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Establishment of Quality System Within Construction Site

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Master’s Thesis | Abstract

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Establishment of quality system within construction site

In this Thesis, the main idea of performed research was to provide an overall understanding of the organizing of quality system at the construction site and give practical hints of the establishment of quality organization within the site environment. The relevance of this issue lies in the fact that the current situation with quality in construction shows no sufficient attention to the organization of quality flow at the site is given from the head companies, that is why the quality of construction gets worse from year to year.

Several activities related to the establishment of QMS are described in the research. QMS in general is represented by two interlinked processes: quality assurance and quality control. The most useful methods to be used at the site are related to quality control, which is represented by a dedicated independent internal organization, using quality tools and elaborating resulting documents – quality outcomes. Examples of documents that represent the hierarchy of quality control system are developed and given in the study as practical assets ready to be implemented in the construction environment.

A significant part of the research is dedicated to nonconformity management and the development of tools for managing nonconformities inside the company in the most efficient way.

Keywords:

quality control, construction, site management, quality engineering

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Laatujärjestelmän käyttöönotto rakennustyömaalla

Nykyisen rakentamisen laatu osoittaa, että emoyhtiöt eivät kiinnitä riittävästi huomiota laatuvirran järjestämiseen työmaalla, minkä vuoksi rakentamisen laatu heikkenee vuosi vuodelta. Tässä opinnäytetyössä tarkastellaan rakennustyömaan vaatimia laatujärjestelmiä ja antaa käytännön vinkkejä laatuhallintajärjestelmän toteuttamiseen työmaaympäristössä.

Kehittämistehtävässä kuvataan useita laadunhallintajärjestelmän luomiseen liittyviä toimintoja. Laadunhallintaan kuuluu keskeisesti yleensä kaksi toisiinsa liittyvää prosessia: laadunvarmistus ja laadunvalvonta. Työmaan tarpeiden kannalta keskeisiä ovat laadunvalvontatoiminnot, joihin kuuluvat tarkastustoimintaa suorittava pätevä laadunvalvontahenkilöstö ja dokumenttienhallintajärjestelmä. Esimerkkejä asiakirjoista, jotka edustavat laadunvalvontajärjestelmän kohdeorganisaatiossa, on kehitetty ja esitetään tässä tutkimuksessa.

Merkittävä osa tästä työstä painottuu poikkeamien hallintaan ja uusien työkalujen kehittämiseen yrityksen sisäisten poikkeamien hallitsemiseksi mahdollisimman tehokkaasti.

Asiasanat:

laadunvalvonta, rakentaminen, työmaajohtaminen, laatusuunnittelu

Content

Appendices

Figures

Tables

List of abbreviations

5S	Sort, Set in Order, Shine, Standardize, Sustain
CA	Corrective Actions
CQCP	Contractor’s Quality Control Plan
EPCM	Engineering, Procurement and Construction Management
HSEQ	Health, Safety, Environment and Quality
IMS	Integrated Quality Management System
IQM	Integrated Quality Management
ISO	International Organization for Standardization
KPI	Key Performance Indicator
NCR	Nonconformity report
OHSAS	Occupational Health and Safety Assessment Series
PDCA	Plan, Do, Check, Act
TQC	Total Quality Control
TQM	Total Quality Management
QC	Quality Control
QCP	Quality Control Plan
QMP	Quality Management Plan
QMS	Quality Management System

1 Introduction

The construction industry is one of the most complex and demanding industries in the world, all aspects of construction are highly regulated because the outcomes of construction works are available for multiple users and the cost of mistake could be people's life. As an engineer with a civil engineering background and project site's experience, I would like to focus attention on quality issues on construction sites and develop an acting system that is aimed to assure and control a high level of quality in construction.

Since the thesis work is related to the commissioning company that has a variety of projects from multiple clients, the main focus of this thesis is the preparation of useful practical tools for quality management systems on already existing construction sites of international clients, working on the Finnish market mostly but also abroad.

The topic of the thesis is actual and relevant as soon as a minor quantity of thesis research for local companies was found and several works related to foreign companies working on foreign construction markets with its own regulations acting. Since the resources and possibilities available in Finland are becoming more and more beneficial for investors, the amount of investments rises continuously.

The research questions of this thesis are concentrated on the practical implementation of a quality management system and the development of tools that shall be used at sites on a daily basis, making the work of quality managers/engineers and supervisors easier and better maintained. The goal is to prepare templates and draft of documents for implementation on sites. These documents shall be unified for all company's projects and according to the management's vision, could be presented to the client companies as additional service to be sold by the commissioning company, which makes this work quite demanding in the practical view. The well-developed quality system model is a value-added service for the company in a whole, which is highlighted by its management. Additionally, some IT tools such as webpages, automated lists or applications could be created also aiming for the simplification of work. Most important needs and demands from construction sites will be investigated through interviews with construction top-management representatives and site inspections to be aware of practical possibilities of developed tools implementation. For the theoretical investigations of the topic, literature review is assumed as the most preferable method.

2 Overview of quality philosophy and history in construction

The word “quality” has no single correct definition. As soon as there are many interpretations of this term, almost all quality professionals understand it according to their own vision. It means many different things to many different people, as noted by Howarth and Watson (2011, p.2). “Whilst it can be recognized that definitions of quality are differing, they are not necessarily conflicting or contradictory. Rather, the diversity of definitions underlines the fact that quality is viewed in various ways. This diversity of views and definitions can be problematic though – it can result in confused understanding, articulation and application of the quality concept within public and private sector organizations” as per Howarth and Watson (2011, p.3).

The history of quality issues has a long story that started about 4000–5000 years ago during the New Stone Age. Strong construction quality control principles appear during the Pyramids construction in Ancient Egypt. Then in the Mesopotamian era (approximately 1792–1750 BC) the King of Babylonia codified the law that builders were responsible for maintaining the quality of buildings and were given the death penalty (sentenced to death) if any of their constructed buildings collapsed and its occupants were killed, as per Rumane, (2013, p.1).

In the Middle Ages, specific professional associations – guilds were responsible for the production of all kinds of goods and some services, therefore management of quality issues and responsibility for the quality of the goods were on their side. Some feedback was also obtained from customers and product users. After the Industrial Revolution the approach to production principles changed completely in Europe. The main purpose of industrialization was to increase productivity and decrease production costs. Individual production of small amounts of items by the force of skillful craftsmen – representatives of guilds, was replaced by plant’s-oriented production. Work processes at plants were divided into several specified operations which were performed by dedicated groups of people and supervisors in such a way that within one group all people performed similar tasks. In such a system quality questions have become a priority. Terms such as quality inspection and audits become widely known during at this stage of quality system development.

During World War I, the manufacturing process became more complex, as noted by Rumane (2013, p. 2), and production quality became the responsibility of dedicated subdivisions of plants – quality control departments. The reason for such a department's formation was the willingness of the responsible supervisors to produce more and get more salary respectively, but as widely known, where productivity is being chased, there is no place for quality. A bright representative of quality control development is Walter Shewart, whose main idea was that quality is not equal to the final product, but to the process of its manufacturing. Considered the “father” of statistical quality control, Shewart identified two categories of variation that he called “assignable-cause” and “chance-cause” variation. Others call the two categories “special-cause” and “common-cause” variation, respectively. He devised the control chart as a tool for distinguishing between the two (Best & Neuhauser, 2006)

Another important person in the quality sphere is William Edwards Deming, a well-known US mathematician and statistician, who contributed a lot for quality management. He started in the agricultural sector and significantly improved productivity in all production aspects, at the peak point of his career he was awarded the right to give lectures on mathematical statistics in Japan, where he also didn’t interrupt his scientific investigations in quality management. Deming is considered the inventor of PDCA (The Plan, Do, Check, Act) Cycle – a methodology for problem solving and improvement, several managerial methodic and change management principle’s development. He places a quality focus upon causes of variation and variability in an organization's manufacturing process. (Howarth & Watson, 2011, p. 9)

As noted by Rumane (2013, p. 3) the concept and techniques of modern quality control evolved into quality control were introduced in Japan immediately after

World War II. The statistical and mathematical techniques, sampling tables, and process control charts emerged during this period.

Japan became the citadel of quality and valuable production successes even today when people think about products manufactured in this country, only good synonyms coming to their mind. Currently the reputation works to the products as soon as the highest level of acting quality standards, and willingness to improve the production process makes it more effective from day to day. The goods and services from Japan in a variety of disciplines from construction to the automotive industry meet customers' demands all over the world.

Total Quality Management (TQM) principles

The quality management approach has changed significantly in the 20th century, especially after World War II, showing to many people that past activities in the quality field are no longer relevant. Total Quality Control ideas were formulated and spread by Armand Feigenbaum, US quality philosopher, who is also known as a founder of today's General Electric corporation. His book *Quality Control: Principles, Practice, and Administration,* published in its first edition in 1951, was re-edited many times and published further in a variety of languages. Feigenbaum is recognized as an innovator in the area of quality cost management. His was the first text to characterize quality costs as the costs of prevention, appraisal, and internal and external failure, as noted by the American Society for Quality of which he is an honorable member (*A.V. Feigenbaum. Laying the foundation of modern quality control*). The main principles of TQC represent an actual view to the understanding of quality and current organizational relationships between quality representatives and the company's management within the organization, as noted by Feigenbaum Foundation (2019):

- Quality is the customer's perception of what quality is, not what a company thinks it is.
- Quality and cost are the same, not different.

- Quality is an individual and team commitment.
- Quality and innovation are interrelated and mutually beneficial.
- Managing Quality is managing the business.
- Quality is a principle.
- Quality is not a temporary or quick fix but a continuous process of improvement.
- Productivity gained by cost effective demonstrably beneficial Quality investment.
- Implement Quality by encompassing suppliers and customers in the system.

TQM involves all specialists within an organization and encourages them to increase customer's satisfaction, promotes quality contributions from managers and teaches them to continuously improve the quality in their field of business. With the implementation of the above-mentioned concepts in the company, the following goals are achieved:

- Achieving customers satisfaction
- Continuous improvement
- Developing teamwork
- Establishing a vision for the employees
- Setting standards and goals for the employees
- Building motivation within the organization
- Developing a corporate culture. (Rumane, 2013, p. 4)

During the twentieth century, TQM was the main quality approach for industries and companies who were eager to compete and win the best places in the market, without establishing a quality system it was not possible to gain new clients and provide competitive tools or services to the market. It is good to point out that TQM focuses on customer satisfaction and clients-oriented approach. But as noted by McGeorge and Zou, (2012, p.202) it is hard to know, who is a final customer for the construction industry. That is why separate groups of customers were established for the construction market:

- Internal customers who are customers of processes and are within the organisation (sales department)
- External customers who are customers of processes and are outside the organisation (subcontractors)
- End users who receive, and pay for, the final product (the client).

End of the TQM era arrived with the invention of the Integrated Quality Management system (IQM or IMS). Integrated Quality Management represents the merging of different management systems working as a unified one. It comprises quality management, safety management, environmental management, health and safety management and others narrow profile managements related to specific disciplines (for example food safety management, energy management, compliance management, etc.). For the management of such a complex system, usually quality management professionals or teams are hired, they oversee integrated management system implementation and enforcing all company members to follow its principles in daily activities. Currently all represented on the market companies have such integrated management systems if they want to successfully compete and conform to daily raising customer's demands. As noted by Rumane (2013, p.23), construction projects are unique and nonrepetitive in nature and have their own quality requirements, which can be developed by the integration of project specifications and the organization's quality management system. Normally, quality management system manuals consist of procedures to develop a project quality control plan, taking into consideration contract specifications. This plan is called the Contractor's Quality Control Plan (CQCP). Certain projects specify that value engineering studies be undertaken during the construction phase. The contractor is required to include these studies while developing the CQCP. This plan can be termed an Integrated Quality Management System (IQMS) for construction projects. The contractor has to implement a quality system to ensure that the construction is carried out in accordance with the specification details.

As shown in Figure 1, requirements of QCP could be established in a contract or the author shall follow ISO requirements in defining of the necessary quality document to develop. Depending on the complexity of the project and customer’s demands, chapters related to Environment management and Health and Safety management could be added there. Environmental aspects are regulated by ISO 14000 and health and safety issues are governed by OHSAS 18000. Moreover, it is good to incorporate into overall QCP subcontractor’s procedures and referential documents to provide full applicability of quality system within the construction environment of the dedicated project.

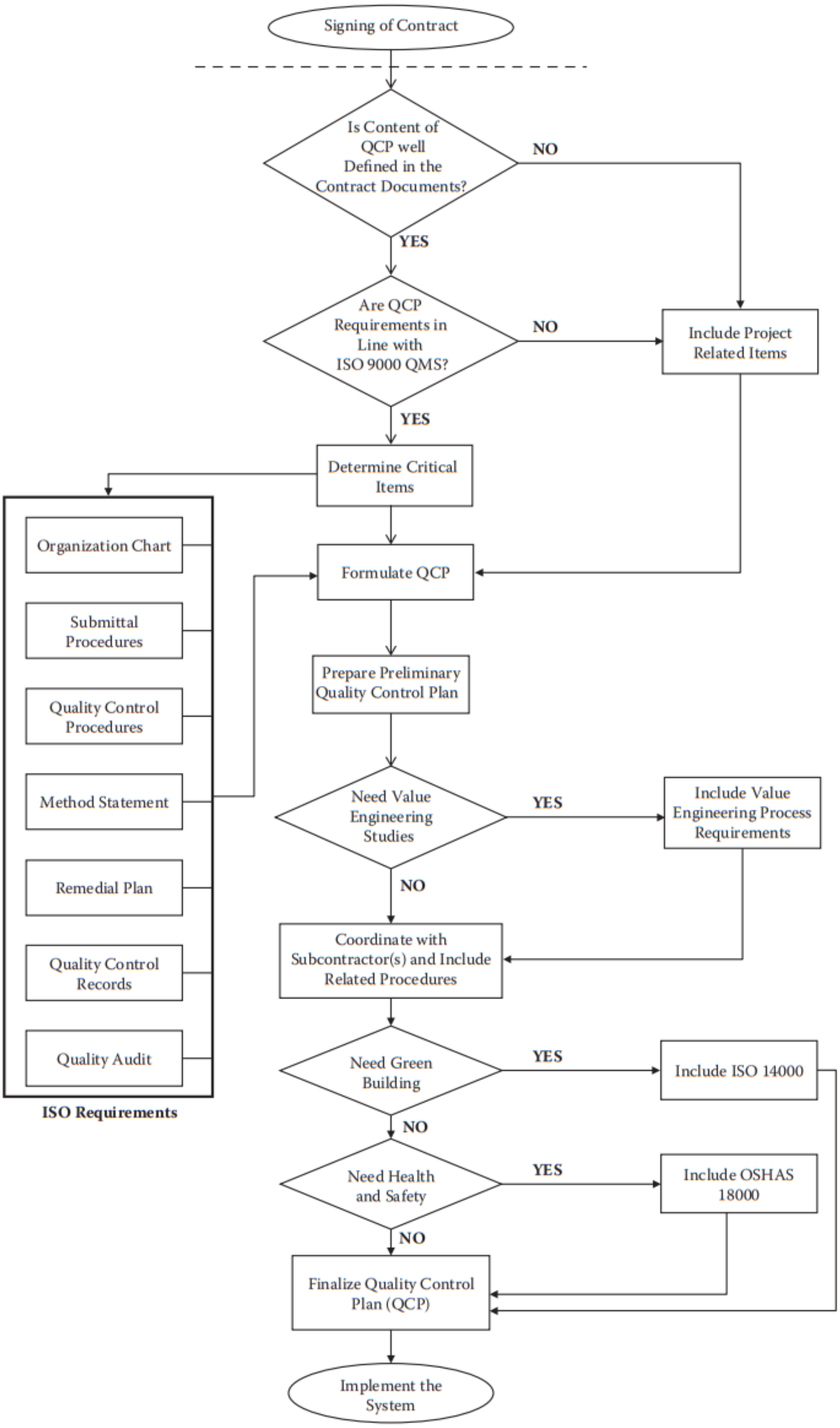

Figure 1 Logic flow diagram for development of IQMS. (Rumane, 2013, p. 24)

3 Quality processes in construction

The term “quality” has born in the industrial field initially and at the beginning was applicable only to manufacturing premises and goods that are produced on them. Only with the development of industry, quality issues began to spread to all sectors of the economy, including construction. But what are the differences in the application of quality to construction and how do people understand and measure quality in this field?

First of all, it is highly crucial to remind that when speaking about industrial manufacturing, usually speak about the production of similar types of products during almost indefinite period of time (until the technology is changed or there are no market demands of such product). Quality could be measured on each stage of the process, as soon as the specific operation is performed one by one with a detailed understanding of how the product looks like after each of such operation. The construction industry is different in that there are multiple stakeholders involved in each step of the manufacturing process. At the initial stage, the designer/consultant is involved, the product which is awaited is the architectural concept which shall be reviewed and approved by the client, later on detailed drawings are developed. At this stage drawing as a final result (including all supporting documents such as calculations, bills of quantities, charters, and explanatory schemes) is the product, which is requested by the client and construction department, quality of this product is measured according to applicable to design works quality metrics and standards. In some countries prior issuance for the construction design part of the future building shall pass independent expertise and receive a positive conclusion. At the next stage construction process begins, which means that drawings as a result of the design phase becomes available at the site and issued for production. Construction comprises different stakeholders such as subcontractors, laboratories, independent third parties providing control functions, the client itself and others. Construction quality check becomes necessary at the production stage and represents by control operations with in advance known control characteristics and metrics. These operations all together represent quality control at the site, which is a huge part of construction quality itself. The main distinction between construction and manufacturing in quality is that the product in construction is unique every time, there are no repetitive units. Even when the decision was taken that there will be the same building made by the previous project as a clone, initial settlement and calculations shall be done due to different soil conditions or another wind rose, which could affect significantly to the whole construction scheme at the end. The second important reason is the price of construction. By settling the price of manufacturing of one item in industrial production, it becomes obvious that the price of bad quality or spoilage is many times lower when compared to the construction quality mistake cost. That is why it is important to pay the highest attention to the controlled operations during routine quality checks at site and establish a working and efficient quality management system by means of quality assurance process.

3.1 Quality assurance

Quality management system in construction consists of two separate parts - quality control and quality assurance. Quality assurance itself provides managerial inputs on how the quality management acts within an organization, provides guidance of quality knowledge transfer by means of written procedures and instructions, and defines functional responsibilities between disciplines in the field of quality. Quality assurance helps to prevent quality deficiencies. As noted by Chung (1999, p. 7), it aims at minimizing the risk of making mistakes in the first place, thereby avoiding the necessity for rework, repair or reject.

Typically, quality assurance policies and procedures are valid for multiple projects and applicable for different construction sites. Such quality function arrangements provide succession inside the company and valuable benefits in quality management: no need to invent a quality system from the beginning every time, procedures are clear for all participants, responsibilities are defined. The establishment of a quality assurance system may be included in the demand of the tendering process which is obligatory for all tender participants. “The basis of competition for business will shift from ‘price only’ to a combination of price and quality. If a contractor does not want to be excluded from bidding for available work, he should wait no more in establishing a quality system in his organization. Even if such external pressure is not on now, he will be fighting a losing battle against his competitors who have enhanced their productivity through better quality management. Notable changes are more effective communication, both within the organization and with outside bodies, less disruption of work and reduced spending on rework. These improvements lead to higher productivity on the one hand and client satisfaction on the other.” (Chung, 1999, p. 8)

But quality assurance is not only a question of time, but it is also a money-wise operation, which requires significant financial resources from the company. As mentioned by Chung (1999, p. 8), it costs to implement and maintain a quality system. Significant investment in terms of money and staff time is needed en route to quality assurance, especially for document preparation and staff training. Some people see this as another item of overhead for the company. However, they should not lose sight of the savings that will accrue later with much reduced incidents of rework or reject. The overall quality related costs decrease rapidly as quality awareness among the staff increases.

One additional benefit from establishing a quality system is in its image and attractiveness in front of authorities and clients. A well-managed quality system is also a marketing tool, which provides the understanding to the clients that the company in question is reliable and able to cover its function efficiently. Moreover, with the presentation of quality assurance certificates issued by independent third-party agencies, the company ensures even more confidence to the client.

3.2 Quality control

Quality control is a second essential part of a total quality management system inside production and construction company. As it was noted in previous chapters, quality control appeared earlier than quality assurance, in medieval period it was more effective and natural to control over execution of products or structures step by step by checks and inspections than to establish a written system of quality assurance to control over quality requirements to be met. “In the building industry, it is traditional practice to have separate contracts for design and construction, with the designer also taking up the role of supervision of construction. The quality of the finished works is controlled by way of inspection and testing as construction proceeds… The major drawback of this ‘inspectorial system’ of quality control is that it identifies the mistakes after the event. Even high strength concrete can be defective if it is not properly compacted and cured, and the potential hazard of steel corrosion will not surface until some years later. Many building defects are covered up during subsequent construction and consequently the quality of the finished works cannot be assessed by final inspection. Unlike consumer goods, defective building work is very difficult, if not impossible, to replace. The client is often left with the patched-up original which will be a source of recurrent trouble and huge expenditure in the years to come.” (Chung, 1999, p. 5).

As noted by Ashford (1989, p. 132), in construction work, it is seldom possible to establish compliance with specification solely by examining the finished article. The final standards achieved are influenced by many intermediate factors such as the quality of the raw materials, the method of processing, the levels of discipline of the work force and so on, and each of these needs to be controlled if the final results are to be satisfactory.

Several types of control operations on construction site exist and followed by companies. Besides them surveillance, document control, sampling, inspection, measuring and testing. Adequate explanation of quality control operations will be given in further chapters.

4 Quality management in construction

Quality is important for all types of industries, related to the production of goods, but how and why quality management shall be established in the construction field, which is more complicated compared to the other spheres of production and produces unique production?

According to Ottosson (2012, p. 158), "study showed that defects in the finished product were due to the following causes:

- 50%: poor engagement
- 30%: lack of knowledge
- 15%: incorrect information
- 5%: other

The purpose of quality management is to

- Ensure that the client gets what is agreed.
- Ensure that consultants, suppliers, and contractors carry out their undertakings in such a way that the scope, schedule, and budget are met."

Typically, the quality management system in construction companies is implemented in two levels – company-wide level with the implementation of quality assurance and all document-related activities to achieve functional succession and compliance with ISO 9001 standard and project-specific system to assure practical implementation of quality control functions on the construction site and control over the building process. Due to the complexity of construction projects, the quality management functions can be implemented on different levels and quality manager can perform multiple roles, such as:

- The client's quality manager
- Project quality manager
- Consultants', suppliers', and contractors' project-specific managers
- Building, mechanical, electrical, and special inspectors

A client’s QM should control that the quality systems for different departments are effective and applied as intended. The QM of the client, consultants, contractors, and suppliers is a person who is responsible for the company’s overall quality management. A quality manager for the project should control that the quality assurance of the project is effective and applied as intended. The project-specific quality managers of the consultants and the contractors should ensure that the client’s quality requirements and their own companies’ quality work are carried out correctly in the project. (Ottosson, 2012, p. 159).

Specialists, responsible for specific construction areas such as electrical, automation, fire-technical, and I&C specialists may act as consultants assisting to QM in the field-specific control functions.

But the general responsibility of applying quality policies on the project lies on the Project Manager, more detailed description of his role is given in subchapter 7.1

4.1 Quality management structure

Overall understanding of the actual quality management system could be described as a hierarchical structure, showing the consecution of documents and phases of the quality process, presented in Figure 2:

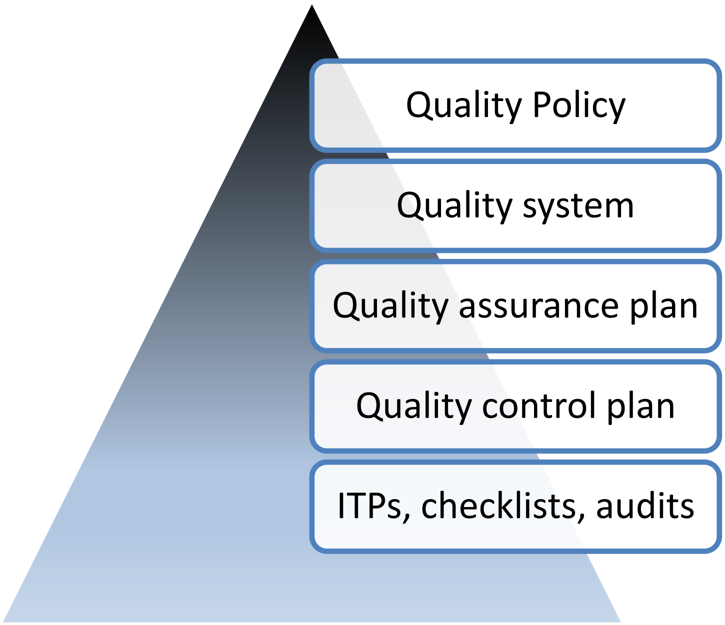

Figure 2 Hierarchical structure of quality management

The implementation of the quality management system to existing and well-functioning company with acting construction sites may lead to several constraints, such as:

1. Lack of willingness from management to deal with new sources of costs, as soon as quality is always requiring resources
2. Implementation problems – not possible to predict, how the process will be driven when the company is acting without a reliable quality system for a certain period
3. Lack of understanding of new implementation from personnel, when all systems are working as previously, but additional resources are needed for quality system implementation
4. Resistance to changes

To avoid or minimize at least the negative effects of quality system implementation, it is necessary to give a short overview of the functioning management system within the thesis commissioning organization.

The company in question is a global leader in design, consultancy and engineering within multiple sectors such as energy, process industries, infrastructure, etc. The implementation of the quality management system was planned for the Process Industries Division, Project and Constriction Management unit, which has a strong need for such functions allocation. The main occupation of the Construction and Project Management Department is providing construction coordination and supervision, hand-over of ready-made facilities, and warranty management. This department also acts as a consultant for construction projects.

Investigation of the current state of the quality management system inside the company shows the following outcomes:

1. Group level – ISO 9001:2015 certification, ISO 14001:2015 certification, ISO 45001:2018 certification (all obtained 20.01.2023, validity till 31.05.2023)
2. Company has a common (group level) Health, Safety, Environment and Quality Group Policy, implemented on 01.06.2022
3. Group level quality directive, which ensures implementation of health, safety, environment and quality Group Policy and its alignment with ISO standards 9001 Quality, 14001, Environment and 45001 Occupational Health and Safety.

It is important to note also that due to the global presence, the company has a multi-level type of organizational structure, which means that besides the division level, the country level exists and within the country’s branches, separate division levels are functioning. The complex responsibilities matrix is shown in Figure 3.

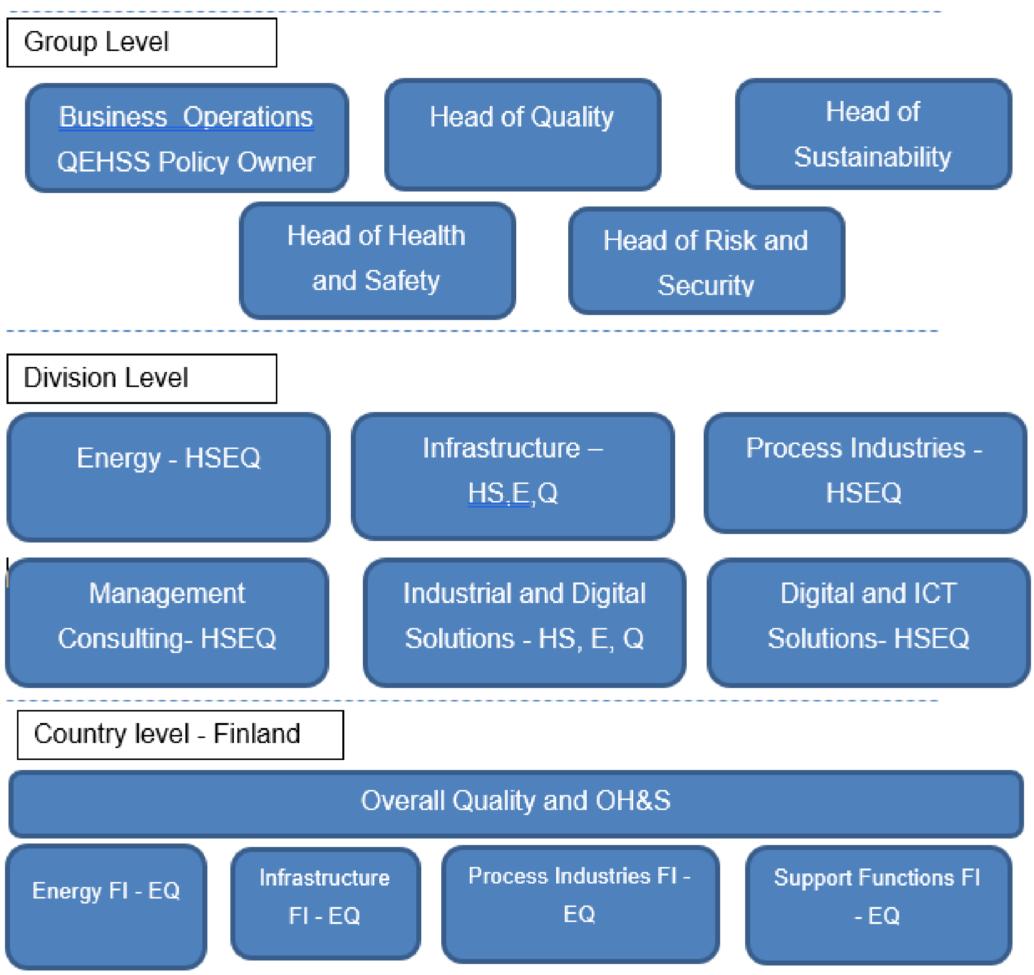

Figure 3. Responisibilities matrix of commissioning company in relation to HSEQ functions.

Due to the high importance of quality management, these functions were separated from the overall HSEQ responsibilities, mostly because quality issues on construction sites require specific engineering investigations and appropriate background to learn the root causes.

4.2 Implementation of ISO 9000 within the company

Standard ISO 9000 is known as an effective and reliable tool in the implementation of quality management systems within multiple industries. Due to the complexity and overall multiplicity of construction field, it is valuable when the quality approach “encompasses the functional fitness of the project, economy, project safety level and perfection of the project completed by the parties involved in the construction industry, while recognizing the fact that the construction industry is composed of groups from various disciplines with different services and products.” (Mastura & Abdul 2013, p. 88). It is obvious that incorporation of a quality management system with interrelation to ISO 9000 is much easier in manufacturing related environment in comparison to the construction industry and especially when an acting construction site is in the focus.

Implementation of ISO 9000 started to become almost obligatory to all construction companies which intend to compete in tenders, especially related to government-organized tenders. ISO 9000 certification shows compliance to common quality management principles and provides the evidence that company’s approach led to the achievement of common goals. Other possible benefits from ISO 9000 implements are as follows:

- Marketing contribution: It helps the company to compete in the world market, especially in European countries where ISO 9000 certification is mandatory. On the other hand, in the national market, by having ISO 9000 certification, it provides a competitive advantage as compared to companies without ISO 9000 certification.
- Improved quality of products: Enhanced efficiency of the organisation streamlining of its operation. A properly run system ensures the quality of products work right the first time.
- Modernisation of the company’s internal organisation and operation: Higher staff morale as ISO 9000 certification provides recognition and enhances the image of the organisation.
- Greater employee quality awareness: A well-developed quality system will enable top management to identify areas that need to be addressed as well as encourage staff to adhere to quality policy and quality objectives in the organisation.

- Better documentation: The ISO 9000 quality management system requires the organisation to document all the activities in their organisation. Therefore, it enhances the documentation of procedures in the organisation.
- Enhanced internal communication: enhanced internal communication. Better documentation of work activities ensures an enhanced internal communication.
- Systematic approach to personnel training: The ISO 9000 quality management system requires continuous training to educate employees on the importance of quality, while enhancing the efficiency of work activities.
- Competitive advantage: By being a certified company, it builds the clients' confidence as their quality management system requirements are met.
- Improved customer demand and easier attraction of new customers: The clients or customers are confident with ISO 9000 certified companies due to the ability of the organizations to implement and maintain a quality management system within their organization.
- Increase of the company's reputation and trust in its products: The implementation of the ISO 9000 quality management system portrays confidence to the clients and gives a positive reputation to the companies in terms of products and services offered. (Mastura & Abdul 2013, pp. 92–93).

Several empirical benefits of ISO 9000 implementation were revealed by Motwani and Kiernan (1998) in their research:

- Business with European countries.
- Recognition by the international community.
- Marketing edge.
- Improvement in quality.
- Productivity.

- Costs, reduction for the need of second party audits, by prospective customers and being listed in an internationally certified supplier directory.

It is also good to point out that self-promoted changes and willingness to implement ISO 9000 quality management system from the point of view of the organization’s internal development is more efficient in comparison to client’s requests driven factors, as studied by Lee et al. (1999).

5 The quality system of the organization

5.1 Organizational structure of quality department

Quality functions inside the organization could be spread between several departments if no dedicated department exists, laid on a specific department or person, acting like a quality manager – depending on size of the company and involvement of quality issues in daily work. For some companies, whose projects are highly demanded, separated quality assurance and quality control departments could be established. Commissioning company, due to the number of projects and taken specific niche on the industrial market, has its own quality managers and separate quality departments in each of the business fields and general quality management of the group level in the headquarter supporting in auditing and assuring the quality system workability in general. Matrix structure is typical to the commissioning company in a whole. In matrix structured companies the line managers for the various specialist areas are responsible for the employees' having the requisite skills. The responsibility for the technical solutions in each department is on the line manager unless the project manager has taken over— in writing (e.g., in the minutes of a meeting)— the responsibility for a certain design. (Ottosson, 2012, p. 11)

A typical construction site organizational structure is shown in Figure 4.

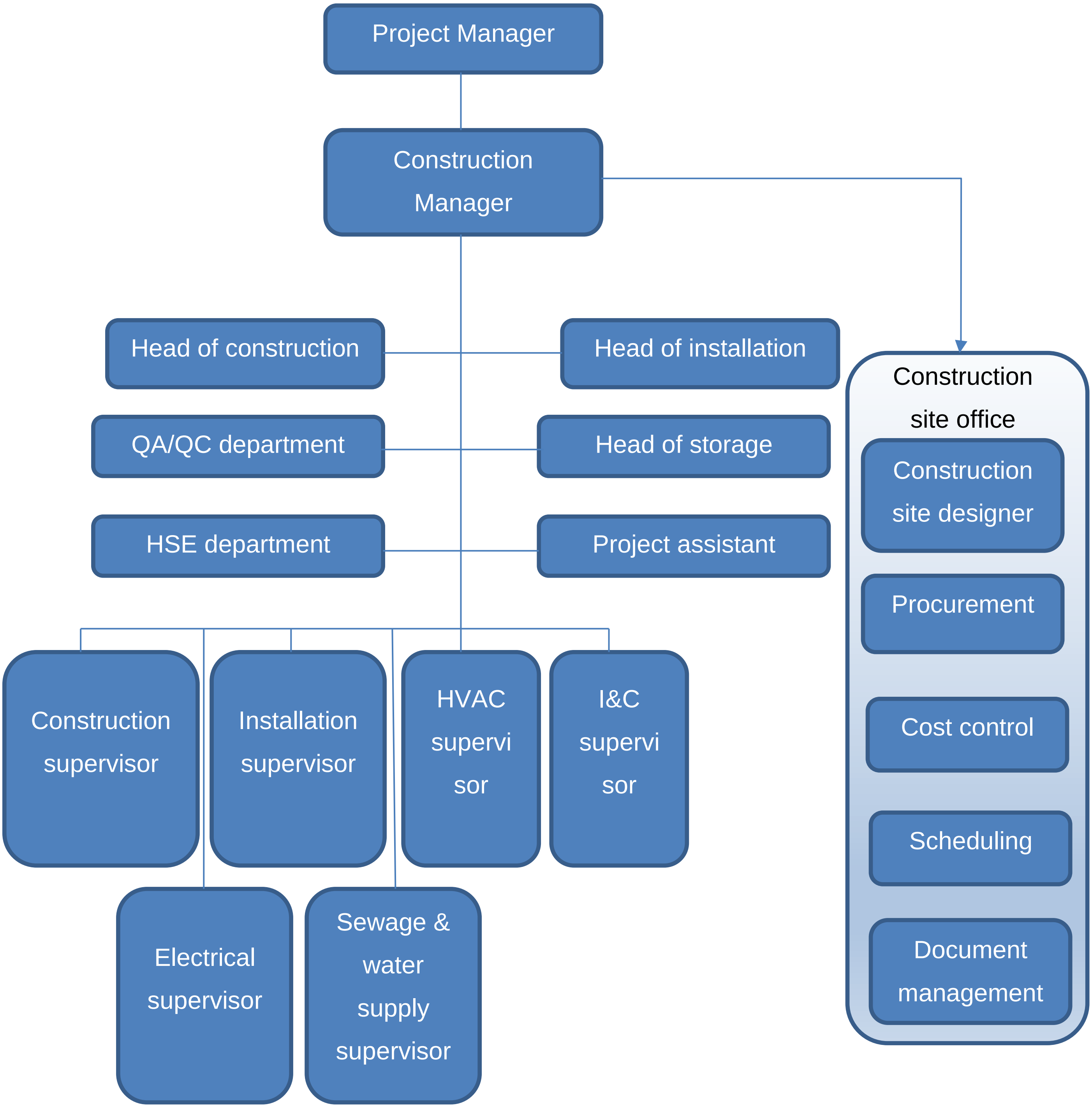

Figure 4 Construction site organizational structure

5.2 System review and audit

As far as the Finnish-based local subdivision is certified by ISO 9001 and other project-related standards, it is good to point out the applicability of auditing programs and purposes. The main idea of auditing measures is to verify the quality system within an organization, find weak points and mark deviations from established processes. It is important to note that audits are not intended to ruin personnel's work or to punish defaulters – audits exist to make a company's work better by highlighting problematic spheres and promoting the right attitude among the personnel about the necessity of quality management.

There are two types of audits:

- The system audit studies the organizational structure, responsibilities, powers, procedures, and resources.
- The process audit studies how the various quality processes are used and work. (Ottosson, 2012, p. 166)

Audits can be done routinely or may be indicated by significant changes in organization, quality, processes, or quality of products or services or the need to follow up on corrective actions. The audit should include questions about the problems encountered so far in the project. (Ottosson, 2012, p. 167) Construction site audits could be performed within the scope of overall project audits on the company's level or with the involvement of separate departments only (for example Cost control or HSE department), in case some deviation in work processes were found and needs in an audit are understandable.

The following issues shall be investigated during general construction site audits:

- Reviews and monitors the contract terms when invoices are received.
- Evaluates proposed and incurred direct labor, overhead or direct material costs to compare these costs to the parameters of what is allowable or reasonable.
- Checks methods and calculations of fees.
- Compiles relevant data needed to confirm or dispute charges.
- Looks into the methodology applied to allocations.
- Analyzes capital construction costs.
- Reviews change order requests.

- Summarizes costs incurred to date and the amount of funds remaining.
- Comments on the appropriateness of billed costs, invoice conformance with contract terms and potential cost adjustments to invoices.
- Determines the effects of modifying existing drawdown payment schedules in the event of approved new contract amendments.
- Comments on adequacy of costs incurred to date and the magnitude of pending costs, prior to closeout of contracts.
- Formulates an impartial and accurate assessment of the construction's percentage of completion. (Braz, 1997, pp. 31–33).

Findings discovered during auditing activities shall be classified by three main groups – major nonconformities, minor nonconformities and proposals for improvements. Also, a separate group of positive findings could be established to promote good perception and encouragement of personnel.

A summary of general characteristics, related to discovered findings is presented in Table 1

Table 1 Classification of audit findings

Type of finding	Description	Example
Major	Significant risks related to deficiencies that most likely will result in not reaching expected result regarding technique, quality, sustainability, economy and legal compliance	Negligence of company’s principles and policies, serious violations against statutory and other requirements
Minor	Risks related to deficiencies that can result in not reaching expected results regarding technique, quality, sustainability, economy and legal compliance	Occasional or single events in fulfilment of the requirements of company’s principles and policies, own processes, contractual obligations and Client’s satisfaction Set of several minor observations, findings or other repeating

		deficiencies in operations that can become a risk in case not settled
Proposal for improvement	Intended for highlighting of areas that requires improvements and not assessed as deviations. Shall be treated as non-obligatory or binding but recommended for implementation	Comments regarding updating of procedure, amendments which intends to provide clearer and more detail information to process involved employees.
Observation	Observations are not typically violations to set requirements but as such essential and recognition of all kinds of minor items supports well development of operations.	All kind of practical daily findings beyond the requirements, both positive and negative, related to OH&S, Environment/Sustainability, Security and Quality on the areas of project management, design, procurement, fabrication and delivery, construction, erection, supervision, commissioning and start-up etc. including supporting activities during the execution of different activities
Best practice	Operation or activity supports well prompt and transparent management and project execution supporting in achievement of set targets and improves Client's satisfaction	Rational execution and simultaneous development of operations Time and cost saving implementation of processes for own and Client's benefit Finding and settling of future risks and conflicting items in advance

5.3 Responsibilities

From the organizational point of view when a separate quality department exists, no additional splitting of competences or responsibilities is required. The quality manager is responsible for all quality assurance and quality control issues arising within the company, acts as an ambassador in quality questions and promotes a corresponding approach to all employees. While dealing with the construction site and production issues, the situation is different, as soon as there is no dedicated quality professional at the site, typically quality roles could be shared as additional competences to dedicated project team members. It is necessary to highlight that within the construction site environment, quality specialists with specific construction-oriented educational background and sufficient work experience are allowed to perform also quality related tasks. The roles and responsibilities of the site team in case of quality are presented in Table 2.

Table 2 Construction site roles and responsibilities in the field of quality

Construction site role	Responsibility
Construction manager (Site manager)	Overall responsible person in front of law, overall quality responsibility
Responsible supervisor/ foreman (Vastaava työnjohtaja)	The responsible foreman must be responsible for the entirety and quality of the construction work and ensure that the construction work is carried out in accordance with the granted permit, construction regulations and regulations, and good construction practice. Responsible foreman ensures that the building control authority is notified of the start of construction work and that the construction work inspection document is kept up-to-date at the construction site. (Land Use and Building Act, 132/199, section 122)
Responsible supervisors/ foremen at special fields (for example water/ sewage, ventilation, etc.)	Overall quality responsibility for dedicated field. Foreman at the special field must ensure that the construction work of the specific field is carried out in accordance with the issued permit, the rules and regulations regarding construction, and good construction practice. (Land Use and Building Act, 132/199, section 122)
Quality manager/ engineer	Responsible for quality assurance implementation at site and quality control activities. Acts as joining person between

	company's management and site management in the field of quality. Provides quality deliverables to the site team – guiding documents (manuals, procedures), checks its implementation and applicability from the personnel side, develops checklists for construction works, Inspection and Test Plans, leads the nonconforming managements and follow-up nonconformity register.

As highlighted by Rumane (2017, p. 762) a quality control (QC) organization is independent of those persons actually performing the work. They will be responsible for implementing the quality plan for the entire contract/ project-related activities by scheduling the inspection, testing, sampling, and preparation of mockup and will ensure that the work is performed as per the approved shop drawings and contract document.

The QC in charge will be responsible to ensure the implementation of project quality. He/she will be supported by QC engineers as follows:

1. QC engineer (Civil works)
2. QC engineer (Concrete works)
3. QC engineer (Mechanical works)
4. QC engineer (Electrical works)
5. Foreman (Concrete works) (Rumane, 2017, p. 763)

These employees are in charge of the implementation of the overall quality management system at the construction site. The head of QC (QC in charge) shall coordinate quality-related activities in cooperation with the company's head office, Project and Site Manager. Discipline's QC engineers are responsible for the implementation of quality requirements in their corresponding fields.

To give an example of quality department organization at the construction site, Figure 5 is served.

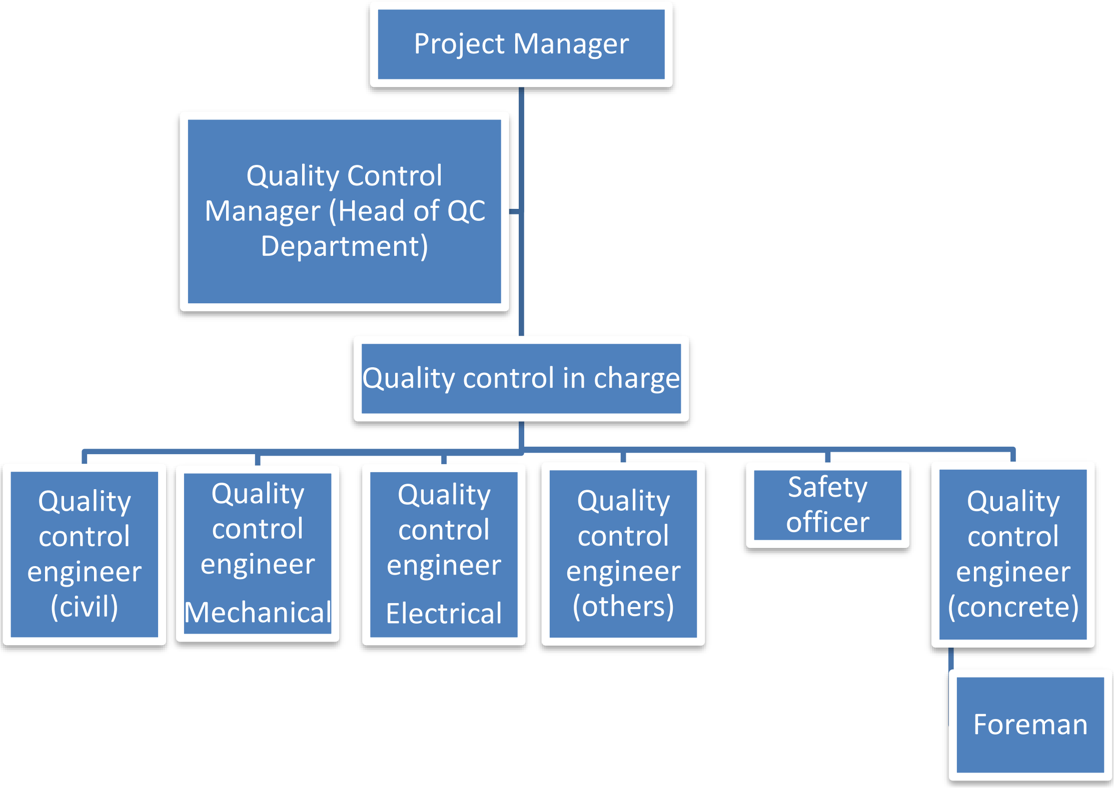

Figure 5 Organization chart of quality department at site

6 Practical issues of establishment of quality system within construction site

6.1 Document management

One of the crucial parts of quality management is a sufficient organization of document management and coordination. As soon as the main outcomes of quality activities besides the overall quality of works are supporting documents, describing interaction between teams and requested actions, it is highly important to pay enough attention to such activities. Procedures and manuals act not as additional papers circulating within the project and presenting during the audits only, their purpose is to support the company's and individual's attentivities in order to provide the required level of quality, hand-over of tasks between teams and continuity of responsibilities. Moreover, these documents provide a clear understanding of the hierarchy of actions and the required chain of activities in each business process. Control of performed actions considering documented subsequence becomes obvious for all process' participants, and the company uses less time on the education of newcomers, on how to deal with work tasks and to whom to address questions and outcomes of the work.

The usage of a common document framework makes work on site easier and faster that is why it is good to insist that a company, which is willing to participate in tendering activities and submit its pricing proposal for construction works to have a valid ISO 9001 certification and be aware on how the quality management system acts. Quality documents, such as the company's quality policy, quality manual, and quality management plan for planned site activities, are to be on place and followed. But as wisely noted by Sutt (2011, p. 98), even if a relevant manual is to be submitted by all the contract or service providers during their preliminary qualification, although in reality this provides no guarantee of the quality of the resulting service. Obtaining the certificate has often become a formal goal and, in practice, the procedures for ensuring certified quality may not be followed. To avoid such situation regular auditing activities is considered sufficient to be sure that the subcontractor’s quality system is in place and followed.

To describe the hierarchical structure of documents involved in project activities, Figure 6 is serving:

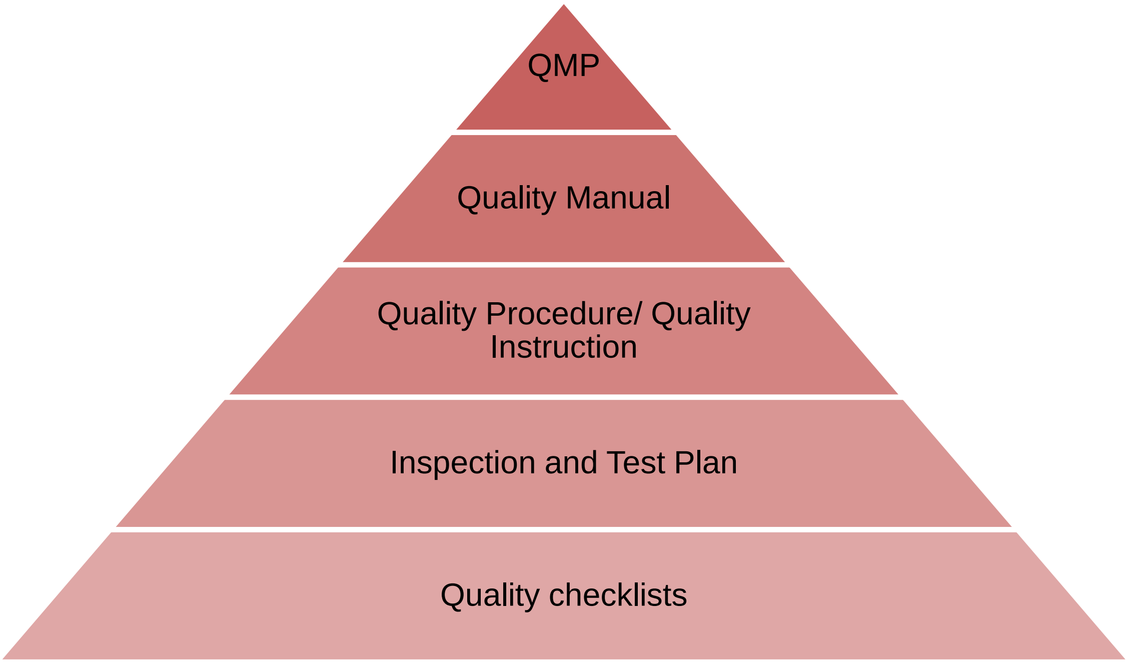

Figure 6 Hierarchy of quality documentation

To provide a deeper understanding of documents that shall be developed at the project and/or requested from involved subcontractors, brief explanation of them is given in the following subchapters.

Project Quality Management Plan

Typically, Quality Management Plan (QMP on Figure 6) defines the quality processes, procedures, and associated resources required to execute the project. It applies to project-specific management, project-specific controls, engineering, procurement, construction, commissioning, and quality functions. ISO 9001 is chosen as a supporting and guiding document for quality activities. The purpose of the Quality Management Plan for the dedicated project is to ensure that the managerial, technical and quality requirements are acknowledged and met.

The Quality Management Plan helps to confirm that deliverables are being produced to an acceptable quality level and that the project processes used to manage and create the deliverables are effective and properly applied.

To understand what kind of quality metrics are used in the project in general, Table 3 is prepared:

Table 3 Quality metrics of typical project

Project function	**Quality requirements**	**Quality metrics and acceptance criteria**
Change management	All changes, claims and additional work shall be managed, approved and recorded according to change management procedure.	Change management procedure and acceptance criteria are defined in Change Management Plan.
Engineering	Engineering requirements are presented in Engineering Management Plan.	Engineering document checking, design reviews and document approvals are defined in detail in the discipline specific Execution Plans.
Procurement	Procurement requirements, procurement strategy and procedures are presented in the Procurement Management Plan.	Procurement progress follow up is defined in Procurement Plan. For purchase approval rights see Procurement Plan.
Construction	For construction requirements refer to the Construction Management Plan.	For construction work quality control and approvals refer to the Construction Management Plan.
Risk management	Required risk management actions are defined in the Risk Management Plan.	Risks are identified and collected to a project specific risk register. Risks are assessed and risk mitigation actions are planned in risk review meetings. Risk assessment, planned actions, and

		mitigation action status are controlled in the project management meetings and approved by project manager.
HSE management	Safety targets for the project are set in the HSE Management Plan. “Inherent safety approach” is to be applied in project’s design activities. HS master action list shall be created in project start and maintained throughout whole project.	Proactive engineering HSE actions are reviewed in engineering management meetings. HSE status and actions are evaluated regularly in project management meetings. Corrective actions are to be determined immediately if necessary.
Security Management	Security targets for the project are to be set depending on the practical requirements of the project.	To be specified case by case.
Document management	Requirements for document management are set in Document and Information Management Guideline. Document approval flows are defined in detail in the discipline specific Execution Plans.	Documents are prepared according to project requirements. Instructions for document management system are created and project operates according to the instructions. Document reviews and approvals are done as instructed.

Quality manuals

Ensure correct implementation of Quality Management Plans by providing more detailed instructions on the implementation of quality activities at the Project. For example, Quality Control Manual’s goal is to define the management for Quality Control Activities of the Project. In other words, Quality Control Manual shall be developed for the Project in order to set provisions on how the quality control activities will be ensured and managed, and to define the purpose and the methods of the quality control. By implementing the Quality Control Manual, the company ensures that quality control activities are planned, implemented, monitored and recorded. Separate requirements for personnel and organizational structure of the Quality Department could be mentioned in this document.

One of the important parts of the Quality Control Manual is establishing of quality control activities' chain and description of the action's subsequences. For example, it is not possible to overhead the intermediate inspections after the kick-off meeting and participate only in the final quality inspection, all steps, described in the Quality Control manual shall be followed and corresponding document evidence exists. Moreover, this document also pays attention to the interaction between subcontracting companies and client organizations by establishing acceptable ways of communication, notification timeframes and sufficient response time. Acting as liaison document for all quality activities, this manual contains links to work or project's phase-related procedures – e.g., material acceptance procedure, inspection performance procedure, hand-over procedure, etc.

Quality procedures

On the following level of the quality system's hierarchy detailed measures and performing actions are described step by step. The main distinction between quality procedures and other documents is their clarity and instruction-based style of narration. By reading the procedure, the employee shall understand what kind of action he/she shall perform in which kind of situation and what timeframes are applied. Also, outcomes shall be clarified. The main purpose of each procedure is to provide a simplified scenario of actions for each possible situation at work.

As a basic idea of procedure usage, a new employee joining the team at the onboarding period shall familiarize himself with the available procedures and guidances at work to be able to perform his task in the most efficient way from the beginning. Procedures or instructions shall cover all “grey” sides of the executed process and provide an easy understanding of how to perform works and control its correct execution not only to the project's personnel but also to the audit committee in case of audit activities at the site.

Inspection and test plan

The main document, which is describing site activities for the dedicated site work phase. Could be developed for several activities, performed by one contractor, depending on the Site Management vision of the work's execution and sequence. Typically, each batch of construction work contains several operations to be checked during execution. Besides the specific control steps, there are two of them which are unified for all site activities: check of prerequisites (including valid and actual design, issued for construction, permission documents, necessary qualification from executors and availability of work scope-specific procedures) and final acceptance inspection (checking of work's results itself, executed and finalized quality documents included in the quality portfolio, work logs and other resulting documents).

Inspection and test plan are usually represented by a table, where separate control steps are listed, responsible sides for acceptance of work are mentioned and there are places for signing when each step is finalized and approved by all involved in control measures parties. It is also beneficial to mark the frequency of inspections and acceptance criteria, depending on the local normatives and project regulations. Clear acceptance criteria provide an overall understanding to the involved personnel how works shall be accepted and what is desired quality level of the structure. Usually, acceptance criteria contain link to the requirement of the standard or the project document if the project has more strict requirements.

For the purpose of quality system implementation on site several Inspection and Test Plans were developed after consultancy with Construction Site Management representatives and an understanding of their needs. Considering that the typical construction site for the subdivision is an industrial facility, which already exists and represents a brownfield project, concrete and steel structures execution is the most important one for arranging of quality control process. Crucial for construction processes activities including foundation works, execution of reinforced concrete structures, installation of steel structures, creating of the envelope of the building – mounting of wall's sandwich panels and execution of socle panels walls above the foundation were chosen for the development of Inspection and Test Plan's templates. These documents are presented in Appendix 1.

Quality checklists

By going to the lower level of project separation, it is necessary to mention specific documents not only for the dedicated type of construction task, but also attached to the spatial position of the work's field. To split controlling activities into vertical or horizontal levels, using the project's axes grid, coordinate system, height marks or project's areas quality checklists are used. Typically represented by tables where the overall volume of one activity is split by a dedicated number of units, levels, axes and accompanying by check fields for marking/signing by responsible parties and employees, involved in execution processes. Several involved participants shall be mentioned in the horizontal upper part of the table forming columns and several split parts shall form a row of the checklist table.

The main distinction between quality checklists and Inspection and Test Plan is the level of accuracy – a quality checklist provides the exact positioning of performed work while the Inspection and Test Plan gives an overall understanding of works type, acceptance criteria and periods of checking. Table 4 represents a simplified general example of a Quality checklist for the execution of concrete structure.

Table 4 Example of Quality checklist for concreting activities

	Subcontractor, who has executed works	Subcontractor, responsible in front of Main Contractor as per Contract	Main Contractor	Client	Independent Inspection Third Party	Building Authorities
Checking of reinforcement Axes 1-5, A	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature
Checking of reinforcement Axes 1-5, B	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature
Checking of reinforcement Axes 1-5, C	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature
Checking of formwork Axes 1-5, A	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature

Checking of formwork Axes 1-5, B	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature
Checking of formwork Axes 1-5, C	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature
Checking of Concrete Axes 1-5, A	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature
Checking of Concrete Axes 1-5, A	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature
Checking of Concrete Axes 1-5, A	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature	Name, Surname Date Signature

6.2 Work outcomes and quality metrics

Work performance requires a step-by-step assessment of the achieved results and in this case quality metrics can help. As noted by Spacey (2017), quality metrics are measurements of the value and performance of products, services and processes. In general, there are many types of quality metrics, such as measuring ~~of~~ customer’~~s~~ satisfaction, ratings, failure rate, mean time between failures, quality of service, quality control and defect rates. For the construction industry the most efficient one is quality control, more rarely used are defect rate (the number of defective samples divided by the dedicated number of samples) and customer satisfaction (for the fully made construction product).

Another useful metric in the industrial sector is Key Performance Indicators. A key performance indicator (KPI) is a metric used to help manage a process, service, or activity. Many metrics may be measured, but only the most important of these are defined as KPIs and are used to actively manage and report on the process, service, or activity. (Kureemun & Fantina, (2011, p. 152).

The statistical analysis shall be implemented to the following sources of data in construction: quantity of performed quality inspections to the quantity of quality inspections with negative results (“not approved inspections”), the quantity of open nonconformities per work field/scope/subcontractor, the quantity of inspections which are performed without comments from the client.

7 Non-conformity management

7.1 Handling of non-conformities

One of the crucial parts of quality management is the management of nonconformities arising at the site and during project activities. Management of nonconformities is a company's obligation according to the provisions of ISO 9001:2015 and shall be implemented in certified by this standard company's units (International Organization for Standardization, ISO, 2015).

Possible sources of nonconformities that could arise in an engineering and construction company are divided into several groups, as shown in Table 5.

Table 5 Sources of nonconformities

Source of nonconformity	Description
Design nonconformities	Typically arise while mismatching of design initial data and project deliverables happens. Mistakes of designer's works – calculations, markings, drawings unclarity.
Project nonconformities	Arise during working processes, typically connected with non-following of work-practices, incorrect internal communication, and misunderstanding within project team.
Construction site nonconformities	Arise while construction regulations are not followed at site, no implemented quality procedures and there is lack of quality management at site.
Audit nonconformities	Connected with audit activities, detailed explanation is given in subchapter 5.2

The quality department is responsible for handling of nonconformities and management of all activities, related to this issue on Division's level. Project teams and especially Project Manager play an important role in solving and eliminating nonconformities as the main responsible person in front of the whole project. He/she shall provide a list of corrective actions and develop a root cause analysis in cooperation with quality representatives and Project Team, in order to avoid the reoccurrence of the same problems in the future. The project manager shall be aware of all nonconformities arising on the Project and monitor the process of its elimination and closure of nonconformities.

Depending on the company's structure and willingness to study root causes and avoid nonconformities in the future, two possible options in forming of nonconformities elimination approach are seen, as shown in Table 6.

Table 6 5D and 8D approaches

5D	8D
D1: Define a problem D2: Define and check the root causes D3: Identify and verify proposed permanent corrective action D4: Implement permanent corrective action D5: Action to prevent re-occurrence of nonconformity	D1: Identify Team members/roles and responsibilities D2. Define a problem D3. Implement and verify interim containment actions D4. Define and verify root causes D5. Identify and verify proposed corrective actions D6. Implement permanent corrective actions D7. Prepare actions to prevent re-Occurrence D8. Communicate results and familiarize the team with outcomes

Typically, an industrial-oriented approach is considered as 8D because it provides wider possibilities to involve more team members, assign roles within the Team and deeply investigate root causes with proposed corrections on short-phase action and for perspective vision. As noted by Elmansy (2022), while 8D problem solving is suitable for recurring problems that may repeatedly occur within a project or company, it is not ideal for simple issues that can be solved quickly by individual efforts. The process is unsuitable for a problem that can be solved with a straightforward solution. The 8D process is designed for complex issues, which require several weeks to solve and the involvement of at least four people.

Thus, the 5D approach could be used for internal investigation and within small projects where forming a team is seen as unbeneficial due to a lack of resources. Another possible solution to implement the 5D approach is when quality issues arising in the production environment are typically repeated and the resource of one employee is considered enough to solve the arising problems.

7.2 Nonconformity management team

The nonconformity management team is formed by the Team Leader or Executor group of employees, authorized to perform nonconformity analysis, define correction and interim containment actions, root causes, corrective and preventive actions and assess nonconformity significance, which can occur during Project implementation. If nonconformity was detected by the subcontractor's or sub-supplier's side (both in this case could be treated as initiators), the team can be also from the initiator's side in order to review performed by the organization responsible for the nonconformity analysis and verify implemented actions. In general cases Executor is an employee of the organization that failed to avoid a nonconformity occurrence, authorized by the management of the organization to make decisions relating to the elimination of the nonconformity and to the prevention of its reappearance or its appearance somewhere else, within the frameworks of their activities which they are managing or organizational control of which he/she is carrying out. A team Leader is a person in an organization, which failed to avoid a nonconformity occurrence, in which scope of responsibility the nonconformity was detected, responsible for the planning action for nonconformity and its causes elimination, significance assessment and control for the performance planned actions, including corrective and preventive by Team members, assigned by the Team Leader, with further Nonconformity Report forming.

After the nonconformity notification has been accepted, the Executor shall assign the Team Leader for Team forming. The Team is formed for each nonconformity and includes at least the Initiator, the Executor, and the Team Leader.

In case of a major product-related nonconformity, the responsible Quality specialist shall verify that representatives of the subcontractor/sub-supplier are included in the Team. Relevant specialists (Team participants) shall be engaged considering a nonconformity nature for each detected case. The composition of the Team can be corrected at the further stages of work with nonconformities. Team Leader can be: Process Owner of the Process, where nonconformity was detected or as a result of which, nonconforming product occurred, Contract manager or assigned by the Process Owner or Contract Manager Supplier’s specialist defined in the internal procedure. The Team Leader, in its turn, has to form the Team in order to eliminate the nonconformity, analyze its causes, and plan corrective and preventive action. The Team must have the skills and competencies necessary to develop immediate corrective actions and determine the causes of nonconformities, develop corrective and preventive actions, and assess the significance of nonconformities. In case of major nonconformity, the Team shall include at least:

- Quality representative to confirm correctness and completeness of information in a nonconformity report;
- Process owner or Contract manager to confirm proposal for correction;
- Technical specialist to evaluate or confirm nonconformity's impact on other equivalent components, items, or related activities;
- Quality control inspector/engineer to verify the elimination of nonconformity.

7.3 Closure of nonconformity reports

The nonconformity report, which template was developed for the commissioning company and presented in Appendix 2, is considered as a closed one when corrective actions are implemented, root cause analysis is performed, and all involved employees are informed about the nonconformity case's outcomes and results. Communication is possible via e-mail, distributed automatically through the means of a nonconformity register or via a dedicated application (if exists), all data related to the corrective action's work is gathered and stored accordingly. All nonconformities related to specific project shall be closed prior to the end of this project.

In a perfect situation all nonconformities that arise within the construction or project company shall be eliminated and corrective actions implemented. But in real-world situation companies usually experience a lack of resources to deal with nonconformity issues and try to limit funds in case of nonconformity management. To limit the resources and means when working with causes of nonconformities, as noted in the study performed by Ivanov (2016, p. 229), the first way is when the least expensive measures are chosen from the list of corrective actions. The second one is when the selected measures are aimed at eliminating the causes of the most resonant nonconformities, which cannot be ignored. In both cases, the efficiency of the use of funds in the corrective actions is not defined and is not considered.

The commissioning company has requested to update the current system of nonconformity management or create a new one. The existing database is located on the internal IMS portal, represented by on-line submission form for the filling of findings and a database comprising all existing reported findings. For some security reasons such a full database is visible only to representatives of the Quality division, reporters are able to see only nonconformities, reported by them. Moreover, statistical information is not automatically available, the IMS tool doesn't send notifications to the handlers and responsible regarding the date of corrective actions' implementation closing and has no automation possibilities.

Instead of the existing system it was proposed to implement a new nonconformity database based on Microsoft SharePoint (Microsoft Lists). Such a tool provides wide possibilities for the provision of statistical information by filtering and sorting of table's columns, and settlement of privacy settings (this requirement is highly important for the commissioning company due to the huge number of confidential projects, where data related to project nonconformities shall not be disclosed to not involved parties/employees). SharePoint decision provide a possibility to notify the dedicated employees about approaching deadlines for implementations of corrective actions or performance of root cause analysis. The owner of the table (usually the Quality division’s employee) receives automated updates on changes and new addings, which were made by reporters during the day or another period. Microsoft List also could be automated with Microsoft Forms which provides a more accomplished and user-friendly interface in the form of a fillable document. After submission by automating scenarios data from Forms is moving to the Nonconformity register on Microsoft List. For automatization purposes Microsoft Power Automate tool is used. The user shall just check again privacy settings and update them according to confidentiality requirements. Examples of Microsoft Lists and Forms’ interfaces are shown in Appendix 3 and 4. The content of Microsoft Forms and List is corresponding to the content of the usual form of a Nonconformity report (presented in Appendix 2) which is aiming to provide transparency to the documents and ease possibilities for filling of forms for employees. For common purposes it is not required to fill both papers (.docx) NCR form and create a new item in Nonconformity Register, paper NCR is required only if Client is requesting.

To facilitate understanding of nonconformity management workflow while working with nonconformity database, following scheme (Figure 7) is created:

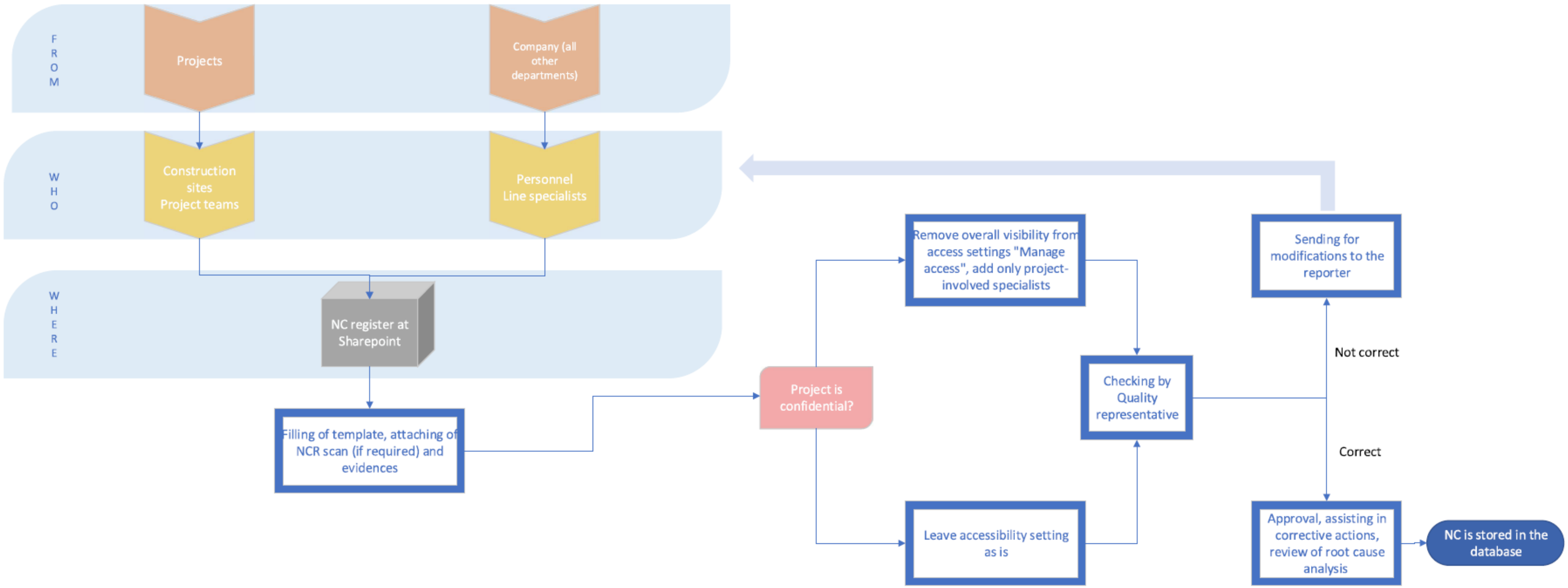

Figure 7 Nonconformity management workflow

7.4 Lessons learned principles

For the company Lessons Learned represent an important and valuable source of information and data, which could be shared within teams to increase collaboration, fruitful cooperation at work and the possibility to avoid similar mistakes in future projects. The target of the Lessons Learned process is to share the best practices and ideas from any of the customer assignments and apply them in the next assignments. Typically sources of Lessons Learned are effectively solved nonconformity cases with universal project-based history, since usually unique nonconformities and correspondingly developed lessons learned have no project value as soon as they are quite rare and don't repeat. Lessons Learned discussion is an important part of the project closure, commissioning company has a valid algorithm on how to deal with Lessons Learned but no approved procedure and lessons learned database. As noted by Carroll (2021), it is a discussion of the knowledge gained from the process of conducting a project, the successes and failures as a team, and an effort to repeat the positive aspects and not repeat the mistakes. This is also called a post-mortem, after-action review, wrap-up, project success meeting, or a retrospective in agile.

Collection of Lessons Learned linked to the project closure. Separate meeting shall be organized to gather all cases which could be considered as Lessons Learned. Involvement of all project teams (including project management office, design team, construction site representatives and even subcontractor organizations) is seen beneficial due to the complexity of knowledge achieved.

8 Discussion

The quality management system has a long story of development, by having its roots in ancient times. Humanity overviews and controls quality aspects for many centuries already, improving overall implementation and developing of new standards. Research questions discussed in this Thesis could raise a lot of questions. One of these questions is related to the applicability of ISO 9001 and its applicability in the construction site environment. As noted by Mastura and Abdul (2013, p.88), it is much easier to implement such a quality management system in a production/industrial environment than in a construction site. I can agree with the sentence that it is easier to control similar parameters on the same products case by case, but obviously, construction management needs a reliable quality management system to deal with quality issues and handle nonconformities in a correct way. Another positive side of the ISO 9000 standard’s implementation is the increase in the company’s competitiveness in front of participation in tenders. When all participating companies are sticking to the same rules and implementing common practices it is easier to compare companies with each other clearer for the Client to whom to give a contract.

For the future perspectives I see the tendencies to digitalization and simplification of quality approaches, moreover it is evident that the quantity of quality checks will be reduced, as soon as a lot of operations which were performed by dedicated specialists in the past, now are handed over to the machines, robots or performed by the specialized equipment with minimum human’s workforce. I consider it is advisable for companies to invest it the means of digitalization of quality activities and avoid the paper type of document management. That is why the usage of even standard Microsoft Office decisions for simplification of the nonconformity management process is seen beneficial for all employees within the commissioning company.

Another possible way of quality management development is the widespread usage of lean practices. Lean provides possibilities to limit waste (both physical waste – rubbish, particles of materials/ products and metaphysical - waiting, unnecessary steps in production flow, dead-end processes). As noted by Egan (1998, p. 15), “…recent studies in the USA, Scandinavia and the UK suggest that up to 30% of construction is rework, labor is used at only 40-60% of potential efficiency, accidents can account for 3-6% of total project costs, and at least 10% of materials are wasted…The message is clear - there is plenty of scope for improving efficiency and quality simply by taking waste out of construction...”

Implementation of lean practices improves the working environment, optimizes processes and provides possibilities to achieve overall goals in a less stressful way. Several lean methods could be used in construction sites, among them Value Stream Mapping, Just in Time Concept and 5S. It is important to note that for the successful implementation of lean manufacturing on a construction site, the full commitment of management and employees is critical. In the event that one of the levels of the company does not follow the principles of lean manufacturing, the entire system may fail.

9 Conclusion

Through the research all planned objectives were achieved, the necessity of quality organization at the site is proven and possibilities to implement quality management within the construction environment are found. The most significant contribution to the establishment of quality organization within the company lays over the company’s management and its commitment and understanding of the positive sides of quality management system implementation. Another crucial finding which was observed during research work is the importance of quality assurance processes which comprises document management, auditing activities and follow-up of internal quality flows within the company.

Main aspects of quality at the site related to quality control functions. The establishment of quality control functions in the construction site environment requires the creation of a separate organization independent from the personnel involved in the work’s execution. Such independence is important for the reason of impartiality. Due to specific activities in the construction sector, it is required that quality control personnel have sufficient work experience and corresponding education in the construction field. According to Finnish law overall responsibility for the construction and its quality lies on the construction manager and responsible site manager(s), such a distribution removes some of the responsibility from the quality in charge person but makes such employee a subordinate in front of the site manager.

Several suggestions could be still found for improvement and optimization of quality issues at the site:

1. For project-oriented companies, working on EPCM-modelled contracts, it is important to understand the cost of quality at the early stages of the project and provide a sufficient quantity of resources for the organization of quality control and quality assurance functions. Poor quality cost may be underestimated, leads to reputational damage and affect negatively on future projects besides the fact that human casualties might happen.

2. To improve quality development, lean principles are suggested to be implemented at the site.
3. Management of the company shall pay additional attention to the remuneration of quality initiatives and implement worthy quality proposals for improvement from the personnel in the daily working environment. For this reason, a quality committee could be arranged, aim of such a committee is to sort proposed solutions and create mechanisms for their implementation, award of initiative’s creators and apprize personnel about quality issues within the company.

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Appendix 1

Inspection and Test Plan examples

Company's Logo				
COMPANY, EXECUTING WORKS	INSPECTION AND TEST PLAN	Inspection Test Plan No (ID CODE)		ITP REVISION
Subcontractor's Logo	PROJECT-BUILDING-SUBCONTRACTOR- FOUNDATIONS			
	According drawings Nº Rev.	According Method Statement Nº	APPROVAL OF ITP: DATE / Subcontractor / General Contractor/Consultant	Client
Location	Building unit	Contract N°		

HP = Hold point – shall refer to an inspection for which invitations have been sent in advance to the defined participants and whose supervision is a condition for proceeding with the work unless the participants have given written permission to proceed without their presence;

WP = Witness Point shall refer to an inspection for which invitations have been sent in advance to the defined participants but whose supervision is not a condition for proceeding with the work.

Phase Nº	DESCRIPTION OF ACTIVITY	Responsible	Inspection /Test method	Frequency of inspection	Acceptance criteria	Notifications (*) Subcontractor	Notifications (*) General Contractor/Consultant	Notifications (*) Client	Result of inspections: Record to be produced	Acceptance Visa after HP/WP point: Subcontractor	Acceptance Visa after HP/WP point: General Contractor/Consultant	Acceptance Visa after HP/WP point: Client	REMARKS
	/1/	/2/	/3/	/4/	/5/	/6/			/7/	/8/			/9/
1	**Preconditions of the works**												
1.1	Check of prerequisites	Site manager/ site engineer/QC manager	Document review	Before start of the works	According to Project's quality control procedures	HP	HP	HP	Signature in ITP				
2	**In process inspection**												
2.1	Foundation pits and trenches depth check	Site engineer/Geodetic surveyor	Geodetic survey - document review	Before gravel base construction	According to design	HP	HP	WP	Signature in ITP, as-built layout				
2.2	Gravel base levelling and compaction	Site manager/ site engineer/QC manager	Geodetic survey - document review	Before construction of formwork and reinforcing	According to design, MaaRYL 2010	HP	HP	WP	Signature in ITP, as-built layout				
2.3	Check of reinforcement, anchors and formwork	Site manager/ site engineer/QC manager/Geodetic surveyor	Visual checking/ Geodetic survey - formwork and anchors	Before concreting	According to design, SFS EN 1090-2, SFS EN 13670	HP	HP	WP	Signature in ITP, as-built layout				
2.4	Check of foundations and anchors	Site manager/ site engineer/QC manager/Geodetic surveyor	Visual checking/ Geodetic survey	After dismantling of formwork	According to design, SFS EN 13670	HP	HP	WP	Signature in ITP, concrete delivery note to be stored, as-built layout				
2.5	Check the backfilling and compaction	Site manager/ site engineer/QC manager/Geodetic surveyor	Visual checking/ Geodetic survey	After execution of backfilling	According to design, MaaRYL 2010	HP	WP	WP	Signature in ITP, as-built layout, compaction test protocol				
3	**Final inspection and acceptance**												
3.1	Final acceptance of foundations works	Site manager/ site engineer/QC manager/Geodetic surveyor	Document review	After completion of foundation works	According to Project's quality control procedures	HP	HP	HP	Set of approved as-built documentation, signature in ITP				

Appendix 1

Company's Logo								
COMPANY, EXECUTING WORKS	INSPECTION AND TEST PLAN			Inspection Test Plan No (ID CODE)				ITP REVISION
Subcontractor's Logo	PROJECT-BUILDING-SUBCONTRACTOR- Concrete structures							
	According drawings Nº Rev.		According Method Statement Nº		APPROVAL OF ITP	DATE	Subcontractor	General Contractor/Consultant	Client
Location		Building unit		Contract N°					

Phase Nº	*HP = Hold point – shall refer to an inspection for which invitations have been sent in advance to the defined participants and whose supervision is a condition for proceeding with the work unless the participants have given written permission to proceed without their presence; DESCRIPTION OF ACTIVITY	*WP = Witness Point shall refer to an inspection for which invitations have been sent in advance to the defined participants but whose supervision is not a condition for proceeding with the work. Responsible	Inspection/Test method	Frequency of inspection	Acceptance criteria	Notifications (*) Subcontractor	General Contractor/Consultant	Client	Result of inspections: Record to be produced/Action	Acceptance Visa after HP/WP point: Subcontractor	General Contractor/Consultant	Client	REMARKS
	/1/	/2/	/3/	/4/	/5/	/6/			/7/	/8/			/9/
1	Preconditions of the works												
1.1	Check of prerequisites	Site manager/ site engineer/QC manager	Document review	Before start of the works	According to Project's quality control procedures	HP	HP	HP	Signature in ITP				
2	In process inspection												
2.1	Material inspection: reinforcement, embedded parts, anchors, formwork, sealants, etc.	Site engineer/QC manager	Visual check, document review	Prior usage	According to applicable product's norms	HP	HP	WP	Quality dossier (set of cerificates, DoPs), signature in ITP				
2.2	Check the readiness for concreting (compaction test, reinforcement, formwork, anchors)	Site manager/ site engineer/QC manager/ Geodetic surveyor	Visual check, document review	Prior concreting	SFS EN 13670: 2010 8.2	HP	HP	WP	Signature in ITP				
2.3	Testing of fresh concrete - Check of compliance of mixed concrete	Site engineer	Document review	Prior concreting	Compliance with order	HP	WP	WP	Quality dossier - insert concrete delivery note/ Signature in ITP				
2.4	Testing of fresh concrete - Slump test	Site engineer	Visual check, measuring	Once per day or per every 100 m3, if required	SFS EN 12350-2:2019	HP	WP	WP	Test report/Log book				
2.5	Testing of fresh concrete - Air content	Site engineer	Visual check, measuring	Once per day, if required	SFS EN 12350-7:2019, SFS 7022:2019 table A4	HP	WP	WP	Test report/Log book				

Company's Logo

COMPANY, EXECUTING WORKS	INSPECTION AND TEST PLAN			Inspection Test Plan No (ID CODE)				ITP REVISION
Subcontractor's Logo	PROJECT-BUILDING-SUBCONTRACTOR- Concrete structures							
	According drawings Nº Rev.		According Method Statement Nº		APPROVAL OF ITP	DATE	Subcontractor	General Contractor/Consultant	Client
Location		Building unit		Contract N°					

*HP = Hold point – shall refer to an inspection for which invitations have been sent in advance to the defined participants and whose supervision is a condition for proceeding with the work unless the participants have given written permission to proceed without their presence;

*WP = Witness Point shall refer to an inspection for which invitations have been sent in advance to the defined participants but whose supervision is not a condition for proceeding with the work.

Phase Nº	DESCRIPTION OF ACTIVITY	Responsible	Inspection/Test method	Frequency of inspection	Acceptance criteria	Notifications (*) Subcontractor	Notifications (*) General Contractor/Consultant	Notifications (*) Client	Result of inspections: Record to be produced/Action	Acceptance Visa after HP/WP point: Subcontractor	Acceptance Visa after HP/WP point: General Contractor/Consultant	Acceptance Visa after HP/WP point: Client	REMARKS
	/1/	/2/	/3/	/4/	/5/	/6/			/7/	/8/			/9/
2.6	Installation of temperature measuring devices	Site engineer	Visial check	Prior concreting	Concreting plan, design requirements	HP	WP	WP	Signature in ITP				
2.7	Check the structure and anhcors after formwork dismantling	Site manager/ site engineer/QC manager/Geodetic surveyor	Visual check, document review (as-built layouts)	Before further worksteps	SFS EN 13670:2010, BY 65 2016, SFS EN1090 (if appl.)	HP	HP	WP	As-built layout, signature in ITP				
3	Final inspection and acceptance												
3.1	Final QC documents inspection	Site manager/QC manager	Document review	After finishing of all works	According to Project's quality control procedures	HP	HP	HP	Set of as-built documents, signature in ITP				

Company's Logo

COMPANY, EXECUTING WORKS	INSPECTION AND TEST PLAN	Inspection Test Plan No (ID CODE)	ITP REVISION
Subcontractor's Logo	PROJECT-BUILDING-SUBCONTRACTOR- Steel Structures Installation		
	According drawings Nº Rev. / According Method Statement Nº	APPROVAL OF ITP: DATE / Subcontractor / General Contractor/Consultant / Client	
Location	Building unit / Contract N°		

HP = Hold point – shall refer to an inspection for which invitations have been sent in advance to the defined participants and whose supervision is a condition for proceeding with the work unless the participants have given written permission to proceed without their presence;

WP = Witness Point shall refer to an inspection for which invitations have been sent in advance to the defined participants but whose supervision is not a condition for proceeding with the work.

Phase Nº	DESCRIPTION OF ACTIVITY	Responsible	Inspection/Test method	Frequency of inspection	Acceptance criteria	Notifications (*): Subcontractor	Notifications (*): General Contractor/Co	Notifications (*): Client	Result of inspections: Record to be produced	Acceptance Visa after HP/WP point: Subcontractor	Acceptance Visa after HP/WP point: General Contractor/Consultant	Acceptance Visa after HP/WP point: Client	REMARKS
	/1/	/2/	/3/	/4/	/5/	/6/			/7/	/8/			/9/
1	Preconditions of the works												
1.1	Check of prerequisites	Site manager/ site engineer/QC manager	Document review	Before start of the works	According to Project's quality control procedures	HP	HP	HP	Signature in ITP				
2	In process inspection												
2.1	Material inspection: steel parts, fixings, welding consumables	Site engineer/QC manager	Visual check, document review	Prior usage	According to applicable product's norms	HP	HP	WP	Quality dossier (set of cerificates, DoPs), signature in ITP				
2.2	Installation of steel structures, check of bolting connections, check of welding seams	Site manager/ site engineer/QC manager/Geodetic surveyor	Visual check, document review	After assembly, check of 5% bolted connections/seams	According to design, SFS EN 1090-2 ch. 12.5	HP	HP	WP	As-built layout, signature in ITP				
2.3	Touch-up painting inspection	Site manager/ site engineer/QC manager	Visual check	Before covering by final structures	According to design, SFS EN 12944-5, ch.7	HP	HP	WP	Signature in ITP				
2.4	Installation of walls and roofing structures	Site manager/ site engineer/QC manager	Visual check, document review	After painting performing	According to design, SFS EN 1090-2	HP	HP	WP	Signature in ITP				
3	Final inspection and acceptance												
3.1	Final acceptance inspection	Site manager/ site engineer/QC manager	Visual check, document review	After finishing of works	According to Project's quality control procedures	HP	HP	HP	Signature in ITP				

Company's Logo

COMPANY, EXECUTING WORKS	INSPECTION AND TEST PLAN	Inspection Test Plan No (ID CODE)	ITP REVISION
Subcontractor's Logo	PROJECT-BUILDING-SUBCONTRACTOR-SOCLE PANELS INSTALLATION		
	According drawings Nº Rev.	According Method Statement Nº	
Location	Building unit	Contract Nº	

APPROVAL OF ITP	DATE	Subcontractor	General Contractor /Consultant	Client

HP = Hold point – shall refer to an inspection for which invitations have been sent in advance to the defined participants and whose supervision is a condition for proceeding with the work unless the participants have given written permission to proceed without their presence;

WP = Witness Point shall refer to an inspection for which invitations have been sent in advance to the defined participants but whose supervision is not a condition for proceeding with the work.

Phase Nº	DESCRIPTION OF ACTIVITY	Responsible	Inspection/Test method	Frequency of inspection	Acceptance criteria	Notifications (*) Subcontractor	General Contractor/Consultant	Client	Result of inspections: Record to be produced	Acceptance Visa after HP/WP point: Subcontractor	General Contractor/Consultant	Client	REMARKS
	/1/	/2/	/3/	/4/	/5/	/6/			/7/	/8/			/9/
1	**Preconditions of the works**												
1.1	Check of prerequisites (design, certificates, qualification records, etc.)	Site manager/ site engineer/QC manager	Document review	Before start of the works	According to Project's quality control procedures	HP	HP	HP	Signature in ITP				
2	**In process inspection**												
2.1	Material inspection - check of socle panels, fixings, consumables	Site engineer/ QC manager	Visual check, measurements document review	Before installation works	According to Project's quality control procedures, SFS EN 13670:2010	HP	HP	WP	Quality dossier (set of cerificates, DoPs)/ Signature in ITP				
2.2	Check of installed socle panels	Site manager/ site engineer/QC manager	Visual check, measurements	After installation	According to design, SFS EN 13670:2010, SFS EN 3834-4 (if welded)	HP	HP	WP	Signature in ITP				
3	**Final inspection and acceptance**												
3.1	Final acceptance of installation works	Site manager/ site engineer/QC manager	Document review	After completion of works	According to Project's quality control procedures	HP	HP	HP	Signature in ITP				

Company's Logo										
COMPANY, EXECUTING WORKS	***INSPECTION AND TEST PLAN***					***Inspection Test Plan No (ID CODE)***				**ITP REVISION**
Subcontractor's Logo	*PROJECT-BUILDING-SUBCONTRACTOR-SANDWICH WALLS*									
	According drawings Nº Rev.		***According Method Statement Nº***			***APPROVAL OF ITP***	***DATE***	***Subcontractor***	***General Contractor /Consultant***	***Client***
Location		**Building unit**		**Contract Nº**						

Phase Nº	DESCRIPTION OF ACTIVITY	Responsible	Inspection/Test method	Frequency of inspection	Acceptance criteria	Notifications (*) Subcontractor	General Contractor/Co	Client	Record to be produced	Result of inspections – Acceptance Visa after HP/WP point: Subcontractor	General Contractor/Consultant	Client	REMARKS
	HP = Hold point – shall refer to an inspection for which invitations have been sent in advance to the defined participants and whose supervision is a condition for proceeding with the work unless the participants have given written permission to proceed without their presence;	*WP = Witness Point shall refer to an inspection for which invitations have been sent in advance to the defined participants but whose supervision is not a condition for proceeding with the work.*											
	/1/	/2/	/3/	/4/	/5/	/6/			/7/	/8/			/9/
1	**Preconditions of the works**												
1.1	Check of prerequisites (design, certificates, qualification records, etc.)	Site manager/ site engineer/QC manager	Document review	Before start of the works	According to Project's quality control procedures	HP	HP	HP	Signature in ITP				
2	**In process inspection**												
2.1	Material inspection - check of SW, sheets and fixings	Site engineer	Visual check, document review	Before installation works	According to Project's quality control procedures	HP	WP	WP	Quality dossier (set of cerificates, DoPs)Signature in ITP				
2.2	Check of installed SW panels	Site manager/ site engineer/QC manager	Visual check, measurements	After installation	According to design, manufacturer's guidances, SFS EN 14509	HP	HP	WP	Signature in ITP				
2.3	Check of installed metal sheets, coverings	Site manager/ site engineer/QC manager	Visual check, measurements	After installation	According to design, manufacturer's guidances	HP	HP	WP	Signature in ITP				
3	**Final inspection and acceptance**												
3.1	Final acceptance of installation works	Site manager/ site engineer/QC manager	Document review	After completion of works	According to Project's quality control procedures	HP	HP	HP	Signature in ITP				

Nonconformity report template

Nonconformity report №

Click or tap here to enter text. Click or tap to enter a date.

Subject of nonconformity: Click or tap here to enter text.

Project №:
Sub-Project №:

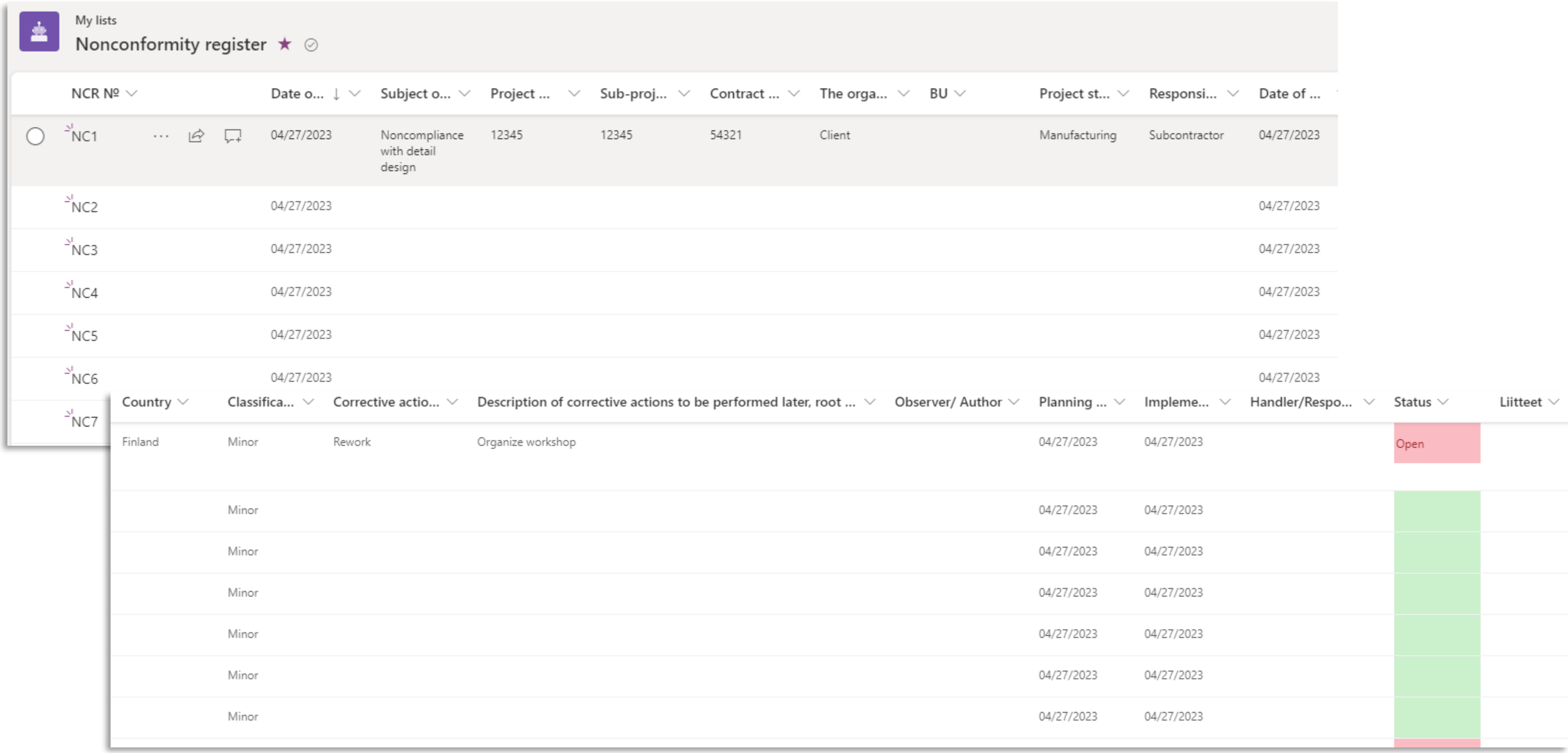
Information on detection		
The organization that detected the nonconformity:		
Business group/Unit	*Choose a BU*	
Project stage:	*Choose an option…*	
Responsible organization-who performs works:		
Contract № (in case related to project works with Subcontractor who has no contract relations with AFRY, but with Client)		
Date when nonconformity was detected:	Click or tap to enter a date.	
Country (of project execution/according to which norms the project is designed):	*Choose a country*	
Description of the nonconformity		
Detailed description of nonconformity:		
Violated requirements:		
Classification of nonconformity	*Choose an option*	
Nonconformity location (address, place, zone, axes):		
Project documentation identification (unique document code, drawing №):		
Immediate corrective actions taken		
Description of corrective actions:		
Observer (employee who detected the nonconformity):		
Planned actions, root cause		
Description of corrective actions (CA) to be performed later, root cause analysis (if required):		
	Planning date for CA approval	*Handler*
	Click or tap to enter a date.	
Implementation of CA deadline	Click or tap to enter a date.	
Distribution of the report		
Company	*Name, position*	

Page **1** of **2**

Attachments

N	Description
1.	
2.	

Interface of Nonconformity Register based on Microsoft List framework



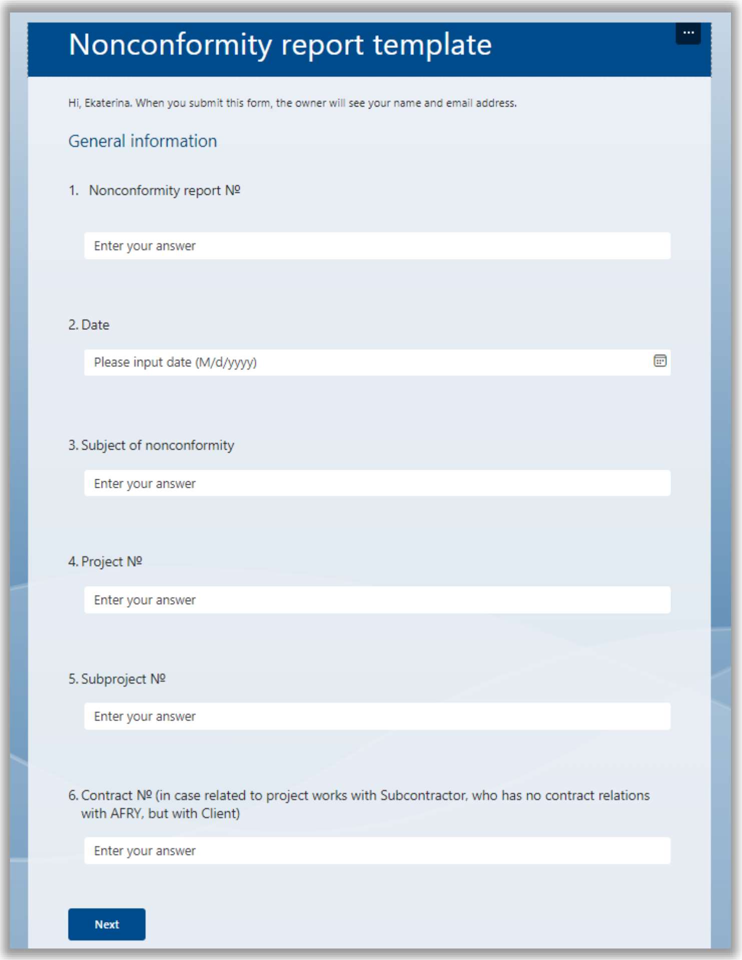
My lists

Nonconformity register

NCR №	Date o...	Subject o...	Project ...	Sub-proj...	Contract ...	The orga...	BU	Project st...	Responsi...	Date of ...
NC1	04/27/2023	Noncompliance with detail design	12345	12345	54321	Client		Manufacturing	Subcontractor	04/27/2023
NC2	04/27/2023									04/27/2023
NC3	04/27/2023									04/27/2023
NC4	04/27/2023									04/27/2023
NC5	04/27/2023									04/27/2023
NC6	04/27/2023									04/27/2023
NC7										

Country	Classifica...	Corrective actio...	Description of corrective actions to be performed later, root ...	Observer/ Author	Planning ...	Impleme...	Handler/Respo...	Status	Liitteet
Finland	Minor	Rework	Organize workshop		04/27/2023	04/27/2023		Open	
	Minor				04/27/2023	04/27/2023			
	Minor				04/27/2023	04/27/2023			
	Minor				04/27/2023	04/27/2023			
	Minor				04/27/2023	04/27/2023			
	Minor				04/27/2023	04/27/2023			
	Minor				04/27/2023	04/27/2023			

Fragments of Nonconformity reporting template based on Microsoft Forms framework



Nonconformity report template

Hi, Ekaterina. When you submit this form, the owner will see your name and email address.

General information

1. Nonconformity report №

Enter your answer

2. Date

Please input date (M/d/yyyy)

3. Subject of nonconformity

Enter your answer

4. Project №

Enter your answer

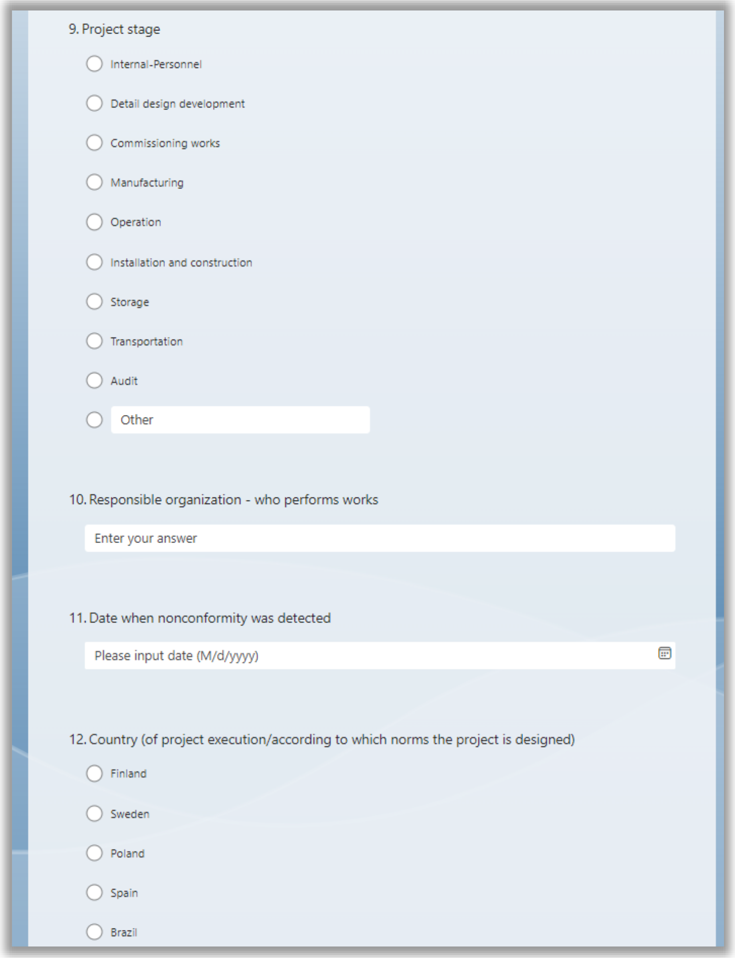
5. Subproject №

Enter your answer

6. Contract № (in case related to project works with Subcontractor, who has no contract relations with AFRY, but with Client)

Enter your answer

Next



9. Project stage

- Internal-Personnel
- Detail design development
- Commissioning works
- Manufacturing
- Operation
- Installation and construction
- Storage
- Transportation
- Audit
- Other

10. Responsible organization - who performs works

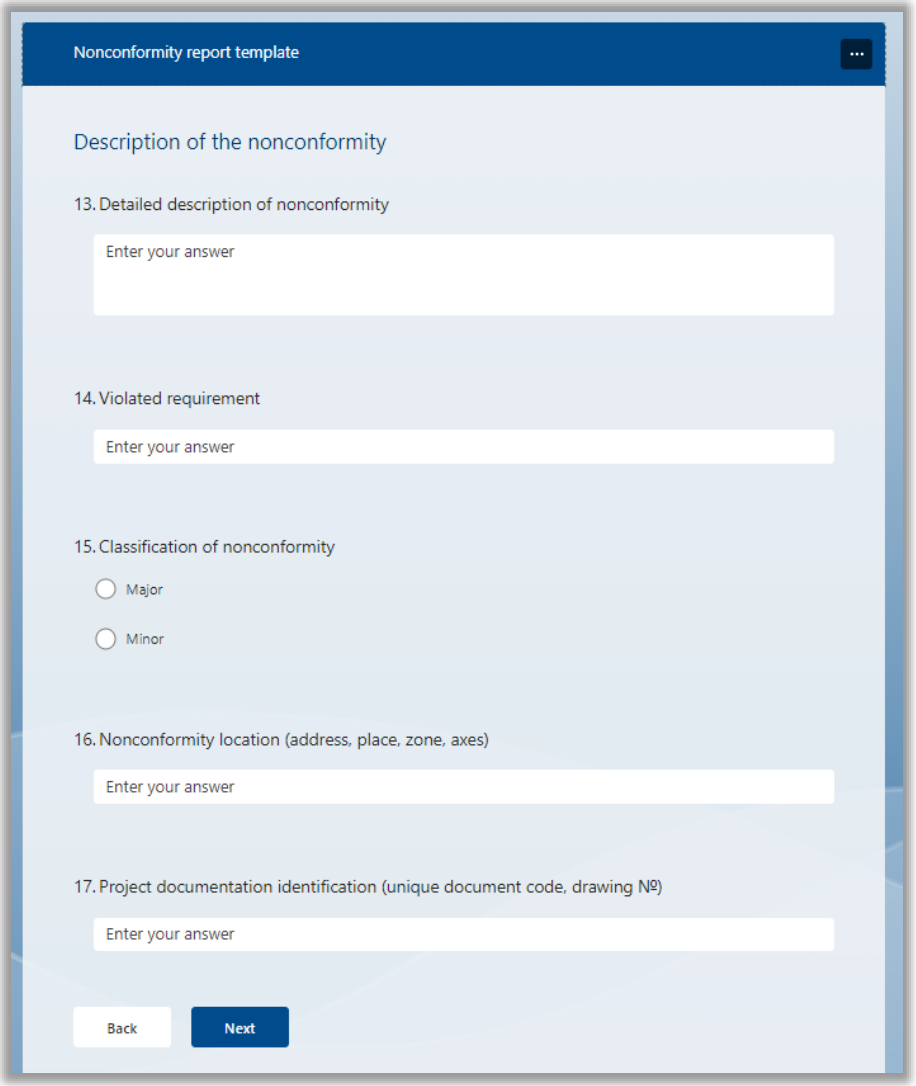
Enter your answer

11. Date when nonconformity was detected

Please input date (M/d/yyyy)

12. Country (of project execution/according to which norms the project is designed)

- Finland
- Sweden
- Poland
- Spain
- Brazil



Nonconformity report template

Description of the nonconformity

13. Detailed description of nonconformity

Enter your answer

14. Violated requirement

Enter your answer

15. Classification of nonconformity

Major

Minor

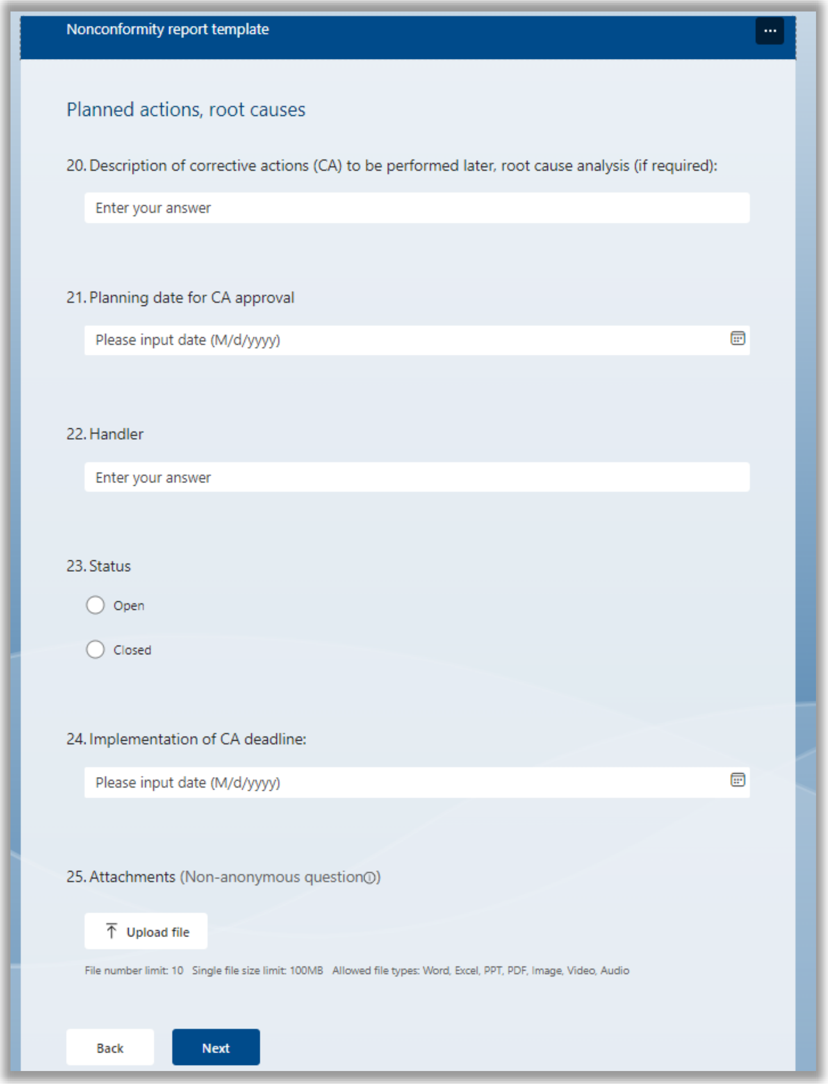
16. Nonconformity location (address, place, zone, axes)

Enter your answer

17. Project documentation identification (unique document code, drawing №)

Enter your answer

Back Next



Nonconformity report template

Planned actions, root causes

20. Description of corrective actions (CA) to be performed later, root cause analysis (if required):

Enter your answer

21. Planning date for CA approval

Please input date (M/d/yyyy)

22. Handler

Enter your answer

23. Status

Open

Closed

24. Implementation of CA deadline:

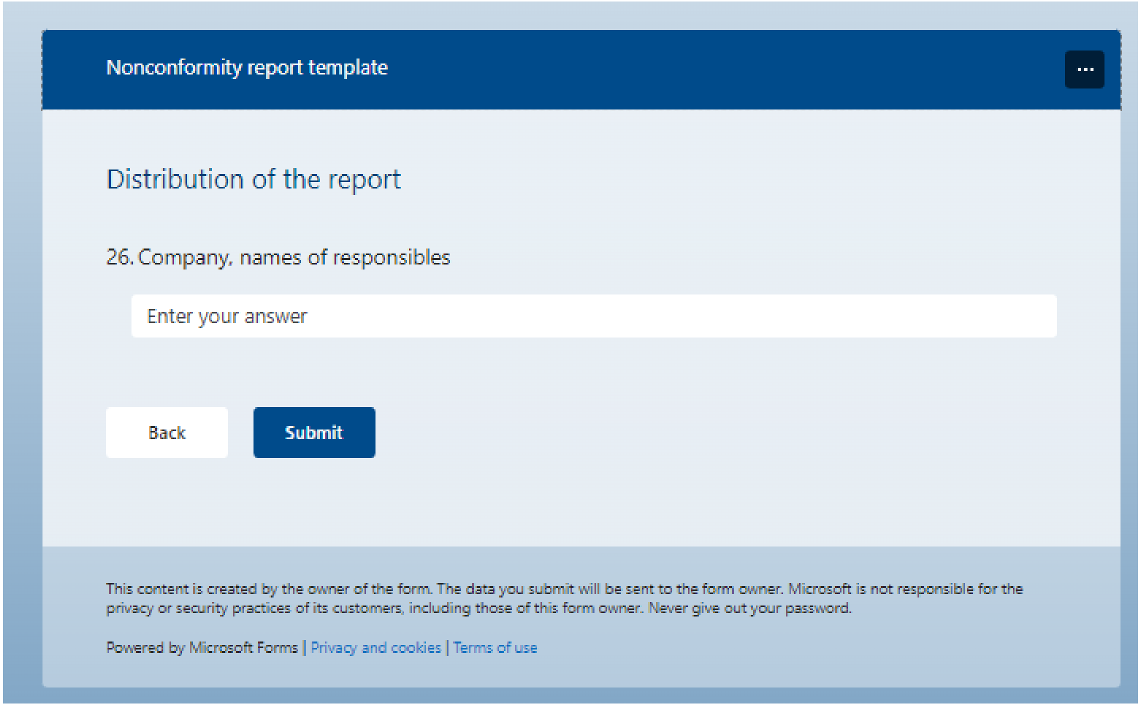
Please input date (M/d/yyyy)

25. Attachments (Non-anonymous question)

Upload file

File number limit: 10 Single file size limit: 100MB Allowed file types: Word, Excel, PPT, PDF, Image, Video, Audio

Back Next


Nonconformity report template
Distribution of the report
26. Company, names of responsibles
Enter your answer
Back
Submit
This content is created by the owner of the form. The data you submit will be sent to the form owner. Microsoft is not responsible for the privacy or security practices of its customers, including those of this form owner. Never give out your password.
Powered by Microsoft Forms | Privacy and cookies | Terms of use