asymp. Sig. (2-tailed)	.074

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeexperience WITH Designchanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Design changes - Employee experience	Negative Ranks	6[a]	10.42	62.50
	Positive Ranks	17[b]	12.56	213.50
	Ties	14[c]		
	Total	37		

a. Design changes < Employee experience

b. Design changes > Employee experience

c. Design changes = Employee experience

Test Statistics[a]

	Design changes - Employee experience
Z	-2.401[b]
Asymp. Sig. (2-tailed)	.016

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeeexperience WITH Incompleteorunclearspecificationofthework (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Incomplete or unclear specification of the work - Employee experience	Negative Ranks	5[a]	14.80	74.00
	Positive Ranks	24[b]	15.04	361.00
	Ties	8[c]		
	Total	37		

a. Incomplete or unclear specification of the work < Employee experience

b. Incomplete or unclear specification of the work > Employee experience

c. Incomplete or unclear specification of the work = Employee experience

Test Statistics[a]

	Incomplete or unclear specification of the work - Employee experience
Z	-3.208[b]
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeeexperience WITH
    Clientandconsultantsclientinterferenceapprovalsanddisputesdecisi (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Client and consultants (client interference, approvals and disputes, decision making, competence) - Employee experience	Negative Ranks	3[a]	14.00	42.00
	Positive Ranks	21[b]	12.29	258.00
	Ties	13[c]		
	Total	37		

a. Client and consultants (client interference, approvals and disputes, decision making, competence) < Employee experience

b. Client and consultants (client interference, approvals and disputes, decision making, competence) > Employee experience

c. Client and consultants (client interference, approvals and disputes, decision making, competence) = Employee experience

Test Statistics[a]

	Client and consultants (client interference, approvals and disputes, decision making, competence) - Employee experience
Z	-3.226[b]
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Employeeexperience WITH
    Financialstabilitystabilityofcountryinflationcostofcapitalfinanc (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Financial stability (stability of country, inflation, cost of capital, financial crisis) - Employee experience	Negative Ranks	26[a]	14.63	380.50
	Positive Ranks	2[b]	12.75	25.50
	Ties	9[c]		
	Total	37		

a. Financial stability (stability of country, inflation, cost of capital, financial crisis) < Employee experience

b. Financial stability (stability of country, inflation, cost of capital, financial crisis) > Employee experience

c. Financial stability (stability of country, inflation, cost of capital, financial crisis) = Employee experience

Test Statistics[a]

	Financial stability (stability of country, inflation, cost of capital, financial crisis) - Employee experience
Z	-4.116[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeexperience WITH Permits (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Permits - Employee experience	Negative Ranks	18[a]	14.17	255.00
	Positive Ranks	7[b]	10.00	70.00
	Ties	12[c]		
	Total	37		

a. Permits < Employee experience

b. Permits > Employee experience

c. Permits = Employee experience

Test Statistics[a]

	Permits - Employee experience
Z	-2.572[b]
Asymp. Sig. (2-tailed)	.010

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeexperience WITH Legislation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Legislation - Employee experience	Negative Ranks	20[a]	14.85	297.00
	Positive Ranks	7[b]	11.57	81.00
	Ties	10[c]		
	Total	37		

a. Legislation < Employee experience

b. Legislation > Employee experience

c. Legislation = Employee experience

Test Statistics[a]

	Legislation - Employee experience
Z	-2.665[b]
Asymp. Sig. (2-tailed)	.008

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Employeeexperience WITH Weather (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Weather - Employee experience	Negative Ranks	28[a]	15.29	428.00
	Positive Ranks	1[b]	7.00	7.00
	Ties	8[c]		
	Total	37		

a. Weather < Employee experience

b. Weather > Employee experience

c. Weather = Employee experience

Test Statistics[a]

	Weather - Employee experience
Z	-4.622[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Laborworkfacilitiesandsatisfaction WITH Laborfatigue (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Labor fatigue - Labor work facilities and satisfaction	Negative Ranks	8[a]	8.63	69.00
	Positive Ranks	7[b]	7.29	51.00
	Ties	22[c]		
	Total	37		

a. Labor fatigue < Labor work facilities and satisfaction

b. Labor fatigue > Labor work facilities and satisfaction

c. Labor fatigue = Labor work facilities and satisfaction

Test Statistics[a]

	Labor fatigue - Labor work facilities and satisfaction
Z	-.536[b]
Asymp. Sig. (2-tailed)	.592

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Laborworkfacilitiesandsatisfaction WITH Supervision (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Supervision - Labor work facilities and satisfaction	Negative Ranks	12[a]	12.63	151.50
	Positive Ranks	13[b]	13.35	173.50
	Ties	12[c]		
	Total	37		

a. Supervision < Labor work facilities and satisfaction

b. Supervision > Labor work facilities and satisfaction

c. Supervision = Labor work facilities and satisfaction

Test Statistics[a]

	Supervision - Labor work facilities and satisfaction
Z	-.306[b]
Asymp. Sig. (2-tailed)	.760

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Laborworkfacilitiesandsatisfaction WITH Planningandsequencing (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Planning and sequencing - Labor work facilities and satisfaction	Negative Ranks	3[a]	12.67	38.00
	Positive Ranks	24[b]	14.17	340.00
	Ties	10[c]		
	Total	37		

a. Planning and sequencing < Labor work facilities and satisfaction

b. Planning and sequencing > Labor work facilities and satisfaction

c. Planning and sequencing = Labor work facilities and satisfaction

Test Statistics[a]

	Planning and sequencing - Labor work facilities and satisfaction
Z	-3.737[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Laborworkfacilitiesandsatisfaction WITH Competencyofprojectmanager (PAIRED
)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Competency of project manager - Labor work facilities and satisfaction	Negative Ranks	4[a]	12.88	51.50
	Positive Ranks	24[b]	14.77	354.50
	Ties	9[c]		
	Total	37		

a. Competency of project manager < Labor work facilities and satisfaction

b. Competency of project manager > Labor work facilities and satisfaction

c. Competency of project manager = Labor work facilities and satisfaction

Test Statistics[a]

	Competency of project manager - Labor work facilities and satisfaction
Z	-3.578[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Laborworkfacilitiesandsatisfaction WITH Availabilityandqualityofinformatio
n (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Availability and quality of information - Labor work facilities and satisfaction	Negative Ranks	0[a]	.00	.00
	Positive Ranks	20[b]	10.50	210.00
	Ties	17[c]		
	Total	37		

a. Availability and quality of information < Labor work facilities and satisfaction

b. Availability and quality of information > Labor work facilities and satisfaction

c. Availability and quality of information = Labor work facilities and satisfaction

Test Statistics[a]

	Availability and quality of information - Labor work facilities and satisfaction
Z	-4.005[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Laborworkfacilitiesandsatisfaction WITH Coordinationandcollaboration (PAIR
ED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Coordination and collaboration - Labor work facilities and satisfaction	Negative Ranks	2[a]	15.25	30.50
	Positive Ranks	23[b]	12.80	294.50
	Ties	12[c]		
	Total	37		

a. Coordination and collaboration < Labor work facilities and satisfaction

b. Coordination and collaboration > Labor work facilities and satisfaction

c. Coordination and collaboration = Labor work facilities and satisfaction

Test Statistics[a]

	Coordination and collaboration - Labor work facilities and satisfaction
Z	-3.619[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Laborworkfacilitiesandsatisfaction WITH Toolsandprograms (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Tools and programs - Labor work facilities and satisfaction	Negative Ranks	10[a]	11.70	117.00
	Positive Ranks	13[b]	12.23	159.00
	Ties	14[c]		
	Total	37		

a. Tools and programs < Labor work facilities and satisfaction

b. Tools and programs > Labor work facilities and satisfaction

c. Tools and programs = Labor work facilities and satisfaction

Test Statistics[a]

	Tools and programs - Labor work facilities and satisfaction
Z	-.678[b]
Asymp. Sig. (2-tailed)	.498

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Laborworkfacilitiesandsatisfaction WITH Technochanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Techno changes - Labor work facilities and satisfaction	Negative Ranks	15[a]	11.57	173.50
	Positive Ranks	8[b]	12.81	102.50
	Ties	14[c]		
	Total	37		

a. Techno changes < Labor work facilities and satisfaction

b. Techno changes > Labor work facilities and satisfaction

c. Techno changes = Labor work facilities and satisfaction

Test Statistics[a]

	Techno changes - Labor work facilities and satisfaction
Z	-1.129[b]
Asymp. Sig. (2-tailed)	.259

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Laborworkfacilitiesandsatisfaction WITH Designchanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Design changes - Labor work facilities and satisfaction	Negative Ranks	6[a]	10.67	64.00
	Positive Ranks	17[b]	12.47	212.00
	Ties	14[c]		
	Total	37		

a. Design changes < Labor work facilities and satisfaction

b. Design changes > Labor work facilities and satisfaction

c. Design changes = Labor work facilities and satisfaction

Test Statistics[a]

	Design changes - Labor work facilities and satisfaction
Z	-2.366[b]
Asymp. Sig. (2-tailed)	.018

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Laborworkfacilitiesandsatisfaction WITH Incompleteorunclearspecificationof
thework
```

```
    (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Incomplete or unclear specification of the work - Labor work facilities and satisfaction	Negative Ranks	5[a]	8.50	42.50
	Positive Ranks	21[b]	14.69	308.50
	Ties	11[c]		
	Total	37		

a. Incomplete or unclear specification of the work < Labor work facilities and satisfaction

b. Incomplete or unclear specification of the work > Labor work facilities and satisfaction

c. Incomplete or unclear specification of the work = Labor work facilities and satisfaction

Test Statistics[a]

	Incomplete or unclear specification of the work - Labor work facilities and satisfaction
Z	-3.483[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Laborworkfacilitiesandsatisfaction WITH
    Clientandconsultantsclientinterferenceapprovalsanddisputesdecisi (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Client and consultants (client interference, approvals and disputes, decision making, competence) - Labor work facilities and satisfaction	Negative Ranks	2[a]	11.50	23.00
	Positive Ranks	18[b]	10.39	187.00
	Ties	17[c]		
	Total	37		

a. Client and consultants (client interference, approvals and disputes, decision making, competence) < Labor work facilities and satisfaction

b. Client and consultants (client interference, approvals and disputes, decision making, competence) > Labor work facilities and satisfaction

c. Client and consultants (client interference, approvals and disputes, decision making, competence) = Labor work facilities and satisfaction

Test Statistics[a]

	Client and consultants (client interference, approvals and disputes, decision making, competence) - Labor work facilities and satisfaction
Z	-3.169[b]
Asymp. Sig. (2-tailed)	.002

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Laborworkfacilitiesandsatisfaction WITH
    Financialstabilitystabilityofcountryinflationcostofcapitalfinanc (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Financial stability (stability of country, inflation, cost of capital, financial crisis) - Labor work facilities and satisfaction	Negative Ranks	28[a]	16.02	448.50
	Positive Ranks	3[b]	15.83	47.50
	Ties	6[c]		
	Total	37		

a. Financial stability (stability of country, inflation, cost of capital, financial crisis) < Labor work facilities and satisfaction

b. Financial stability (stability of country, inflation, cost of capital, financial crisis) > Labor work facilities and satisfaction

c. Financial stability (stability of country, inflation, cost of capital, financial crisis) = Labor work facilities and satisfaction

Test Statistics[a]

	Financial stability (stability of country, inflation, cost of capital, financial crisis) - Labor work facilities and satisfaction
Z	-4.026[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Laborworkfacilitiesandsatisfaction WITH Permits (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Permits - Labor work facilities and satisfaction	Negative Ranks	19[a]	13.21	251.00
	Positive Ranks	6[b]	12.33	74.00
	Ties	12[c]		
	Total	37		

a. Permits < Labor work facilities and satisfaction

b. Permits > Labor work facilities and satisfaction

c. Permits = Labor work facilities and satisfaction

Test Statistics[a]

	Permits - Labor work facilities and satisfaction
Z	-2.465[b]
Asymp. Sig. (2-tailed)	.014

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Laborworkfacilitiesandsatisfaction WITH Legislation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Legislation - Labor work facilities and satisfaction	Negative Ranks	22[a]	15.59	343.00
	Positive Ranks	7[b]	13.14	92.00
	Ties	8[c]		
	Total	37		

a. Legislation < Labor work facilities and satisfaction

b. Legislation > Labor work facilities and satisfaction

c. Legislation = Labor work facilities and satisfaction

Test Statistics[a]

	Legislation - Labor work facilities and satisfaction
Z	-2.831[b]
Asymp. Sig. (2-tailed)	.005

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Laborworkfacilitiesandsatisfaction WITH Weather (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Weather - Labor work facilities and satisfaction	Negative Ranks	28[a]	16.18	453.00
	Positive Ranks	3[b]	14.33	43.00
	Ties	6[c]		
	Total	37		

a. Weather < Labor work facilities and satisfaction

b. Weather > Labor work facilities and satisfaction

c. Weather = Labor work facilities and satisfaction

Test Statistics[a]

	Weather - Labor work facilities and satisfaction
Z	-4.086[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Laborfatigue WITH Supervision (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Supervision - Labor fatigue	Negative Ranks	10[a]	10.50	105.00
	Positive Ranks	11[b]	11.45	126.00
	Ties	16[c]		
	Total	37		

a. Supervision < Labor fatigue

b. Supervision > Labor fatigue

c. Supervision = Labor fatigue

Test Statistics[a]

	Supervision - Labor fatigue
Z	-.386[b]
Asymp. Sig. (2-tailed)	.700

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Laborfatigue WITH Planningandsequencing (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Planning and sequencing - Labor fatigue	Negative Ranks	1[a]	17.50	17.50
	Positive Ranks	23[b]	12.28	282.50
	Ties	13[c]		
	Total	37		

a. Planning and sequencing < Labor fatigue

b. Planning and sequencing > Labor fatigue

c. Planning and sequencing = Labor fatigue

Test Statistics[a]

	Planning and sequencing - Labor fatigue
Z	-3.876[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Laborfatigue WITH Competencyofprojectmanager (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Competency of project manager - Labor fatigue	Negative Ranks	3[a]	13.50	40.50
	Positive Ranks	23[b]	13.50	310.50
	Ties	11[c]		
	Total	37		

a. Competency of project manager < Labor fatigue

b. Competency of project manager > Labor fatigue

c. Competency of project manager = Labor fatigue

Test Statistics[a]

	Competency of project manager - Labor fatigue
Z	-3.518[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Laborfatigue WITH Availabilityandqualityofinformation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Availability and quality of information - Labor fatigue	Negative Ranks	2[a]	16.00	32.00
	Positive Ranks	24[b]	13.29	319.00
	Ties	11[c]		
	Total	37		

a. Availability and quality of information < Labor fatigue

b. Availability and quality of information > Labor fatigue

c. Availability and quality of information = Labor fatigue

Test Statistics[a]

	Availability and quality of information - Labor fatigue
Z	-3.721[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Laborfatigue WITH Coordinationandcollaboration (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Coordination and collaboration - Labor fatigue	Negative Ranks	2[a]	10.75	21.50
	Positive Ranks	22[b]	12.66	278.50
	Ties	13[c]		
	Total	37		

a. Coordination and collaboration < Labor fatigue

b. Coordination and collaboration > Labor fatigue

c. Coordination and collaboration = Labor fatigue

Test Statistics[a]

	Coordination and collaboration - Labor fatigue
Z	-3.746[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Laborfatigue WITH Toolsandprograms (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Tools and programs - Labor fatigue	Negative Ranks	10[a]	10.95	109.50
	Positive Ranks	13[b]	12.81	166.50
	Ties	14[c]		
	Total	37		

a. Tools and programs < Labor fatigue

b. Tools and programs > Labor fatigue

c. Tools and programs = Labor fatigue

Test Statistics[a]

	Tools and programs - Labor fatigue
Z	-.897[b]
Asymp. Sig. (2-tailed)	.370

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Laborfatigue WITH Technochanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Techno changes - Labor fatigue	Negative Ranks	13[a]	11.04	143.50
	Positive Ranks	8[b]	10.94	87.50
	Ties	16[c]		
	Total	37		

a. Techno changes < Labor fatigue

b. Techno changes > Labor fatigue

c. Techno changes = Labor fatigue

Test Statistics[a]

	Techno changes - Labor fatigue
Z	-1.008[b]
Asymp. Sig. (2-tailed)	.313

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Laborfatigue WITH Designchanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Design changes - Labor fatigue	Negative Ranks	6[a]	11.83	71.00
	Positive Ranks	19[b]	13.37	254.00
	Ties	12[c]		
	Total	37		

a. Design changes < Labor fatigue

b. Design changes > Labor fatigue

c. Design changes = Labor fatigue

Test Statistics[a]

	Design changes - Labor fatigue
Z	-2.579[b]
Asymp. Sig. (2-tailed)	.010

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Laborfatigue WITH Incompleteoruncl earspecificationofthework (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Incomplete or unclear specification of the work - Labor fatigue	Negative Ranks	5[a]	13.50	67.50
	Positive Ranks	25[b]	15.90	397.50
	Ties	7[c]		
	Total	37		

a. Incomplete or unclear specification of the work < Labor fatigue

b. Incomplete or unclear specification of the work > Labor fatigue

c. Incomplete or unclear specification of the work = Labor fatigue

Test Statistics[a]

	Incomplete or unclear specification of the work - Labor fatigue
Z	-3.496[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Laborfatigue WITH Clientandconsultantsclientinterferenceapprovalsanddisput
esdecisi
    (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Client and consultants (client interference, approvals and disputes, decision making, competence) - Labor fatigue	Negative Ranks	3[a]	11.00	33.00
	Positive Ranks	20[b]	12.15	243.00
	Ties	14[c]		
	Total	37		

a. Client and consultants (client interference, approvals and disputes, decision making, competence) < Labor fatigue

b. Client and consultants (client interference, approvals and disputes, decision making, competence) > Labor fatigue

c. Client and consultants (client interference, approvals and disputes, decision making, competence) = Labor fatigue

Test Statistics[a]

	Client and consultants (client interference, approvals and disputes, decision making, competence) - Labor fatigue
Z	-3.293[b]
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Laborfatigue WITH Financialstabilitystabilityofcountryinflationcostofcapit
alfinanc
    (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Financial stability (stability of country, inflation, cost of capital, financial crisis) - Labor fatigue	Negative Ranks	27[a]	16.57	447.50
	Positive Ranks	4[b]	12.13	48.50
	Ties	6[c]		
	Total	37		

a. Financial stability (stability of country, inflation, cost of capital, financial crisis) < Labor fatigue

b. Financial stability (stability of country, inflation, cost of capital, financial crisis) > Labor fatigue

c. Financial stability (stability of country, inflation, cost of capital, financial crisis) = Labor fatigue

Test Statistics[a]

	Financial stability (stability of country, inflation, cost of capital, financial crisis) - Labor fatigue
Z	-4.011[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Laborfatigue WITH Permits (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Permits - Labor fatigue	Negative Ranks	18[a]	13.92	250.50
	Positive Ranks	7[b]	10.64	74.50
	Ties	12[c]		
	Total	37		

a. Permits < Labor fatigue

b. Permits > Labor fatigue

c. Permits = Labor fatigue

Test Statistics[a]

	Permits - Labor fatigue
Z	-2.465[b]
Asymp. Sig. (2-tailed)	.014

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Laborfatigue WITH Legislation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Legislation - Labor fatigue	Negative Ranks	19[a]	12.89	245.00
	Positive Ranks	6[b]	13.33	80.00
	Ties	12[c]		
	Total	37		

a. Legislation < Labor fatigue

b. Legislation > Labor fatigue

c. Legislation = Labor fatigue

Test Statistics[a]

	Legislation - Labor fatigue
Z	-2.273[b]
Asymp. Sig. (2-tailed)	.023

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Laborfatigue WITH Weather (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Weather - Labor fatigue	Negative Ranks	24[a]	15.38	369.00
	Positive Ranks	4[b]	9.25	37.00
	Ties	9[c]		
	Total	37		

a. Weather < Labor fatigue

b. Weather > Labor fatigue

c. Weather = Labor fatigue

Test Statistics[a]

	Weather - Labor fatigue
Z	-3.825[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Supervision WITH Planningandsequencing (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Planning and sequencing - Supervision	Negative Ranks	1[a]	5.50	5.50
	Positive Ranks	20[b]	11.28	225.50
	Ties	16[c]		
	Total	37		

a. Planning and sequencing < Supervision

b. Planning and sequencing > Supervision

c. Planning and sequencing = Supervision

Test Statistics[a]

	Planning and sequencing - Supervision
Z	-3.922[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Supervision WITH Competencyofprojectmanager (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Competency of project manager - Supervision	Negative Ranks	2[a]	14.75	29.50
	Positive Ranks	22[b]	12.30	270.50
	Ties	13[c]		
	Total	37		

a. Competency of project manager < Supervision

b. Competency of project manager > Supervision

c. Competency of project manager = Supervision

Test Statistics[a]

	Competency of project manager - Supervision
Z	-3.603[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Supervision WITH Availabilityandqualityofinformation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Availability and quality of information - Supervision	Negative Ranks	2[a]	16.50	33.00
	Positive Ranks	24[b]	13.25	318.00
	Ties	11[c]		
	Total	37		

a. Availability and quality of information < Supervision

b. Availability and quality of information > Supervision

c. Availability and quality of information = Supervision

Test Statistics[a]

	Availability and quality of information - Supervision
Z	-3.723[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Supervision WITH Coordinationandcollaboration (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Coordination and collaboration - Supervision	Negative Ranks	3[a]	12.33	37.00
	Positive Ranks	24[b]	14.21	341.00
	Ties	10[c]		
	Total	37		

a. Coordination and collaboration < Supervision

b. Coordination and collaboration > Supervision

c. Coordination and collaboration = Supervision

Test Statistics[a]

	Coordination and collaboration - Supervision
Z	-3.759[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Supervision WITH Toolsandprograms (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Tools and programs - Supervision	Negative Ranks	9[a]	11.50	103.50
	Positive Ranks	12[b]	10.63	127.50
	Ties	16[c]		
	Total	37		

a. Tools and programs < Supervision

b. Tools and programs > Supervision

c. Tools and programs = Supervision

Test Statistics[a]

	Tools and programs - Supervision
Z	-.437[b]
Asymp. Sig. (2-tailed)	.662

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Supervision WITH Technochanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Techno changes - Supervision	Negative Ranks	17[a]	11.18	190.00
	Positive Ranks	6[b]	14.33	86.00
	Ties	14[c]		
	Total	37		

a. Techno changes < Supervision

b. Techno changes > Supervision

c. Techno changes = Supervision

Test Statistics[a]

	Techno changes - Supervision
Z	-1.720[b]
Asymp. Sig. (2-tailed)	.085

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Supervision WITH Designchanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Design changes - Supervision	Negative Ranks	6[a]	12.00	72.00
	Positive Ranks	18[b]	12.67	228.00
	Ties	13[c]		
	Total	37		

a. Design changes < Supervision

b. Design changes > Supervision

c. Design changes = Supervision

Test Statistics[a]

	Design changes - Supervision
Z	-2.310[b]
Asymp. Sig. (2-tailed)	.021

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Supervision WITH Incompleteorunclearspecificationofthework (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Incomplete or unclear specification of the work - Supervision	Negative Ranks	4[a]	14.00	56.00
	Positive Ranks	24[b]	14.58	350.00
	Ties	9[c]		
	Total	37		

a. Incomplete or unclear specification of the work < Supervision

b. Incomplete or unclear specification of the work > Supervision

c. Incomplete or unclear specification of the work = Supervision

Test Statistics[a]

	Incomplete or unclear specification of the work - Supervision
Z	-3.468[b]
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Supervision WITH Clientandconsultantsclientinterferenceapprovalsanddispute
sdecisi
     (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Client and consultants (client interference, approvals and disputes, decision making, competence) - Supervision	Negative Ranks	4[a]	9.63	38.50
	Positive Ranks	18[b]	11.92	214.50
	Ties	15[c]		
	Total	37		

a. Client and consultants (client interference, approvals and disputes, decision making, competence) < Supervision

b. Client and consultants (client interference, approvals and disputes, decision making, competence) > Supervision

c. Client and consultants (client interference, approvals and disputes, decision making, competence) = Supervision

Test Statistics[a]

	Client and consultants (client interference, approvals and disputes, decision making, competence) - Supervision
Z	-2.945[b]
Asymp. Sig. (2-tailed)	.003

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Supervision WITH Financialstabilitystabilityofcountryinflationcostofcapita
lfinanc
    (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Financial stability (stability of country, inflation, cost of capital, financial crisis) - Supervision	Negative Ranks	24[a]	15.46	371.00
	Positive Ranks	4[b]	8.75	35.00
	Ties	9[c]		
	Total	37		

a. Financial stability (stability of country, inflation, cost of capital, financial crisis) < Supervision

b. Financial stability (stability of country, inflation, cost of capital, financial crisis) > Supervision

c. Financial stability (stability of country, inflation, cost of capital, financial crisis) = Supervision

Test Statistics[a]

	Financial stability (stability of country, inflation, cost of capital, financial crisis) - Supervision
Z	-3.886[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Supervision WITH Permits (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Permits - Supervision	Negative Ranks	19[a]	14.37	273.00
	Positive Ranks	7[b]	11.14	78.00
	Ties	11[c]		
	Total	37		

a. Permits < Supervision

b. Permits > Supervision

c. Permits = Supervision

Test Statistics[a]

	Permits - Supervision
Z	-2.541[b]
Asymp. Sig. (2-tailed)	.011

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Supervision WITH Legislation (PAIRED)
```

```
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Legislation - Supervision	Negative Ranks	19[a]	15.34	291.50
	Positive Ranks	7[b]	8.50	59.50
	Ties	11[c]		
	Total	37		

a. Legislation < Supervision

b. Legislation > Supervision

c. Legislation = Supervision

Test Statistics[a]

	Legislation - Supervision
Z	-3.046[b]
Asymp. Sig. (2-tailed)	.002

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Supervision WITH Weather (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Weather - Supervision	Negative Ranks	28[a]	16.25	455.00
	Positive Ranks	3[b]	13.67	41.00
	Ties	6[c]		
	Total	37		

a. Weather < Supervision

b. Weather > Supervision

c. Weather = Supervision

Test Statistics[a]

	Weather - Supervision
Z	-4.112[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Planningandsequencing WITH Competencyofprojectmanager (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Competency of project manager - Planning and sequencing	Negative Ranks	11[a]	9.32	102.50
	Positive Ranks	7[b]	9.79	68.50
	Ties	19[c]		
	Total	37		

a. Competency of project manager < Planning and sequencing

b. Competency of project manager > Planning and sequencing

c. Competency of project manager = Planning and sequencing

Test Statistics[a]

	Competency of project manager - Planning and sequencing
Z	-.808[b]
Asymp. Sig. (2-tailed)	.419

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Planningandsequencing WITH Availabilityandqualityofinformation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Availability and quality of information - Planning and sequencing	Negative Ranks	8[a]	8.00	64.00
	Positive Ranks	8[b]	9.00	72.00
	Ties	21[c]		
	Total	37		

a. Availability and quality of information < Planning and sequencing

b. Availability and quality of information > Planning and sequencing

c. Availability and quality of information = Planning and sequencing

Test Statistics[a]

	Availability and quality of information - Planning and sequencing
Z	-.221[b]
Asymp. Sig. (2-tailed)	.825

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Planningandsequencing WITH Coordinationandcollaboration (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Coordination and collaboration - Planning and sequencing	Negative Ranks	6[a]	6.58	39.50
	Positive Ranks	7[b]	7.36	51.50
	Ties	24[c]		
	Total	37		

a. Coordination and collaboration < Planning and sequencing

b. Coordination and collaboration > Planning and sequencing

c. Coordination and collaboration = Planning and sequencing

Test Statistics[a]

	Coordination and collaboration - Planning and sequencing
Z	-.443[b]
Asymp. Sig. (2-tailed)	.658

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Planningandsequencing WITH Toolsandprograms (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Tools and programs - Planning and sequencing	Negative Ranks	22[a]	13.18	290.00
	Positive Ranks	3[b]	11.67	35.00
	Ties	12[c]		
	Total	37		

a. Tools and programs < Planning and sequencing

b. Tools and programs > Planning and sequencing

c. Tools and programs = Planning and sequencing

Test Statistics[a]

	Tools and programs - Planning and sequencing
Z	-3.540[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Planningandsequencing WITH Technochanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Techno changes - Planning and sequencing	Negative Ranks	29[a]	16.00	464.00
	Positive Ranks	2[b]	16.00	32.00
	Ties	6[c]		
	Total	37		

a. Techno changes < Planning and sequencing

b. Techno changes > Planning and sequencing

c. Techno changes = Planning and sequencing

Test Statistics[a]

	Techno changes - Planning and sequencing
Z	-4.353[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Planningandsequencing WITH Designchanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Design changes - Planning and sequencing	Negative Ranks	15[a]	10.03	150.50
	Positive Ranks	4[b]	9.88	39.50
	Ties	18[c]		
	Total	37		

a. Design changes < Planning and sequencing

b. Design changes > Planning and sequencing

c. Design changes = Planning and sequencing

Test Statistics[a]

	Design changes - Planning and sequencing
Z	-2.349[b]
Asymp. Sig. (2-tailed)	.019

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Planningandsequencing WITH Incompleteorunclearspecificationofthework (PAIR
ED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Incomplete or unclear specification of the work - Planning and sequencing	Negative Ranks	9[a]	9.89	89.00
	Positive Ranks	8[b]	8.00	64.00
	Ties	20[c]		
	Total	37		

a. Incomplete or unclear specification of the work < Planning and sequencing

b. Incomplete or unclear specification of the work > Planning and sequencing

c. Incomplete or unclear specification of the work = Planning and sequencing

Test Statistics[a]

	Incomplete or unclear specification of the work - Planning and sequencing
Z	-.645[b]
Asymp. Sig. (2-tailed)	.519

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Planningandsequencing WITH
```

```
    Clientandconsultantsclientinterferenceapprovalsanddisputesdecisi (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Client and consultants (client interference, approvals and disputes, decision making, competence) - Planning and sequencing	Negative Ranks	12[a]	8.63	103.50
	Positive Ranks	5[b]	9.90	49.50
	Ties	20[c]		
	Total	37		

a. Client and consultants (client interference, approvals and disputes, decision making, competence) < Planning and sequencing

b. Client and consultants (client interference, approvals and disputes, decision making, competence) > Planning and sequencing

c. Client and consultants (client interference, approvals and disputes, decision making, competence) = Planning and sequencing

Test Statistics[a]

	Client and consultants (client interference, approvals and disputes, decision making, competence) - Planning and sequencing
Z	-1.337[b]
Asymp. Sig. (2-tailed)	.181

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Planningandsequencing WITH
    Financialstabilitystabilityofcountryinflationcostofcapitalfinanc (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Financial stability (stability of country, inflation, cost of capital, financial crisis) - Planning and sequencing	Negative Ranks	33[a]	18.47	609.50
	Positive Ranks	2[b]	10.25	20.50
	Ties	2[c]		
	Total	37		

a. Financial stability (stability of country, inflation, cost of capital, financial crisis) < Planning and sequencing

b. Financial stability (stability of country, inflation, cost of capital, financial crisis) > Planning and sequencing

c. Financial stability (stability of country, inflation, cost of capital, financial crisis) = Planning and sequencing

Test Statistics[a]

	Financial stability (stability of country, inflation, cost of capital, financial crisis) - Planning and sequencing
Z	-4.884[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Planningandsequencing WITH Permits (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Permits - Planning and sequencing	Negative Ranks	29[a]	15.43	447.50
	Positive Ranks	1[b]	17.50	17.50
	Ties	7[c]		
	Total	37		

a. Permits < Planning and sequencing

b. Permits > Planning and sequencing

c. Permits = Planning and sequencing

Test Statistics[a]

	Permits - Planning and sequencing
Z	-4.519[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Planningandsequencing WITH Legislation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Legislation - Planning and sequencing	Negative Ranks	31[a]	16.82	521.50
	Positive Ranks	1[b]	6.50	6.50
	Ties	5[c]		
	Total	37		

a. Legislation < Planning and sequencing

b. Legislation > Planning and sequencing

c. Legislation = Planning and sequencing

Test Statistics[a]

	Legislation - Planning and sequencing
Z	-4.935[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Planningandsequencing WITH Weather (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Weather - Planning and sequencing	Negative Ranks	33[a]	18.36	606.00
	Positive Ranks	2[b]	12.00	24.00
	Ties	2[c]		
	Total	37		

a. Weather < Planning and sequencing

b. Weather > Planning and sequencing

c. Weather = Planning and sequencing

Test Statistics[a]

	Weather - Planning and sequencing
Z	-4.845[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Competencyofprojectmanager WITH Availabilityandqualityofinformation (PAIRE
D)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Availability and quality of information - Competency of project manager	Negative Ranks	6[a]	8.00	48.00
	Positive Ranks	10[b]	8.80	88.00
	Ties	21[c]		
	Total	37		

a. Availability and quality of information < Competency of project manager

b. Availability and quality of information > Competency of project manager

c. Availability and quality of information = Competency of project manager

Test Statistics[a]

	Availability and quality of information - Competency of project manager
Z	-1.147[b]
Asymp. Sig. (2-tailed)	.251

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Competencyofprojectmanager WITH Coordinationandcollaboration (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Coordination and collaboration - Competency of project manager	Negative Ranks	4[a]	9.88	39.50
	Positive Ranks	11[b]	7.32	80.50
	Ties	22[c]		
	Total	37		

a. Coordination and collaboration < Competency of project manager

b. Coordination and collaboration > Competency of project manager

c. Coordination and collaboration = Competency of project manager

Test Statistics[a]

	Coordination and collaboration - Competency of project manager
Z	-1.220[b]
Asymp. Sig. (2-tailed)	.222

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Competencyofprojectmanager WITH Toolsandprograms (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Tools and programs - Competency of project manager	Negative Ranks	22[a]	13.23	291.00
	Positive Ranks	4[b]	15.00	60.00
	Ties	11[c]		
	Total	37		

a. Tools and programs < Competency of project manager

b. Tools and programs > Competency of project manager

c. Tools and programs = Competency of project manager

Test Statistics[a]

	Tools and programs - Competency of project manager
Z	-3.039[b]
Asymp. Sig. (2-tailed)	.002

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Competencyofprojectmanager WITH Technochanges (PAIRED)
```

```
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Techno changes - Competency of project manager	Negative Ranks	29[a]	17.02	493.50
	Positive Ranks	3[b]	11.50	34.50
	Ties	5[c]		
	Total	37		

a. Techno changes < Competency of project manager

b. Techno changes > Competency of project manager

c. Techno changes = Competency of project manager

Test Statistics[a]

	Techno changes - Competency of project manager
Z	-4.481[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Competencyofprojectmanager WITH Designchanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Design changes - Competency of project manager	Negative Ranks	16[a]	14.75	236.00
	Positive Ranks	10[b]	11.50	115.00
	Ties	11[c]		
	Total	37		

a. Design changes < Competency of project manager

b. Design changes > Competency of project manager

c. Design changes = Competency of project manager

Test Statistics[a]

	Design changes - Competency of project manager
Z	-1.660[b]
Asymp. Sig. (2-tailed)	.097

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Competencyofprojectmanager WITH Incompleteorunclearspecificationofthework
(PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Incomplete or unclear specification of the work - Competency of project manager	Negative Ranks	9[a]	10.06	90.50
	Positive Ranks	10[b]	9.95	99.50
	Ties	18[c]		
	Total	37		

a. Incomplete or unclear specification of the work < Competency of project manager

b. Incomplete or unclear specification of the work > Competency of project manager

c. Incomplete or unclear specification of the work = Competency of project manager

Test Statistics[a]

	Incomplete or unclear specification of the work - Competency of project manager
Z	-.198[b]
Asymp. Sig. (2-tailed)	.843

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Competencyofprojectmanager WITH
    Clientandconsultantsclientinterferenceapprovalsanddisputesdecisi (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Client and consultants (client interference, approvals and disputes, decision making, competence) - Competency of project manager	Negative Ranks	12[a]	10.17	122.00
	Positive Ranks	8[b]	11.00	88.00
	Ties	17[c]		
	Total	37		

a. Client and consultants (client interference, approvals and disputes, decision making, competence) < Competency of project manager

b. Client and consultants (client interference, approvals and disputes, decision making, competence) > Competency of project manager

c. Client and consultants (client interference, approvals and disputes, decision making, competence) = Competency of project manager

Test Statistics[a]

	Client and consultants (client interference, approvals and disputes, decision making, competence) - Competency of project manager
Z	-.676[b]
Asymp. Sig. (2-tailed)	.499

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Competencyofprojectmanager WITH
    Financialstabilitystabilityofcountryinflationcostofcapitalfinanc (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Financial stability (stability of country, inflation, cost of capital, financial crisis) - Competency of project manager	Negative Ranks	32[a]	18.92	605.50
	Positive Ranks	3[b]	8.17	24.50
	Ties	2[c]		
	Total	37		

a. Financial stability (stability of country, inflation, cost of capital, financial crisis) < Competency of project manager

b. Financial stability (stability of country, inflation, cost of capital, financial crisis) > Competency of project manager

c. Financial stability (stability of country, inflation, cost of capital, financial crisis) = Competency of project manager

Test Statistics[a]

	Financial stability (stability of country, inflation, cost of capital, financial crisis) - Competency of project manager
Z	-4.825[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Competencyofprojectmanager WITH Permits (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Permits - Competency of project manager	Negative Ranks	29[a]	17.33	502.50
	Positive Ranks	3[b]	8.50	25.50
	Ties	5[c]		
	Total	37		

a. Permits < Competency of project manager

b. Permits > Competency of project manager

c. Permits = Competency of project manager

Test Statistics[a]

	Permits - Competency of project manager
Z	-4.545[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Competencyofprojectmanager WITH Legislation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Legislation - Competency of project manager	Negative Ranks	29[a]	16.55	480.00
	Positive Ranks	2[b]	8.00	16.00
	Ties	6[c]		
	Total	37		

a. Legislation < Competency of project manager

b. Legislation > Competency of project manager

c. Legislation = Competency of project manager

Test Statistics[a]

	Legislation - Competency of project manager
Z	-4.629[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Competencyofprojectmanager WITH Weather (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Weather - Competency of project manager	Negative Ranks	32[a]	18.34	587.00
	Positive Ranks	2[b]	4.00	8.00
	Ties	3[c]		
	Total	37		

a. Weather < Competency of project manager

b. Weather > Competency of project manager

c. Weather = Competency of project manager

Test Statistics[a]

	Weather - Competency of project manager
Z	-5.002[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Availabilityandqualityofinformation WITH Coordinationandcollaboration (PAI
RED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Coordination and collaboration - Availability and quality of information	Negative Ranks	6[a]	7.17	43.00
	Positive Ranks	7[b]	6.86	48.00
	Ties	24[c]		
	Total	37		

a. Coordination and collaboration < Availability and quality of information

b. Coordination and collaboration > Availability and quality of information

c. Coordination and collaboration = Availability and quality of information

Test Statistics[a]

	Coordination and collaboration - Availability and quality of information
Z	-.182[b]
Asymp. Sig. (2-tailed)	.856

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Availabilityandqualityofinformation WITH Toolsandprograms (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Tools and programs - Availability and quality of information	Negative Ranks	22[a]	13.05	287.00
	Positive Ranks	3[b]	12.67	38.00
	Ties	12[c]		
	Total	37		

a. Tools and programs < Availability and quality of information

b. Tools and programs > Availability and quality of information

c. Tools and programs = Availability and quality of information

Test Statistics[a]

	Tools and programs - Availability and quality of information
Z	-3.440[b]
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Availabilityandqualityofinformation WITH Technochanges (PAIRED)
```

```
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Techno changes - Availability and quality of information	Negative Ranks	31[a]	16.94	525.00
	Positive Ranks	2[b]	18.00	36.00
	Ties	4[c]		
	Total	37		

a. Techno changes < Availability and quality of information

b. Techno changes > Availability and quality of information

c. Techno changes = Availability and quality of information

Test Statistics[a]

	Techno changes - Availability and quality of information
Z	-4.506[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Availabilityandqualityofinformation WITH Designchanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Design changes - Availability and quality of information	Negative Ranks	16[a]	12.44	199.00
	Positive Ranks	6[b]	9.00	54.00
	Ties	15[c]		
	Total	37		

a. Design changes < Availability and quality of information

b. Design changes > Availability and quality of information

c. Design changes = Availability and quality of information

Test Statistics[a]

	Design changes - Availability and quality of information
Z	-2.495[b]
Asymp. Sig. (2-tailed)	.013

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Availabilityandqualityofinformation WITH Incompleteorunclearspecificationo
ftheework
    (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Incomplete or unclear specification of the work - Availability and quality of information	Negative Ranks	10[a]	10.30	103.00
	Positive Ranks	8[b]	8.50	68.00
	Ties	19[c]		
	Total	37		

a. Incomplete or unclear specification of the work < Availability and quality of information

b. Incomplete or unclear specification of the work > Availability and quality of information

c. Incomplete or unclear specification of the work = Availability and quality of information

Test Statistics[a]

	Incomplete or unclear specification of the work - Availability and quality of information
Z	-.832[b]
Asymp. Sig. (2-tailed)	.405

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Availabilityandqualityofinformation WITH
    Clientandconsultantsclientinterferenceapprovalsanddisputesdecisi (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Client and consultants (client interference, approvals and disputes, decision making, competence) - Availability and quality of information	Negative Ranks	14[a]	10.39	145.50
	Positive Ranks	6[b]	10.75	64.50
	Ties	17[c]		
	Total	37		

a. Client and consultants (client interference, approvals and disputes, decision making, competence) < Availability and quality of information

b. Client and consultants (client interference, approvals and disputes, decision making, competence) > Availability and quality of information

c. Client and consultants (client interference, approvals and disputes, decision making, competence) = Availability and quality of information

Test Statistics[a]

	Client and consultants (client interference, approvals and disputes, decision making, competence) - Availability and quality of information
Z	-1.633[b]
Asymp. Sig. (2-tailed)	.103

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Availabilityandqualityofinformation WITH
    Financialstabilitystabilityofcountryinflationcostofcapitalfinanc (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Financial stability (stability of country, inflation, cost of capital, financial crisis) - Availability and quality of information	Negative Ranks	33[a]	17.29	570.50
	Positive Ranks	1[b]	24.50	24.50
	Ties	3[c]		
	Total	37		

a. Financial stability (stability of country, inflation, cost of capital, financial crisis) < Availability and quality of information

b. Financial stability (stability of country, inflation, cost of capital, financial crisis) > Availability and quality of information

c. Financial stability (stability of country, inflation, cost of capital, financial crisis) = Availability and quality of information

Test Statistics[a]

	Financial stability (stability of country, inflation, cost of capital, financial crisis) - Availability and quality of information
Z	-4.725[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Availabilityandqualityofinformation WITH Permits (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Permits - Availability and quality of information	Negative Ranks	29[a]	17.16	497.50
	Positive Ranks	3[b]	10.17	30.50
	Ties	5[c]		
	Total	37		

a. Permits < Availability and quality of information

b. Permits > Availability and quality of information

c. Permits = Availability and quality of information

Test Statistics[a]

	Permits - Availability and quality of information
Z	-4.433[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Availabilityandqualityofinformation WITH Legislation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Legislation - Availability and quality of information	Negative Ranks	31[a]	17.61	546.00
	Positive Ranks	2[b]	7.50	15.00
	Ties	4[c]		
	Total	37		

a. Legislation < Availability and quality of information

b. Legislation > Availability and quality of information

c. Legislation = Availability and quality of information

Test Statistics[a]

	Legislation - Availability and quality of information
Z	-4.825[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Availabilityandqualityofinformation WITH Weather (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Weather - Availability and quality of information	Negative Ranks	32[a]	16.50	528.00
	Positive Ranks	0[b]	.00	.00
	Ties	5[c]		
	Total	37		

a. Weather < Availability and quality of information

b. Weather > Availability and quality of information

c. Weather = Availability and quality of information

Test Statistics[a]

	Weather - Availability and quality of information
Z	-4.985[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Coordinationandcollaboration WITH Toolsandprograms (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Tools and programs - Coordination and collaboration	Negative Ranks	25[a]	14.44	361.00
	Positive Ranks	3[b]	15.00	45.00
	Ties	9[c]		
	Total	37		

a. Tools and programs < Coordination and collaboration

b. Tools and programs > Coordination and collaboration

c. Tools and programs = Coordination and collaboration

Test Statistics[a]

	Tools and programs - Coordination and collaboration
Z	-3.708[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Coordinationandcollaboration WITH Technochanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Techno changes - Coordination and collaboration	Negative Ranks	28[a]	14.50	406.00
	Positive Ranks	1[b]	29.00	29.00
	Ties	8[c]		
	Total	37		

a. Techno changes < Coordination and collaboration

b. Techno changes > Coordination and collaboration

c. Techno changes = Coordination and collaboration

Test Statistics[a]

	Techno changes - Coordination and collaboration
Z	-4.172[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Coordinationandcollaboration WITH Designchanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Design changes - Coordination and collaboration	Negative Ranks	16[a]	11.38	182.00
	Positive Ranks	5[b]	9.80	49.00
	Ties	16[c]		
	Total	37		

a. Design changes < Coordination and collaboration

b. Design changes > Coordination and collaboration

c. Design changes = Coordination and collaboration

Test Statistics[a]

	Design changes - Coordination and collaboration
Z	-2.384[b]
Asymp. Sig. (2-tailed)	.017

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Coordinationandcollaboration WITH Incompleteorunclearspecificationofthewor
k (PAIRED)
```

```
/MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Incomplete or unclear specification of the work - Coordination and collaboration	Negative Ranks	10[a]	9.05	90.50
	Positive Ranks	7[b]	8.93	62.50
	Ties	20[c]		
	Total	37		

a. Incomplete or unclear specification of the work < Coordination and collaboration

b. Incomplete or unclear specification of the work > Coordination and collaboration

c. Incomplete or unclear specification of the work = Coordination and collaboration

Test Statistics[a]

	Incomplete or unclear specification of the work - Coordination and collaboration
Z	-.691[b]
Asymp. Sig. (2-tailed)	.489

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Coordinationandcollaboration WITH
    Clientandconsultantsclientinterferenceapprovalsanddisputesdecisi (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Client and consultants (client interference, approvals and disputes, decision making, competence) - Coordination and collaboration	Negative Ranks	14[a]	9.32	130.50
	Positive Ranks	4[b]	10.13	40.50
	Ties	19[c]		
	Total	37		

a. Client and consultants (client interference, approvals and disputes, decision making, competence) < Coordination and collaboration

b. Client and consultants (client interference, approvals and disputes, decision making, competence) > Coordination and collaboration

c. Client and consultants (client interference, approvals and disputes, decision making, competence) = Coordination and collaboration

Test Statistics[a]

	Client and consultants (client interference, approvals and disputes, decision making, competence) - Coordination and collaboration
Z	-2.076[b]
Asymp. Sig. (2-tailed)	.038

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Coordinationandcollaboration WITH
    Financialstabilitystabilityofcountryinflationcostofcapitalfinanc (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Financial stability (stability of country, inflation, cost of capital, financial crisis) - Coordination and collaboration	Negative Ranks	34[a]	18.46	627.50
	Positive Ranks	2[b]	19.25	38.50
	Ties	1[c]		
	Total	37		

a. Financial stability (stability of country, inflation, cost of capital, financial crisis) < Coordination and collaboration

b. Financial stability (stability of country, inflation, cost of capital, financial crisis) > Coordination and collaboration

c. Financial stability (stability of country, inflation, cost of capital, financial crisis) = Coordination and collaboration

Test Statistics[a]

	Financial stability (stability of country, inflation, cost of capital, financial crisis) - Coordination and collaboration
Z	-4.673[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Coordinationandcollaboration WITH Permits (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Permits - Coordination and collaboration	Negative Ranks	32[a]	18.22	583.00
	Positive Ranks	3[b]	15.67	47.00
	Ties	2[c]		
	Total	37		

a. Permits < Coordination and collaboration

b. Permits > Coordination and collaboration

c. Permits = Coordination and collaboration

Test Statistics[a]

	Permits - Coordination and collaboration
Z	-4.464[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Coordinationandcollaboration WITH Legislation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Legislation - Coordination and collaboration	Negative Ranks	31[a]	16.44	509.50
	Positive Ranks	1[b]	18.50	18.50
	Ties	5[c]		
	Total	37		

a. Legislation < Coordination and collaboration

b. Legislation > Coordination and collaboration

c. Legislation = Coordination and collaboration

Test Statistics[a]

	Legislation - Coordination and collaboration
Z	-4.666[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Coordinationandcollaboration WITH Weather (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Weather - Coordination and collaboration	Negative Ranks	32[a]	18.38	588.00
	Positive Ranks	3[b]	14.00	42.00
	Ties	2[c]		
	Total	37		

a. Weather < Coordination and collaboration

b. Weather > Coordination and collaboration

c. Weather = Coordination and collaboration

Test Statistics[a]

	Weather - Coordination and collaboration
Z	-4.526[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Toolsandprograms WITH Technochanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Techno changes - Tools and programs	Negative Ranks	16[a]	11.31	181.00
	Positive Ranks	5[b]	10.00	50.00
	Ties	16[c]		
	Total	37		

a. Techno changes < Tools and programs

b. Techno changes > Tools and programs

c. Techno changes = Tools and programs

Test Statistics[a]

	Techno changes - Tools and programs
Z	-2.502[b]
Asymp. Sig. (2-tailed)	.012

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Toolsandprograms WITH Designchanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Design changes - Tools and programs	Negative Ranks	5[a]	12.90	64.50
	Positive Ranks	17[b]	11.09	188.50
	Ties	15[c]		
	Total	37		

a. Design changes < Tools and programs

b. Design changes > Tools and programs

c. Design changes = Tools and programs

Test Statistics[a]

	Design changes - Tools and programs
Z	-2.115[b]
Asymp. Sig. (2-tailed)	.034

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Toolsandprograms WITH Incompleteorunclearspecificationofthework (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Incomplete or unclear specification of the work - Tools and programs	Negative Ranks	5[a]	13.20	66.00
	Positive Ranks	23[b]	14.78	340.00
	Ties	9[c]		
	Total	37		

a. Incomplete or unclear specification of the work < Tools and programs

b. Incomplete or unclear specification of the work > Tools and programs

c. Incomplete or unclear specification of the work = Tools and programs

Test Statistics[a]

	Incomplete or unclear specification of the work - Tools and programs
Z	-3.236[b]
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Toolsandprograms WITH Clientandconsultantsclientinterferenceapprovalsanddi
sputesdecisi
```

```
    (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Client and consultants (client interference, approvals and disputes, decision making, competence) - Tools and programs	Negative Ranks	4[a]	11.38	45.50
	Positive Ranks	19[b]	12.13	230.50
	Ties	14[c]		
	Total	37		

a. Client and consultants (client interference, approvals and disputes, decision making, competence) < Tools and programs

b. Client and consultants (client interference, approvals and disputes, decision making, competence) > Tools and programs

c. Client and consultants (client interference, approvals and disputes, decision making, competence) = Tools and programs

Test Statistics[a]

	Client and consultants (client interference, approvals and disputes, decision making, competence) - Tools and programs
Z	-2.941[b]
Asymp. Sig. (2-tailed)	.003

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Toolsandprograms WITH Financialstabilitystabilityofcountryinflationcostofc
apitalfinanc
    (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Financial stability (stability of country, inflation, cost of capital, financial crisis) - Tools and programs	Negative Ranks	27[a]	14.00	378.00
	Positive Ranks	0[b]	.00	.00
	Ties	10[c]		
	Total	37		

a. Financial stability (stability of country, inflation, cost of capital, financial crisis) < Tools and programs

b. Financial stability (stability of country, inflation, cost of capital, financial crisis) > Tools and programs

c. Financial stability (stability of country, inflation, cost of capital, financial crisis) = Tools and programs

Test Statistics[a]

	Financial stability (stability of country, inflation, cost of capital, financial crisis) - Tools and programs
Z	-4.640[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Toolsandprograms WITH Permits (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Permits - Tools and programs	Negative Ranks	19[a]	12.95	246.00
	Positive Ranks	4[b]	7.50	30.00
	Ties	14[c]		
	Total	37		

a. Permits < Tools and programs

b. Permits > Tools and programs

c. Permits = Tools and programs

Test Statistics[a]

	Permits - Tools and programs
Z	-3.392[b]
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Toolsandprograms WITH Legislation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Legislation - Tools and programs	Negative Ranks	20[a]	11.45	229.00
	Positive Ranks	2[b]	12.00	24.00
	Ties	15[c]		
	Total	37		

a. Legislation < Tools and programs

b. Legislation > Tools and programs

c. Legislation = Tools and programs

Test Statistics[a]

	Legislation - Tools and programs
Z	-3.431[b]
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Toolsandprograms WITH Weather (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Weather - Tools and programs	Negative Ranks	30[a]	15.90	477.00
	Positive Ranks	1[b]	19.00	19.00
	Ties	6[c]		
	Total	37		

a. Weather < Tools and programs

b. Weather > Tools and programs

c. Weather = Tools and programs

Test Statistics[a]

	Weather - Tools and programs
Z	-4.562[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Technochanges WITH Designchanges (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Design changes - Techno changes	Negative Ranks	2[a]	6.00	12.00
	Positive Ranks	19[b]	11.53	219.00
	Ties	16[c]		
	Total	37		

a. Design changes < Techno changes

b. Design changes > Techno changes

c. Design changes = Techno changes

Test Statistics[a]

	Design changes - Techno changes
Z	-3.707[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Technochanges WITH Incompleteorunclearspecificationofthework (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Incomplete or unclear specification of the work - Techno changes	Negative Ranks	2[a]	15.00	30.00
	Positive Ranks	27[b]	15.00	405.00
	Ties	8[c]		
	Total	37		

a. Incomplete or unclear specification of the work < Techno changes

b. Incomplete or unclear specification of the work > Techno changes

c. Incomplete or unclear specification of the work = Techno changes

Test Statistics[a]

	Incomplete or unclear specification of the work - Techno changes
Z	-4.168[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Technochanges WITH Clientandconsultantsclientinterferenceapprovalsanddispu
tesdecisi
    (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Client and consultants (client interference, approvals and disputes, decision making, competence) - Techno changes	Negative Ranks	3[a]	13.00	39.00
	Positive Ranks	25[b]	14.68	367.00
	Ties	9[c]		
	Total	37		

a. Client and consultants (client interference, approvals and disputes, decision making, competence) < Techno changes

b. Client and consultants (client interference, approvals and disputes, decision making, competence) > Techno changes

c. Client and consultants (client interference, approvals and disputes, decision making, competence) = Techno changes

Test Statistics[a]

	Client and consultants (client interference, approvals and disputes, decision making, competence) - Techno changes
Z	-3.848[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Technochanges WITH Financialstabilitystabilityofcountryinflationcostofcapi
talfinanc
    (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Financial stability (stability of country, inflation, cost of capital, financial crisis) - Techno changes	Negative Ranks	22[a]	13.82	304.00
	Positive Ranks	3[b]	7.00	21.00
	Ties	12[c]		
	Total	37		

a. Financial stability (stability of country, inflation, cost of capital, financial crisis) < Techno changes

b. Financial stability (stability of country, inflation, cost of capital, financial crisis) > Techno changes

c. Financial stability (stability of country, inflation, cost of capital, financial crisis) = Techno changes

Test Statistics[a]

	Financial stability (stability of country, inflation, cost of capital, financial crisis) - Techno changes
Z	-3.925[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Technochanges WITH Permits (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Permits - Techno changes	Negative Ranks	18[a]	14.50	261.00
	Positive Ranks	9[b]	13.00	117.00
	Ties	10[c]		
	Total	37		

a. Permits < Techno changes

b. Permits > Techno changes

c. Permits = Techno changes

Test Statistics[a]

	Permits - Techno changes
Z	-1.812[b]
Asymp. Sig. (2-tailed)	.070

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Technochanges WITH Legislation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Legislation - Techno changes	Negative Ranks	16[a]	11.31	181.00
	Positive Ranks	6[b]	12.00	72.00
	Ties	15[c]		
	Total	37		

a. Legislation < Techno changes

b. Legislation > Techno changes

c. Legislation = Techno changes

Test Statistics[a]

	Legislation - Techno changes
Z	-1.857[b]
Asymp. Sig. (2-tailed)	.063

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Technochanges WITH Weather (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Weather - Techno changes	Negative Ranks	26[a]	14.60	379.50
	Positive Ranks	2[b]	13.25	26.50
	Ties	9[c]		
	Total	37		

a. Weather < Techno changes

b. Weather > Techno changes

c. Weather = Techno changes

Test Statistics[a]

	Weather - Techno changes
Z	-4.107[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Designchanges WITH Incompleteorunclearspecificationofthework (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Incomplete or unclear specification of the work - Design changes	Negative Ranks	5[a]	9.00	45.00
	Positive Ranks	14[b]	10.36	145.00
	Ties	18[c]		
	Total	37		

a. Incomplete or unclear specification of the work < Design changes

b. Incomplete or unclear specification of the work > Design changes

c. Incomplete or unclear specification of the work = Design changes

Test Statistics[a]

	Incomplete or unclear specification of the work - Design changes
Z	-2.202[b]
Asymp. Sig. (2-tailed)	.028

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Designchanges WITH Clientandconsultantsclientinterferenceapprovalsanddispu
tesdecisi
    (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Client and consultants (client interference, approvals and disputes, decision making, competence) - Design changes	Negative Ranks	10[a]	11.10	111.00
	Positive Ranks	13[b]	12.69	165.00
	Ties	14[c]		
	Total	37		

a. Client and consultants (client interference, approvals and disputes, decision making, competence) < Design changes

b. Client and consultants (client interference, approvals and disputes, decision making, competence) > Design changes

c. Client and consultants (client interference, approvals and disputes, decision making, competence) = Design changes

Test Statistics[a]

	Client and consultants (client interference, approvals and disputes, decision making, competence) - Design changes
Z	-.882[b]
Asymp. Sig. (2-tailed)	.378

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Designchanges WITH Financialstabilitystabilityofcountryinflationcostofcapi
talfinanc
    (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Financial stability (stability of country, inflation, cost of capital, financial crisis) - Design changes	Negative Ranks	29[a]	16.34	474.00
	Positive Ranks	2[b]	11.00	22.00
	Ties	6[c]		
	Total	37		

a. Financial stability (stability of country, inflation, cost of capital, financial crisis) < Design changes

b. Financial stability (stability of country, inflation, cost of capital, financial crisis) > Design changes

c. Financial stability (stability of country, inflation, cost of capital, financial crisis) = Design changes

Test Statistics[a]

	Financial stability (stability of country, inflation, cost of capital, financial crisis) - Design changes
Z	-4.482[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Designchanges WITH Permits (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Permits - Design changes	Negative Ranks	24[a]	13.23	317.50
	Positive Ranks	1[b]	7.50	7.50
	Ties	12[c]		
	Total	37		

a. Permits < Design changes

b. Permits > Design changes

c. Permits = Design changes

Test Statistics[a]

	Permits - Design changes
Z	-4.277[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Designchanges WITH Legislation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Legislation - Design changes	Negative Ranks	27[a]	14.70	397.00
	Positive Ranks	1[b]	9.00	9.00
	Ties	9[c]		
	Total	37		

a. Legislation < Design changes

b. Legislation > Design changes

c. Legislation = Design changes

Test Statistics[a]

	Legislation - Design changes
Z	-4.558[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Designchanges WITH Weather (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Weather - Design changes	Negative Ranks	31[a]	16.53	512.50
	Positive Ranks	1[b]	15.50	15.50
	Ties	5[c]		
	Total	37		

a. Weather < Design changes

b. Weather > Design changes

c. Weather = Design changes

Test Statistics[a]

	Weather - Design changes
Z	-4.689[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Incompleteorunclearspecificationofthework WITH
    Clientandconsultantsclientinterferenceapprovalsanddisputesdecisi (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Client and consultants (client interference, approvals and disputes, decision making, competence) - Incomplete or unclear specification of the work	Negative Ranks	13[a]	10.46	136.00
	Positive Ranks	7[b]	10.57	74.00
	Ties	17[c]		
	Total	37		

a. Client and consultants (client interference, approvals and disputes, decision making, competence) < Incomplete or unclear specification of the work

b. Client and consultants (client interference, approvals and disputes, decision making, competence) > Incomplete or unclear specification of the work

c. Client and consultants (client interference, approvals and disputes, decision making, competence) = Incomplete or unclear specification of the work

Test Statistics[a]

	Client and consultants (client interference, approvals and disputes, decision making, competence) - Incomplete or unclear specification of the work
Z	-1.250[b]
Asymp. Sig. (2-tailed)	.211

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Incompleteorunclearspecificationofthework WITH
    Financialstabilitystabilityofcountryinflationcostofcapitalfinanc (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Financial stability (stability of country, inflation, cost of capital, financial crisis) - Incomplete or unclear specification of the work	Negative Ranks	31[a]	18.08	560.50
	Positive Ranks	3[b]	11.50	34.50
	Ties	3[c]		
	Total	37		

a. Financial stability (stability of country, inflation, cost of capital, financial crisis) < Incomplete or unclear specification of the work

b. Financial stability (stability of country, inflation, cost of capital, financial crisis) > Incomplete or unclear specification of the work

c. Financial stability (stability of country, inflation, cost of capital, financial crisis) = Incomplete or unclear specification of the work

Test Statistics[a]

	Financial stability (stability of country, inflation, cost of capital, financial crisis) - Incomplete or unclear specification of the work
Z	-4.535[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Incompleteorunclearspecificationofthework WITH Permits (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Permits - Incomplete or unclear specification of the work	Negative Ranks	28[a]	16.66	466.50
	Positive Ranks	3[b]	9.83	29.50
	Ties	6[c]		
	Total	37		

a. Permits < Incomplete or unclear specification of the work

b. Permits > Incomplete or unclear specification of the work

c. Permits = Incomplete or unclear specification of the work

Test Statistics[a]

	Permits - Incomplete or unclear specification of the work
Z	-4.372[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Incompleteorunclearspecificationofthework WITH Legislation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Legislation - Incomplete or unclear specification of the work	Negative Ranks	31[a]	17.55	544.00
	Positive Ranks	2[b]	8.50	17.00
	Ties	4[c]		
	Total	37		

a. Legislation < Incomplete or unclear specification of the work

b. Legislation > Incomplete or unclear specification of the work

c. Legislation = Incomplete or unclear specification of the work

Test Statistics[a]

	Legislation - Incomplete or unclear specification of the work
Z	-4.810[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Incompleteorunclearspecificationofthework WITH Weather (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Weather - Incomplete or unclear specification of the work	Negative Ranks	31[a]	18.58	576.00
	Positive Ranks	3[b]	6.33	19.00
	Ties	3[c]		
	Total	37		

a. Weather < Incomplete or unclear specification of the work

b. Weather > Incomplete or unclear specification of the work

c. Weather = Incomplete or unclear specification of the work

Test Statistics[a]

	Weather - Incomplete or unclear specification of the work
Z	-4.803[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Clientandconsultantsclientinterferenceapprovalsanddisputesdecisi WITH
    Financialstabilitystabilityofcountryinflationcostofcapitalfinanc (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Financial stability (stability of country, inflation, cost of capital, financial crisis) - Client and consultants (client interference, approvals and disputes, decision making, competence)	Negative Ranks	29[a]	15.86	460.00
	Positive Ranks	1[b]	5.00	5.00
	Ties	7[c]		
	Total	37		

a. Financial stability (stability of country, inflation, cost of capital, financial crisis) < Client and consultants (client interference, approvals and disputes, decision making, competence)

b. Financial stability (stability of country, inflation, cost of capital, financial crisis) > Client and consultants (client interference, approvals and disputes, decision making, competence)

c. Financial stability (stability of country, inflation, cost of capital, financial crisis) = Client and consultants (client interference, approvals and disputes, decision making, competence)

Test Statistics[a]

	Financial stability (stability of country, inflation, cost of capital, financial crisis) - Client and consultants (client interference, approvals and disputes, decision making, competence)
Z	-4.725[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Clientandconsultantsclientinterferenceapprovalsanddisputesdecisi WITH Perm
its (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Permits - Client and consultants (client interference, approvals and disputes, decision making, competence)	Negative Ranks	26[a]	15.12	393.00
	Positive Ranks	2[b]	6.50	13.00
	Ties	9[c]		
	Total	37		

a. Permits < Client and consultants (client interference, approvals and disputes, decision making, competence)

b. Permits > Client and consultants (client interference, approvals and disputes, decision making, competence)

c. Permits = Client and consultants (client interference, approvals and disputes, decision making, competence)

Test Statistics[a]

	Permits - Client and consultants (client interference, approvals and disputes, decision making, competence)
Z	-4.401[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Clientandconsultantsclientinterferenceapprovalsanddisputesdecisi WITH Legi
slation
    (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Legislation - Client and consultants (client interference, approvals and disputes, decision making, competence)	Negative Ranks	27[a]	15.63	422.00
	Positive Ranks	2[b]	6.50	13.00
	Ties	8[c]		
	Total	37		

a. Legislation < Client and consultants (client interference, approvals and disputes, decision making, competence)

b. Legislation > Client and consultants (client interference, approvals and disputes, decision making, competence)

c. Legislation = Client and consultants (client interference, approvals and disputes, decision making, competence)

Test Statistics[a]

	Legislation - Client and consultants (client interference, approvals and disputes, decision making, competence)
Z	-4.510[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Clientandconsultantsclientinterferenceapprovalsanddisputesdecisi WITH Weat
her (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Weather - Client and consultants (client interference, approvals and disputes, decision making, competence)	Negative Ranks	30[a]	15.58	467.50
	Positive Ranks	1[b]	28.50	28.50
	Ties	6[c]		
	Total	37		

a. Weather < Client and consultants (client interference, approvals and disputes, decision making, competence)

b. Weather > Client and consultants (client interference, approvals and disputes, decision making, competence)

c. Weather = Client and consultants (client interference, approvals and disputes, decision making, competence)

Test Statistics[a]

	Weather - Client and consultants (client interference, approvals and disputes, decision making, competence)
Z	-4.353[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Financialstabilitystabilityofcountryinflationcostofcapitalfinanc WITH Perm
its (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Permits - Financial stability (stability of country, inflation, cost of capital, financial crisis)	Negative Ranks	6[a]	10.92	65.50
	Positive Ranks	18[b]	13.03	234.50
	Ties	13[c]		
	Total	37		

a. Permits < Financial stability (stability of country, inflation, cost of capital, financial crisis)

b. Permits > Financial stability (stability of country, inflation, cost of capital, financial crisis)

c. Permits = Financial stability (stability of country, inflation, cost of capital, financial crisis)

Test Statistics[a]

	Permits - Financial stability (stability of country, inflation, cost of capital, financial crisis)
Z	-2.526[b]
Asymp. Sig. (2-tailed)	.012

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Financialstabilitystabilityofcountryinflationcostofcapitalfinanc WITH Legi
slation
    (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Legislation - Financial stability (stability of country, inflation, cost of capital, financial crisis)	Negative Ranks	7[a]	11.43	80.00
	Positive Ranks	17[b]	12.94	220.00
	Ties	13[c]		
	Total	37		

a. Legislation < Financial stability (stability of country, inflation, cost of capital, financial crisis)

b. Legislation > Financial stability (stability of country, inflation, cost of capital, financial crisis)

c. Legislation = Financial stability (stability of country, inflation, cost of capital, financial crisis)

Test Statistics[a]

	Legislation - Financial stability (stability of country, inflation, cost of capital, financial crisis)
Z	-2.054[b]
Asymp. Sig. (2-tailed)	.040

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Financialstabilitystabilityofcountryinflationcostofcapitalfinanc WITH Weat
her (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Weather - Financial stability (stability of country, inflation, cost of capital, financial crisis)	Negative Ranks	13[a]	8.69	113.00
	Positive Ranks	5[b]	11.60	58.00
	Ties	19[c]		
	Total	37		

a. Weather < Financial stability (stability of country, inflation, cost of capital, financial crisis)

b. Weather > Financial stability (stability of country, inflation, cost of capital, financial crisis)

c. Weather = Financial stability (stability of country, inflation, cost of capital, financial crisis)

Test Statistics[a]

	Weather - Financial stability (stability of country, inflation, cost of capital, financial crisis)
Z	-1.242[b]
Asymp. Sig. (2-tailed)	.214

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Permits WITH Legislation (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Legislation - Permits	Negative Ranks	10[a]	9.40	94.00
	Positive Ranks	9[b]	10.67	96.00
	Ties	18[c]		
	Total	37		

a. Legislation < Permits

b. Legislation > Permits

c. Legislation = Permits

Test Statistics[a]

	Legislation - Permits
Z	-.042[b]
Asymp. Sig. (2-tailed)	.966

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
NPAR TESTS
  /WILCOXON=Permits WITH Weather (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Weather - Permits	Negative Ranks	19[a]	10.82	205.50
	Positive Ranks	2[b]	12.75	25.50
	Ties	16[c]		
	Total	37		

a. Weather < Permits

b. Weather > Permits

c. Weather = Permits

Test Statistics[a]

	Weather - Permits
Z	-3.198[b]
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /WILCOXON=Legislation WITH Weather (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Weather - Legislation	Negative Ranks	21[a]	12.86	270.00
	Positive Ranks	4[b]	13.75	55.00
	Ties	12[c]		
	Total	37		

a. Weather < Legislation

b. Weather > Legislation

c. Weather = Legislation

Test Statistics[a]

	Weather - Legislation
Z	-2.948[b]
Asymp. Sig. (2-tailed)	.003

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

13.6 Appendix F - Holm's correction

Pos.:	*Groups*		*Asymp. Sig (2-tailed) from Wilcoxon test*	*Rank*	*Holm's correction*	*Corrected Holm's α >= p-value*
26	Project location	Project complexity	0,000	1	0,050	Yes
29	Project location	Employee availability	0,000	2	0,025	Yes
30	Project location	Employee motivation	0,000	3	0,017	Yes
38	Project location	Coordination and collaboration	0,000	4	0,013	Yes
129	Employee skills	Weather	0,000	5	0,010	Yes
144	Employee availability	Financial stability	0,000	6	0,008	Yes
147	Employee availability	Weather	0,000	7	0,007	Yes
164	Employee motivation	Weather	0,000	8	0,006	Yes
231	Planning and sequencing	Financial stability	0,000	9	0,006	Yes
234	Planning and sequencing	Weather	0,000	10	0,005	Yes
242	Competency of project manager	Financial stability	0,000	11	0,005	Yes
254	Availability and quality of information	Legislation	0,000	12	0,004	Yes
36	Project location	Competency of project manager	0,000	13	0,004	Yes
37	Project location	Availability and quality of information	0,000	14	0,004	Yes
126	Employee skills	Financial stability	0,000	15	0,003	Yes
163	Employee motivation	Legislation	0,000	16	0,003	Yes
252	Availability and quality of information	Financial stability	0,000	17	0,003	Yes
289	Incomplete or unclear specification of the work	Legislation	0,000	18	0,003	Yes
290	Incomplete or unclear specification of the work	Weather	0,000	19	0,003	Yes
291	Client and consultants	Financial stability	0,000	20	0,003	Yes
28	Project location	Employee skills	0,000	21	0,002	Yes
43	Project location	Client and consultants	0,000	22	0,002	Yes
261	Coordination and collaboration	Financial stability	0,000	23	0,002	Yes
263	Coordination and collaboration	Legislation	0,000	24	0,002	Yes
269	Tools and programs	Financial stability	0,000	25	0,002	Yes
285	Design changes	Weather	0,000	26	0,002	Yes
90	Project complexity	Weather	0,000	27	0,002	Yes
162	Employee motivation	Permits	0,000	28	0,002	Yes
180	Employee experience	Weather	0,000	29	0,002	Yes
244	Competency of project manager	Legislation	0,000	30	0,002	Yes
272	Tools and programs	Weather	0,000	31	0,002	Yes
284	Design changes	Legislation	0,000	32	0,002	Yes
89	Project complexity	Legislation	0,000	33	0,002	Yes
232	Planning and sequencing	Permits	0,000	34	0,001	Yes
243	Competency of project manager	Permits	0,000	35	0,001	Yes
264	Coordination and collaboration	Weather	0,000	36	0,001	Yes
287	Incomplete or unclear specification of the work	Financial stability	0,000	37	0,001	Yes
293	Client and consultants	Legislation	0,000	38	0,001	Yes
42	Project location	Incomplete or unclear specification of the work	0,000	39	0,001	Yes
238	Competency of project manager	Techno changes	0,000	40	0,001	Yes
248	Availability and quality of information	Techno changes	0,000	41	0,001	Yes
282	Design changes	Financial stability	0,000	42	0,001	Yes
262	Coordination and collaboration	Permits	0,000	43	0,001	Yes
1	Project scope	Project location	0,000	44	0,001	Yes
87	Project complexity	Financial stability	0,000	45	0,001	Yes
253	Availability and quality of information	Permits	0,000	46	0,001	Yes
25	Project location	Project characteristics	0,000	47	0,001	Yes
292	Client and consultants	Permits	0,000	48	0,001	Yes
41	Project location	Design changes	0,000	49	0,001	Yes
288	Incomplete or unclear specification of the work	Permits	0,000	50	0,001	Yes
227	Planning and sequencing	Techno changes	0,000	51	0,001	Yes
294	Client and consultants	Weather	0,000	52	0,001	Yes
157	Employee motivation	Techno changes	0,000	53	0,001	Yes
34	Project location	Supervision	0,000	54	0,001	Yes
39	Project location	Tools and programs	0,000	55	0,001	Yes
110	Rework and delays	Weather	0,000	56	0,001	Yes
283	Design changes	Permits	0,000	57	0,001	Yes
128	Employee skills	Legislation	0,000	58	0,001	Yes
88	Project complexity	Permits	0,000	59	0,001	Yes
27	Project location	Rework and delays	0,000	60	0,001	Yes
257	Coordination and collaboration	Techno changes	0,000	61	0,001	Yes
24	Project scope	Weather	0,000	62	0,001	Yes
274	Techno changes	Incomplete or unclear specification of the work	0,000	63	0,001	Yes
31	Project location	Employee experience	0,000	64	0,001	Yes

69	Project characteristics	Weather	0,000	65	0,001	Yes
66	Project characteristics	Financial stability	0,000	66	0,001	Yes
177	Employee experience	Financial stability	0,000	67	0,001	Yes
222	Supervision	Weather	0,000	68	0,001	Yes
279	Techno changes	Weather	0,000	69	0,001	Yes
33	Project location	Labor fatigue	0,000	70	0,001	Yes
83	Project complexity	Techno changes	0,000	71	0,001	Yes
107	Rework and delays	Financial stability	0,000	72	0,001	Yes
195	Labor work facilities and satisfaction	Weather	0,000	73	0,001	Yes
21	Project scope	Financial stability	0,000	74	0,001	Yes
170	Employee experience	Availability and quality of information	0,000	75	0,001	Yes
32	Project location	Labor work facilities and satisfaction	0,000	76	0,001	Yes
192	Labor work facilities and satisfaction	Financial stability	0,000	77	0,001	Yes
206	Labor fatigue	Financial stability	0,000	78	0,001	Yes
185	Labor work facilities and satisfaction	Availability and quality of information	0,000	79	0,001	Yes
127	Employee skills	Permits	0,000	80	0,001	Yes
145	Employee availability	Permits	0,000	81	0,001	Yes
276	Techno changes	Financial stability	0,000	82	0,001	Yes
210	Supervision	Planning and sequencing	0,000	83	0,001	Yes
219	Supervision	Financial stability	0,000	84	0,001	Yes
197	Labor fatigue	Planning and sequencing	0,000	85	0,001	Yes
122	Employee skills	Techno changes	0,000	86	0,001	Yes
275	Techno changes	Client and consultants	0,000	87	0,001	Yes
74	Project complexity	Employee experience	0,000	88	0,001	Yes
209	Labor fatigue	Weather	0,000	89	0,001	Yes
109	Rework and delays	Legislation	0,000	90	0,001	Yes
68	Project characteristics	Legislation	0,000	91	0,001	Yes
213	Supervision	Coordination and collaboration	0,000	92	0,001	Yes
40	Project location	Techno changes	0,000	93	0,001	Yes
146	Employee availability	Legislation	0,000	94	0,001	Yes
200	Labor fatigue	Coordination and collaboration	0,000	95	0,001	Yes
183	Labor work facilities and satisfaction	Planning and sequencing	0,000	96	0,001	Yes
212	Supervision	Availability and quality of information	0,000	97	0,001	Yes
199	Labor fatigue	Availability and quality of information	0,000	98	0,001	Yes
256	Coordination and collaboration	Tools and programs	0,000	99	0,001	Yes
273	Techno changes	Design changes	0,000	100	0,001	Yes
140	Employee availability	Techno changes	0,000	101	0,000	Yes
48	Project characteristics	Project complexity	0,000	102	0,000	Yes
186	Labor work facilities and satisfaction	Coordination and collaboration	0,000	103	0,000	Yes
75	Project complexity	Labor work facilities and satisfaction	0,000	104	0,000	Yes
211	Supervision	Competency of project manager	0,000	105	0,000	Yes
168	Employee experience	Planning and sequencing	0,000	106	0,000	Yes
184	Labor work facilities and satisfaction	Competency of project manager	0,000	107	0,000	Yes
15	Project scope	Coordination and collaboration	0,000	108	0,000	Yes
226	Planning and sequencing	Tools and programs	0,000	109	0,000	Yes
76	Project complexity	Labor fatigue	0,000	110	0,000	Yes
198	Labor fatigue	Competency of project manager	0,000	111	0,000	Yes
108	Rework and delays	Permits	0,000	112	0,000	No
204	Labor fatigue	Incomplete or unclear specification of the work	0,000	113	0,000	No
190	Labor work facilities and satisfaction	Incomplete or unclear specification of the work	0,000	114	0,000	No
217	Supervision	Incomplete or unclear specification of the work	0,001	115	0,000	No
14	Project scope	Availability and quality of information	0,001	116	0,000	No
247	Availability and quality of information	Tools and programs	0,001	117	0,000	No
271	Tools and programs	Legislation	0,001	118	0,000	No
77	Project complexity	Supervision	0,001	119	0,000	No
60	Project characteristics	Coordination and collaboration	0,001	120	0,000	No
270	Tools and programs	Permits	0,001	121	0,000	No
67	Project characteristics	Permits	0,001	122	0,000	No
169	Employee experience	Competency of project manager	0,001	123	0,000	No
12	Project scope	Planning and sequencing	0,001	124	0,000	No
82	Project complexity	Tools and programs	0,001	125	0,000	No
149	Employee motivation	Labor work facilities and satisfaction	0,001	126	0,000	No
205	Labor fatigue	Client and consultants	0,001	127	0,000	No
156	Employee motivation	Tools and programs	0,001	128	0,000	No
57	Project characteristics	Planning and sequencing	0,001	129	0,000	No
171	Employee experience	Coordination and collaboration	0,001	130	0,000	No
267	Tools and programs	Incomplete or unclear specification of the work	0,001	131	0,000	No
176	Employee experience	Client and consultants	0,001	132	0,000	No
150	Employee motivation	Labor fatigue	0,001	133	0,000	No

175	Employee experience	Incomplete or unclear specification of the work	0,001	134	0,000	No
299	Permits	Weather	0,001	135	0,000	No
23	Project scope	Legislation	0,001	136	0,000	No
148	Employee motivation	Employee experience	0,001	137	0,000	No
191	Labor work facilities and satisfaction	Client and consultants	0,002	138	0,000	No
13	Project scope	Competency of project manager	0,002	139	0,000	No
19	Project scope	Incomplete or unclear specification of the work	0,002	140	0,000	No
151	Employee motivation	Supervision	0,002	141	0,000	No
103	Rework and delays	Techno changes	0,002	142	0,000	No
221	Supervision	Legislation	0,002	143	0,000	No
237	Competency of project manager	Tools and programs	0,002	144	0,000	No
3	Project scope	Project complexity	0,003	145	0,000	No
62	Project characteristics	Techno changes	0,003	146	0,000	No
300	Legislation	Weather	0,003	147	0,000	No
218	Supervision	Client and consultants	0,003	148	0,000	No
268	Tools and programs	Client and consultants	0,003	149	0,000	No
133	Employee availability	Labor fatigue	0,004	150	0,000	No
137	Employee availability	Availability and quality of information	0,004	151	0,000	No
22	Project scope	Permits	0,005	152	0,000	No
194	Labor work facilities and satisfaction	Legislation	0,005	153	0,000	No
116	Employee skills	Supervision	0,005	154	0,000	No
35	Project location	Planning and sequencing	0,005	155	0,000	No
245	Competency of project manager	Weather	0,006	156	0,000	No
255	Availability and quality of information	Weather	0,006	157	0,000	No
64	Project characteristics	Incomplete or unclear specification of the work	0,007	158	0,000	No
59	Project characteristics	Availability and quality of information	0,008	159	0,000	No
179	Employee experience	Legislation	0,008	160	0,000	No
233	Planning and sequencing	Legislation	0,008	161	0,000	No
20	Project scope	Client and consultants	0,009	162	0,000	No
96	Rework and delays	Labor fatigue	0,010	163	0,000	No
161	Employee motivation	Financial stability	0,010	164	0,000	No
203	Labor fatigue	Design changes	0,010	165	0,000	No
178	Employee experience	Permits	0,010	166	0,000	No
98	Rework and delays	Planning and sequencing	0,010	167	0,000	No
220	Supervision	Permits	0,011	168	0,000	No
295	Financial stability	Permits	0,012	169	0,000	No
100	Rework and delays	Availability and quality of information	0,012	170	0,000	No
72	Project complexity	Employee availability	0,012	171	0,000	No
265	Tools and programs	Techno changes	0,012	172	0,000	No
249	Availability and quality of information	Design changes	0,013	173	0,000	No
7	Project scope	Employee motivation	0,013	174	0,000	No
132	Employee availability	Labor work facilities and satisfaction	0,013	175	0,000	No
58	Project characteristics	Competency of project manager	0,013	176	0,000	No
138	Employee availability	Coordination and collaboration	0,013	177	0,000	No
193	Labor work facilities and satisfaction	Permits	0,014	178	0,000	No
207	Labor fatigue	Permits	0,014	179	0,000	No
113	Employee skills	Employee experience	0,015	180	0,000	No
121	Employee skills	Tools and programs	0,016	181	0,000	No
174	Employee experience	Design changes	0,016	182	0,000	No
135	Employee availability	Planning and sequencing	0,017	183	0,000	No
45	Project location	Permits	0,017	184	0,000	No
258	Coordination and collaboration	Design changes	0,017	185	0,000	No
114	Employee skills	Labor work facilities and satisfaction	0,018	186	0,000	No
115	Employee skills	Labor fatigue	0,018	187	0,000	No
84	Project complexity	Design changes	0,018	188	0,000	No
189	Labor work facilities and satisfaction	Design changes	0,018	189	0,000	No
228	Planning and sequencing	Design changes	0,019	190	0,000	No
46	Project location	Legislation	0,019	191	0,000	No
216	Supervision	Design changes	0,021	192	0,000	No
136	Employee availability	Competency of project manager	0,021	193	0,000	No
208	Labor fatigue	Legislation	0,023	194	0,000	No
95	Rework and delays	Labor work facilities and satisfaction	0,024	195	0,000	No
101	Rework and delays	Coordination and collaboration	0,025	196	0,000	No
97	Rework and delays	Supervision	0,026	197	0,000	No
105	Rework and delays	Incomplete or unclear specification of the work	0,027	198	0,000	No
280	Design changes	Incomplete or unclear specification of the work	0,028	199	0,000	No
131	Employee availability	Employee experience	0,029	200	0,000	No
120	Employee skills	Coordination and collaboration	0,031	201	0,000	No
119	Employee skills	Availability and quality of information	0,032	202	0,000	No

266	Tools and programs	Design changes	0,034	203	0,000	No
94	Rework and delays	Employee experience	0,036	204	0,000	No
155	Employee motivation	Coordination and collaboration	0,037	205	0,000	No
260	Coordination and collaboration	Client and consultants	0,038	206	0,000	No
5	Project scope	Employee skills	0,039	207	0,000	No
296	Financial stability	Legislation	0,040	208	0,000	No
142	Employee availability	Incomplete or unclear specification of the work	0,044	209	0,000	No
71	Project complexity	Employee skills	0,049	210	0,000	No
4	Project scope	Rework and delays	0,055	211	0,000	No
139	Employee availability	Tools and programs	0,058	212	0,000	No
17	Project scope	Techno changes	0,059	213	0,000	No
134	Employee availability	Supervision	0,060	214	0,000	No
278	Techno changes	Legislation	0,063	215	0,000	No
52	Project characteristics	Employee motivation	0,065	216	0,000	No
277	Techno changes	Permits	0,070	217	0,000	No
154	Employee motivation	Availability and quality of information	0,071	218	0,000	No
54	Project characteristics	Labor work facilities and satisfaction	0,074	219	0,000	No
173	Employee experience	Techno changes	0,074	220	0,000	No
152	Employee motivation	Planning and sequencing	0,074	221	0,000	No
18	Project scope	Design changes	0,076	222	0,000	No
55	Project characteristics	Labor fatigue	0,078	223	0,000	No
70	Project complexity	Rework and delays	0,078	224	0,000	No
215	Supervision	Techno changes	0,085	225	0,000	No
102	Rework and delays	Tools and programs	0,088	226	0,000	No
99	Rework and delays	Competency of project manager	0,088	227	0,000	No
6	Project scope	Employee availability	0,090	228	0,000	No
117	Employee skills	Planning and sequencing	0,091	229	0,000	No
65	Project characteristics	Client and consultants	0,096	230	0,000	No
56	Project characteristics	Supervision	0,097	231	0,000	No
239	Competency of project manager	Design changes	0,097	232	0,000	No
143	Employee availability	Client and consultants	0,099	233	0,000	No
73	Project complexity	Employee motivation	0,100	234	0,000	No
251	Availability and quality of information	Client and consultants	0,103	235	0,000	No
124	Employee skills	Incomplete or unclear specification of the work	0,130	236	0,000	No
53	Project characteristics	Employee experience	0,132	237	0,000	No
118	Employee skills	Competency of project manager	0,142	238	0,000	No
130	Employee availability	Employee motivation	0,146	239	0,000	No
61	Project characteristics	Tools and programs	0,151	240	0,000	No
50	Project characteristics	Employee skills	0,178	241	0,000	No
230	Planning and sequencing	Client and consultants	0,181	242	0,000	No
286	Incomplete or unclear specification of the work	Client and consultants	0,211	243	0,000	No
297	Financial stability	Weather	0,214	244	0,000	No
236	Competency of project manager	Coordination and collaboration	0,222	245	0,000	No
86	Project complexity	Client and consultants	0,250	246	0,000	No
158	Employee motivation	Design changes	0,251	247	0,000	No
235	Competency of project manager	Availability and quality of information	0,251	248	0,000	No
2	Project scope	Project characteristics	0,257	249	0,000	No
188	Labor work facilities and satisfaction	Techno changes	0,259	250	0,000	No
159	Employee motivation	Incomplete or unclear specification of the work	0,268	251	0,000	No
49	Project characteristics	Rework and delays	0,301	252	0,000	No
125	Employee skills	Client and consultants	0,310	253	0,000	No
202	Labor fatigue	Techno changes	0,314	254	0,000	No
153	Employee motivation	Competency of project manager	0,340	255	0,000	No
201	Labor fatigue	Tools and programs	0,370	256	0,000	No
63	Project characteristics	Design changes	0,375	257	0,000	No
281	Design changes	Client and consultants	0,378	258	0,000	No
106	Rework and delays	Client and consultants	0,391	259	0,000	No
10	Project scope	Labor fatigue	0,399	260	0,000	No
250	Availability and quality of information	Incomplete or unclear specification of the work	0,405	261	0,000	No
223	Planning and sequencing	Competency of project manager	0,419	262	0,000	No
111	Employee skills	Employee availability	0,433	263	0,000	No
93	Rework and delays	Employee motivation	0,438	264	0,000	No
259	Coordination and collaboration	Incomplete or unclear specification of the work	0,489	265	0,000	No
187	Labor work facilities and satisfaction	Tools and programs	0,498	266	0,000	No
241	Competency of project manager	Client and consultants	0,499	267	0,000	No
47	Project location	Weather	0,514	268	0,000	No
229	Planning and sequencing	Incomplete or unclear specification of the work	0,519	269	0,000	No
79	Project complexity	Competency of project manager	0,524	270	0,000	No
166	Employee experience	Labor fatigue	0,529	271	0,000	No

11	Project scope	Supervision	0,539	272	0,000	No
9	Project scope	Labor work facilities and satisfaction	0,569	273	0,000	No
181	Labor work facilities and satisfaction	Labor fatigue	0,592	274	0,000	No
112	Employee skills	Employee motivation	0,608	275	0,000	No
81	Project complexity	Coordination and collaboration	0,623	276	0,000	No
92	Rework and delays	Employee availability	0,638	277	0,000	No
44	Project location	Financial stability	0,638	278	0,000	No
165	Employee experience	Labor work facilities and satisfaction	0,642	279	0,000	No
225	Planning and sequencing	Coordination and collaboration	0,658	280	0,000	No
214	Supervision	Tools and programs	0,662	281	0,000	No
78	Project complexity	Planning and sequencing	0,697	282	0,000	No
141	Employee availability	Design changes	0,700	283	0,000	No
196	Labor fatigue	Supervision	0,700	284	0,000	No
172	Employee experience	Tools and programs	0,710	285	0,000	No
51	Project characteristics	Employee availability	0,711	286	0,000	No
85	Project complexity	Incomplete or unclear specification of the work	0,735	287	0,000	No
182	Labor work facilities and satisfaction	Supervision	0,760	288	0,000	No
8	Project scope	Employee experience	0,810	289	0,000	No
123	Employee skills	Design changes	0,822	290	0,000	No
224	Planning and sequencing	Availability and quality of information	0,825	291	0,000	No
80	Project complexity	Availability and quality of information	0,834	292	0,000	No
240	Competency of project manager	Incomplete or unclear specification of the work	0,843	293	0,000	No
246	Availability and quality of information	Coordination and collaboration	0,856	294	0,000	No
160	Employee motivation	Client and consultants	0,874	295	0,000	No
167	Employee experience	Supervision	0,885	296	0,000	No
91	Rework and delays	Employee skills	0,924	297	0,000	No
298	Permits	Legislation	0,966	298	0,000	No
16	Project scope	Tools and programs	0,967	299	0,000	No
104	Rework and delays	Design changes	1,000	300	0,000	No

***Samples* 300**

***Alpha value* 0,05**

factors ranked as mostly low impact from Friedman's test

mostly high impact from Friedman's test