Lecture Notes on Data Engineering
and Communications Technologies 208

Peter Štarchoň
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Data-Centric Business and Applications

Advancements in Information and Knowledge Management, Volume 2

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Lecture Notes on Data Engineering and Communications Technologies

Volume 208

The aim of the book series is to present cutting edge engineering approaches to data technologies and communications. It will publish latest advances on the engineering task of building and deploying distributed, scalable and reliable data infrastructures and communication systems.

The series will have a prominent applied focus on data technologies and communications with aim to promote the bridging from fundamental research on data science and networking to data engineering and communications that lead to industry products, business knowledge and standardisation.

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Preface

In the ever-evolving landscape of today's digital age, data has emerged as the lifeblood of businesses and a cornerstone for innovative applications across various domains. *Data-Centric Business and Applications: Advancements in Information and Knowledge Management* delves into the transformative power of data, exploring the latest advancements in information and knowledge management that reshape how organizations operate and make decisions. This book is a comprehensive exploration of data's crucial role in contemporary business environments. It seeks to provide readers with a nuanced understanding of the ongoing paradigm shift toward data-centric approaches and their profound impact on business strategies, decision-making processes, and application development.

The journey through these pages begins with exploring cutting-edge concepts and methodologies in information and knowledge management. From data governance and analytics to knowledge discovery and artificial intelligence, the book unravels the intricacies of managing, analyzing, and deriving meaningful insights from vast and complex datasets.

As we navigate through the chapters, readers will encounter a diverse array of topics, including integrating data-centric approaches in business models, the challenges and opportunities presented by emerging technologies, and the ethical considerations surrounding data-driven decision-making. Each chapter is authored by experts in their respective fields, contributing unique perspectives and insights to create a holistic view of the data-centric landscape.

In Chapter "Hydrogen Project Execution Plan for Domestic Use", authors Frank Jordan and Michal Greguš present an in-depth execution plan for a domestic hydrogen project. The chapter provides valuable insights into strategic considerations, implementation processes, and potential benefits, making it an essential resource for those interested in sustainable energy solutions.

Chapter "Exploring Different Approaches to Epidemic Processes Simulation: Compartmental, Machine Learning, and Agent-Based Models", authored by Dmytro Chumachenko, explores various simulation approaches for epidemic processes. Covering compartmental models, machine learning techniques, and agent-based

models, the chapter guides researchers and practitioners seeking a comprehensive understanding of different methodologies to analyze and simulate epidemic scenarios.

In Chapter "Enhancing a Learning Management System's Effectiveness Through NEP-Compliant Curriculum Changes and Their Effects at HEIs", authors delve into enhancing learning management systems through curriculum changes compliant with the National Education Policy. The chapter provides insights into the effects of these changes at Higher Education Institutions, catering to educators, administrators, and policymakers involved in curriculum development.

In Chapter "Analysis of Modern Approaches to the Transformation of Social Systems in Postmodern Society", Kateryna Molodetska critically analyzes modern approaches to transforming social systems in postmodern society. This chapter contributes to the discourse on societal evolution, offering a comprehensive understanding of the challenges and opportunities inherent in reshaping social structures.

Chapter "Reputation of a Non-profit Organisation—A Quantitative-Empirical Study Embedded in Risk Management on Police Reputation and Reputation Loss", authored by Lea Saal, Torsten Huschbeck, and Christian Horres, conducts a quantitative-empirical study on the reputation of non-profit organizations, focusing on police reputation and reputation loss. This chapter provides valuable insights for researchers and practitioners in risk management and organizational reputation studies.

The collaborative effort of Anna Kozak, Solomiia Fedushko, and Karolina Szymaniec-Mlicka in Chapter "The Role of Information and Communication Technology in the Social and Healthcare Services Co-production" explores the role of information and communication technology in the co-production of social and healthcare services. The authors shed light on the transformative impact of technology on service delivery, making it essential reading for professionals in healthcare and technology.

Chapter "Trade Unions of Eastern Galicia During the Socio-political Processes of the 19th–Early 20th Centuries", authored by Ihor Berest, Sergiy Honchar, and Oleh Gonchar, delves into the historical development of trade unions in Eastern Galicia during significant socio-political processes from the 19th to the early 20th centuries. This chapter provides valuable insights into the role of trade unions in shaping societal dynamics.

The authors, in Chapter "Image Processing Application Development: A New Approach and Its Economic Profitability", introduce a novel approach to image processing application development and evaluate its economic profitability. The chapter presents a cutting-edge perspective for researchers and practitioners in image processing and application development.

Chapter "Sustainable Supply Chain of Both Organic and Non-organic Food Under Uncertainty", authored by Mehrsa Mashhadi, Reza Shahin, and Azadeh Farsi, addresses the challenges of uncertainty in supply chain management. The chapter explores the sustainable supply chain of organic and non-organic food, providing valuable insights for researchers and practitioners seeking sustainable solutions in the food industry.

In Chapter "Time Series Forecasting for Personal Protective Equipment During COVID-19 Pandemic: A Case Study of Quebec", Reza Shahin, Martin Beaulieu, and Amir Shahin present a case study on time series forecasting for Personal Protective Equipment during the COVID-19 pandemic in Quebec. This chapter offers essential knowledge for researchers and policymakers involved in pandemic preparedness.

Chapter "Cultural Heritage Management: A Review of the Literature", by Olena Shlyakhetko and Clemens Steinringer, comprehensively reviews the literature on Cultural Heritage Management. This chapter is a valuable resource for scholars, practitioners, and policymakers interested in understanding the complexities of managing cultural heritage.

Mariia Sokil, Yuriy Syerov, and Vita Boiko, in Chapter "From Destruction to Digitization: Safeguarding Ukraine's Cultural and Archival Heritage in Wartime", delve into the crucial task of safeguarding Ukraine's cultural and archival heritage during wartime. The chapter offers insights into strategies and challenges associated with preserving cultural artifacts and archival materials in conflict zones.

Chapter "Machine Learning for Predicting Stroke Occurrences Using Imbalanced Data" explores the application of machine learning for predicting stroke occurrences using imbalanced data. This chapter contributes to the advancement of predictive healthcare analytics, offering valuable insights for researchers and healthcare professionals.

Daniela Nováčková, Iveta Stankovičová, and Ľubomíra Strážovská, in Chapter "State Aid—Economic Instrument to Support SME", address the economic support for SMEs by examining State Aid as an economic instrument. This chapter provides a comprehensive perspective for policymakers, economists, and researchers interested in SME development.

Chapter "Identification of Determinants of Using Crowdfunding as a Source of Financing the Development of Social Enterprises–the Perspective of Polish Social Entrepreneurs", by Martyna Wronka-Pośpiech, Maria Węgrzyn, Aldona Frączkiewicz-Wronka, and Krzysztof Leja, explores the determinants of using crowdfunding as a source of financing the development of social enterprises. The chapter offers the perspective of Polish social entrepreneurs, providing valuable insights for researchers and practitioners in the field.

In Chapter "The Slovak Organic Food Market: Development of Organic Agricultural Area, Organic Agricultural Production and Sales of Packaged Organic Food", Malgorzata Agnieszka Jarossová, Renáta Ševčíková, and Katarína Chomová explore the development of the Slovak organic food market. The chapter focuses on the growth of organic agricultural areas, the production of organic agricultural goods, and the sales of packaged organic food. This comprehensive analysis provides valuable insights for researchers, policymakers, and industry professionals interested in Slovakia's organic food sector dynamics.

Chapter "A Survey of Crowdsourcing in Last-Mile Delivery in the Optimization Literature", authored by Reza Shahin, Amir Shahin, and Maxim A. Dulebenets, surveys crowdsourcing in last-mile delivery within the optimization literature. The chapter explores the applications and implications of crowdsourcing in optimizing

the final stages of delivery processes. This research is crucial for professionals and researchers engaged in logistics and supply chain management.

Chapter "Influence of the State on Cross-Border Trade Management in Commercial Global Digitalization", authors investigate the influence of the state on cross-border trade management in the context of commercial global digitalization. The chapter offers a nuanced examination of the roles and impact of state intervention in managing cross-border trade within the framework of global digitalization. This research is essential for policymakers, economists, and scholars studying international trade dynamics.

Chapter "Forecast Modelling of Socio Economic Development Under Social and Economic Transformations" focuses on forecast modeling of socio-economic development under social and economic transformations. The chapter provides insights into modeling techniques and scenarios for predicting socio-economic changes in the context of broader societal transformations. This research is valuable for policymakers, economists, and researchers seeking to understand and anticipate the complex dynamics of socio-economic development in changing environments.

The book is intended for a broad audience, including researchers, practitioners, academicians, and business professionals seeking to stay at the forefront of information and knowledge management advancements. Whether you are a data scientist, a business executive, or an academic researcher, the diverse range of topics covered in this volume offers valuable insights that can inform your understanding of the role of data in shaping the future of businesses and applications.

We express our gratitude to the contributing authors who have shared their expertise and experiences, making this book a collaborative endeavor that reflects the multidimensional nature of the data-centric revolution. As editors, we hope this compilation is a valuable resource, inspiring further exploration and innovation in the dynamic realm of data-centric business and applications.

Companies need sustainable solutions to the pressure to deal with high levels of risk and uncertainty. Many companies face this challenge and must find new ways to deal with it. These solutions are often based on digital-influenced techniques. This volume of our subseries encourages further research by highlighting ongoing progress in structural management. Previously understood knowledge, technologies and data can provide a huge assist with this goal.

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Contents

Hydrogen Project Execution Plan for Domestic Use

Frank Jordan and Michal Greguš

Abstract In today's world, technical systems are progressively becoming more intricate, and as a result, the number of projects that cannot meet their objectives, be it in terms of cost or schedule, is on the rise. Renewable energy projects are essential for the survival of the European economy. These projects need to be implemented fast and without fail. The utilization of hydrogen is the key to expanding the energy contribution of renewable energy by utilizing hydrogen as storage media and decoupling supply and demand, but hydrogen has its drawbacks. However, a promising market for hydrogen as an energy carrier can be implemented with end-users for electricity if all the safety concerns are addressed and the projects are executed with modern management practices. This market will be predominantly made up of small and medium-sized enterprises that engage with both renewable energy providers and homeowners, resulting in a business-to-consumer model that is not likely to draw the attention of more giant corporations. Due to the hazardous nature of hydrogen, which is highly combustible and explosive, there are stringent regulations governing its trade and transport to ensure safety standards are maintained. The ensuing project execution plan is explicitly designed for a hydrogen energy cycle device but can be adapted to fit other projects and industries as required. The project execution plan suits two groups of customers: Producers of hydrogen (such as windmills, PV farms, and bioenergy plants) and consumers of hydrogen as an energy carrier (house owners, small and medium-sized factories, chemical plants, and the food and beverage industry).

Keywords Project execution plan · Renewable energy projects · Hydrogen as an energy carrier · SMEs · Project governance and organization · HSSE

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1 Introduction

1.1 Relevance

Project management is a critical process that requires careful planning, execution, and control of a series of tasks to achieve specific objectives. In any project, the execution phase is the most critical stage, where the actual work is done and project deliverables are produced. For successful project delivery, project managers must have a well-defined plan that outlines the approach, activities, and timeline required to achieve project goals.

The Project Execution Plan (PEP) is an essential document that outlines the project's execution strategy, defines the roles and responsibilities of project stakeholders, and provides a framework for managing project risks and issues. The PEP serves as a guide for project teams to ensure that the project is executed efficiently and effectively, meeting its objectives within the defined scope, time, and budget [1].

In this context, this article aims to provide a detailed guideline of the need for project execution plans for domestic hydrogen projects. The report will begin by defining the concept of a project execution plan and its key components. The paper will then explore the importance of a project execution plan in ensuring successful project delivery, including the benefits of having a well-defined plan, such as clear communication, resource allocation, risk management, and project control. Finally, the paper will conclude with some recommendations for project managers on developing an effective project execution plan that can help ensure project success.

1.2 Goals and Objectives

The overarching goal of a PEP is to ensure successful project delivery by providing a clear and detailed plan for project execution. The PEP is a guiding document outlining the approach, activities, and timeline required to achieve project objectives within the defined scope, time, and budget. The PEP aims to ensure that the project is executed efficiently and effectively by providing a comprehensive framework for project management, including roles and responsibilities, project scope, deliverables, timelines, risk management strategies, and project control and monitoring [1].

The objectives of a PEP can be categorized into several key areas.

Firstly, the PEP aims to define the roles and responsibilities of project stakeholders, ensuring that each team member understands their duties and obligations. This ensures everyone is seamlessly collaborating and reduces the likelihood of misunderstandings and miscommunication.

Secondly, the PEP aims to define the project scope, deliverables, and milestones, ensuring that the project remains on track and within budget. This includes a detailed breakdown of project requirements, objectives, and success criteria.

Thirdly, the PEP aims to outline the project schedule, including timelines for completing each task, dependencies, and critical path analysis. This helps project teams to manage their time effectively and avoid delays, ensuring that the project is delivered on time. Fourthly, the PEP aims to identify project risks and issues and outline mitigation strategies to minimize their impact on the project. This includes a detailed risk management plan, including risk identification, assessment, and response planning [2].

Finally, the PEP aims to provide a framework for project control and monitoring, ensuring that progress is tracked and deviations from the plan are identified and addressed in a timely manner. This includes a project management plan, including project reporting, change management, and quality control processes [3].

This PEP's goals and objectives are associated with small hydrogen projects, which do not have a large organization behind them that can customize the plan as per individual project requirements. The PEP aims to ensure that these small projects are executed efficiently and effectively, meeting their objectives within the defined scope, time, and budget while minimizing risks and issues.

2 Theoretical and Conceptual Background

2.1 Business Requirements

Hence project is specifically dedicated to a domestic hydrogen project, the basic business requirement must be outlined and understood.

The task of this theoretical project is to replace a conventional fossil fuel-operated heating system with a hydrogen-based heating system. The entire system comprises several components depicted in the Fig. 1.

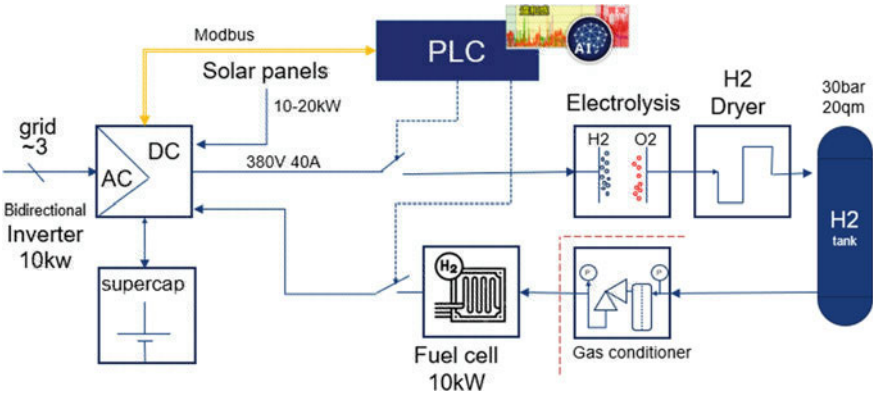

Fig. 1 Block diagram hydrogen system

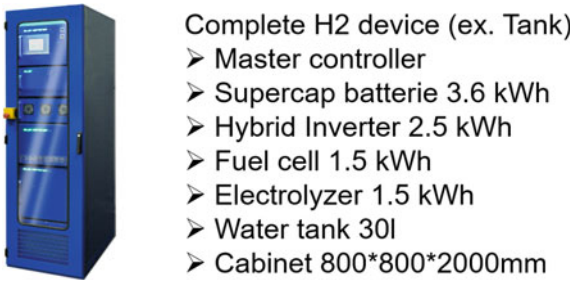

Fig. 2 Domestic system depiction

Please note that the integration into the house's heating system is not depicted. But it can be considered that the heat from electrolysis and the fuel cell contributes to the heating once they are in operation [4].

For the scope of the article, the technical details are irrelevant because the components come in readymade designs that must be integrated at the site (see below). The article will focus only on the project execution plan (Fig. 2).

In contrast to a standard replacement of a heating system, multiple disciplines are involved based on the complexity of the system and the regulatory requirements of the district and regulatory authorities.

There are subcontractors involved, and the scope should be clearly defined. In many of these specific cases, the company is only providing the core components like

OEMs, for:

- Hydrogen-producing cabinet for renewable energy (windmill, PV farm, etc.)
- Fuel cell, control system, inverter battery pack and
- electrical cabling and integration for the final customer needs.

But there is additional work to be considered, such as:

- Trenches for cables, electrical power cabling
- Foundations for the container
- Middle voltage cable connections etc.
- Piping
- Welding Pressure testing will be subcontracted to the local vendor.
- Approving authority such as TUV.

The given samples are just a subset of possible scopes to be considered, which can be expanded depending on the project requirements.

2.2 Opportunity Assurance

Becoming a project manager involves trusting management that you can manage a project successfully in regard to cost and schedule.

Project management is a senior skill of experienced persons who have a general understanding of the subject but are not focused too much on technical details. The skill set should be clearly focused on the following:

- Excellent communication skills
- Managing stakeholders and personal
- Follow the schedule
- Stay within the budget
- Closing the project successfully [2]

The selected personnel (engineers and workers) should have the knowledge and the means to conduct the task as requested. Lessons Learned should be recorded and refreshed before executing the project to become routine. To ensure the work will be executed in a professional manner. Toolbox talks should be conducted prior to work to explain the work and identify the risks.

The routine work should be recorded by checklists, method statements, videos (time slap movies) and pictures as evidence in case events occur which require proof of evidence to divert the responsibility.

The final goal is conducting the business opportunity [5] in a safe manner and maintaining the goals (schedule and budget).

3 Project Governance and Organization

At the initiation of a project, it is imperative to develop an organizational chart. (see attachment 1)This chart shall include all relevant stakeholders, along with their respective names, positions, companies, and communication details such as phone numbers, mobile numbers, and email addresses. The communication channels to be used should be established according to the hierarchy. For emergency situations, the organizational chart should also include the contact information of all relevant personnel, such as first aiders, ambulance services, fire brigades, and police departments. Hydrogen is a highly combustible substance and is, therefore, subject to strict regulations. As a result, the organizational chart should also feature approving authorities such as TUV and local government representatives. With the identified stakeholders, an organizational chart should be employed, which clearly delineates the responsibilities of each member. This chart should be displayed at each site and within the responsible team, and the project manager is responsible for ensuring that it is regularly updated.

The project will be controlled by a project manager at the top of the org chart and is legitimate by the project charter.

A project charter is a document that outlines the project's scope, objectives, and stakeholders, and it is typically developed by the project manager. It serves as a reference guide for the project team, providing clarity on the project's goals and purpose and ensuring that everyone is aligned on the project's direction.

The project charter typically includes the following sections:

1. Project overview: this section describes the project's purpose, objectives, and the problem it aims to solve. it provides an overview of the project's scope, timeline, and budget.
2. Stakeholder analysis: This section identifies the stakeholders who will be affected by the project, including customers, suppliers, team members, and any regulatory bodies. It includes an assessment of their needs and expectations and how they will be impacted by the project.
3. Project scope: This section defines the boundaries of the project and what is included and excluded from the project's scope. It outlines the deliverables that will be produced and the tasks required to achieve them.
4. Project milestones: this section outlines the key milestones and deadlines for the project, including the start and end dates and any important dates in between.
5. Budget and resources: This section outlines the budget and resources required for the project, including personnel, equipment, and materials. It includes a cost-benefit analysis and identifies any risks associated with the budget.
6. Risks and assumptions: This section identifies the risks associated with the project, including potential delays, budget overruns, and other factors that could impact the project's success. It includes a risk management plan and contingency measures to mitigate those risks.
7. Project team: this section lists the team members who will be working on the project, their roles and responsibilities, and their reporting structure.

Overall, the project charter is an essential document that sets the foundation for the project's success. It provides a framework for project planning, execution, and monitoring, ensuring that everyone is aligned on the project's goals and objectives. The project manager is responsible for creating and maintaining the project charter throughout the project's lifecycle.

According to PMI the project charter is a key document in the project integration management process and is described in detail in sect. 4.1 of the PMBOK guide, titled "Develop Project Charter". The thesis will pick some topics out and tailor them for the BH application [6].

4 HSSE and Social Performance

4.1 HSSE Targets

In today's global business environment, the implementation of the Goal Zero mission has become a primary target for world-class corporations, and business conglomerates worldwide. This mission has been widely accepted and embraced by companies of all sizes and sectors [7]. Small and medium-sized companies should not hesitate

Table 1 Previous project's performance

Indicator	Target	Actual	Explanation
Life-saving rules (LSR)	0		
Loss of primary containment (LOPC)	0		
Lost time incidents (LTI)	0		
Total recordable cases (TRC)	0		

to pursue this same goal, as it can have significant benefits for both the company and its customers.

Hydrogen, being a B2C business, often involves one-time transactions with individual customers. Therefore, it is crucial for companies to gain the trust of their customers by demonstrating their competence and reliability. For example, companies may choose to display a chart on their website that provides clients with an overview of their performance in previous projects. This can help build trust and confidence in the company's ability to deliver high-quality work (Table 1).

In contemporary business operations, occurrences may transpire at any given moment, and it is incumbent upon companies to maintain transparency by communicating truthful accounts of such incidents. Thus, it is recommended that any incidents be meticulously recorded, with the due explanation provided as to their cause. Striving towards a goal of zero incidents is a pivotal measure in preventing future reoccurrences and, concurrently, establishing and sustaining the trust of clients [7]. By operating with a transparent and honest disposition, companies can convey a sense of openness, reliability, and integrity. The end customer will get with this information the clear message he is in safe hands with the vendor/construction company.

4.2 HSSE Management System and Standards

The trend of workforce fluctuation is on the rise due to a multitude of reasons, including but not limited to headhunting efforts, increasing versatility and volatility of projects, shorter production and implementation times, changing skill set requirements, and business transformations. It is imperative, therefore, to integrate new members of the workforce into the team in a structured and ongoing manner, providing them with guidance and support to ensure a smooth assimilation process (Table 2).

For international references can be stated following standards:

- International Organization for Standardization (ISO). ISO 45001: Occupational health and safety management systems–Requirements with guidance for use. https://www.iso.org/standard/63787.html.

Table 2 Standard document

Standard document	Description
HSSE	HSSE control within the company
CSSS	Construction site safety standardization
Country specific	Region/cluster/country-specific HSSE management system

- Occupational Safety and Health Administration (OSHA). Process safety management of highly hazardous chemicals. https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.119.

4.3 HSSE Activity Plan

To uphold the objective of zero incidents, it is crucial that every employee is cognizant of their role within the Health, Safety, Security and Environment (HSSE) system and comprehends their corresponding responsibilities. The project manager must designate a responsible individual for each team and establish excursion targets for participation. Thus, the producer and consumer of hydrogen may be viewed as a cohesive unit. Once the protocols, studies, and activities are documented and defined, they can be standardized across the organization. The responsible party is then accountable solely for ensuring that these standardized measures are applicable to the work site and should inform the team of any additional risks or concerns to be considered (Table 3).

Table 3 HSSE activity plan

Activity	Resp. party	Target date	Reviewers	Done? (Y/N)
Conduct HSE studies (HAZOP) and Doc. ALARP				
Define construction safety requirements				
Develop construction safety roadmap				
Develop HSSE premises				
Manage construction safety on site				
Perform HAZID of options				
Prepare HSSE activity plan				
Review contractor HSSE Plan				
Review site HSE requirements for new hazards				
Lessons learned review				
Toolbox talks				

4.4 Construction Safety Roadmap

It is imperative that the following areas are important in project planning. A comprehensive checklist of these areas shall be reviewed during the project's kick-off meeting. One famous quote related to project planning and management is by Harold Kerzner, a renowned scholar and author in the field of project management, who said, "Without proper planning, there can be no real management; only a façade [8]." This highlights the importance of thorough planning and review in successful project management (Table 4).

4.5 Construction Safety Requirements

Construction safety requirements refer to the measures and guidelines put in place to ensure the safety and well-being of workers, visitors, and the general public during construction activities. The construction industry involves high-risk activities that can result in injuries or fatalities if safety measures are not observed. Handling hydrogen in the domestic environment takes special care to ensure long-term safety. As a result, construction safety requirements are essential in mitigating these risks and ensuring that construction activities are carried out safely. These requirements include ensuring that workers have the necessary training and personal protective equipment (PPE), adhering to strict safety protocols, conducting regular safety inspections and risk assessments, providing adequate lighting, ventilation, and emergency exits, and ensuring that construction sites are secure and well-maintained. Additionally, construction safety requirements may also involve implementing measures to prevent falls from heights, electrical hazards, exposure to hazardous chemicals, and other potential hazards that may arise during construction activities. By enforcing strict construction safety requirements, the construction industry can reduce the incidence of injuries and fatalities and create a safer working environment for all workers involved. Ultimately the HSE goal of zero injuries can be achieved once all follow the safety requirements.

4.5.1 Construction Safety Roles and Responsibilities

In a construction project, it is not uncommon to have dedicated personnel who may not be reflected on the organization chart. Nevertheless, it is imperative that everyone's role and responsibilities are clearly identified and understood, e.g., neighbours. In addition to the practical benefits, it is also a legal requirement to designate the person who is in charge. As renowned safety expert John Drebinger once said, "Safety is not just a requirement for the job; it's a mindset for life." This mindset should be instilled in every individual involved in the construction project, regardless of their

Table 4 Construction safety roadmap

Item	Activity	Resp. party	Target date	Done? (Y/N)
Safety leadership	Early and sustained engagement with contractors on HSSE Project-specific goal zero strategy and its implementation Develop safety leaders Right project safety focus through key times Steer safety at the work level Develop a safety culture based on behaviors			
Care for people	Go beyond health and safety requirements Timely develop a strategy to address CfP through execution: Well-being of workers Ease access to resting places, water, facilities, and workplaces Monitor and influence contractors/ subcontractors on workers' living conditions, fair pay, and work regime Keep workers comfortable and productive			
Staffing, training and competency	Set the right construction HSSE organization Timely involvement of key construction HSSE resources in planning Project team competency on construction safety (construction masterclass) Site's HSSE training facilities and resources Contractor's HSSE competency management system			
Communications	Communication's strategy for the project duration—what, how and resources to communicate safety Communications network Awareness communication campaigns—visual management themes and resources Daily awareness communications to the workforce—toolbox, site risk assessments			
Worksite setup	Early HAZID addresses exposure reduction to key risks—methods, plans and timing Constructability review addresses safety aspects HSSE readiness review—main Contractor and execution contractors Address site spatial safety aspects (traffic, temporary facilities etc.)			

Table 5 Construction safety requirements

Role	Name	Contact details
Decision executive		
Engineering service provider		
Facility engineer		
HSSE representative		
Implementation contractor		
Lead facility engineer		
Project manager		
Company safety manager		
Site construction safety lead		
Site project engineer		
Windfarm representative		
Operation representative		
Maintenance representative		
Final customer representative		

position or title, and be reflected in the designated roles and responsibilities assigned to each person [9] (Table 5).

It is a frequent occurrence in construction projects for stakeholders to request changes, but it is essential to determine which client representative is authorized to approve or request such changes. Furthermore, all modifications should be documented and mutually agreed upon before implementation. However, in terms of safety, all individuals involved in the project should be empowered to intervene and halt any unsafe behaviour. There should be no repercussions for stopping an activity that poses a risk to oneself or others. As stated by the Occupational Safety and Health Administration (OSHA), "Employees have the right to a safe workplace" [10]. The law requires employers to provide their employees with safe and healthful workplaces; in the DACH region, this is no exception. The OSHA law also prohibits employers from retaliating against employees for exercising their rights under the law. This highlights the importance of creating a culture of safety and empowering all individuals to take necessary safety measures without fear of retribution.

If there is no way found to execute the task safely, then there should be found another way, and it means to reach the target but safely.

4.6 Hazard Management Process

In many instances, local subcontractors may be necessary, and their selection may be predetermined by the client or local regulations. Mitigating potential risks and foreseeable hazards should be communicated to these subcontractors and clearly define

the expectations of the company. The hazards associated with the work typically remain constant, and it is recommended to address them upfront to avoid disputes on the job site with the customer. This proactive approach demonstrates the company's competence and integrity, and the hazards only need to be reviewed on-site. As noted by the Health and Safety Executive, "Effective management of risk is about controlling the potential harm to people, whether they are employees, contractors, customers, or members of the public, from real risks" [10]. By identifying and addressing hazards up front, companies can proactively manage risks and protect the well-being of all involved parties (Table 6).

Additional safety practices require the need to identify and to address the responsibility of one person to be accountable (Table 7).

Table 6 Hazard management process

Hazardous activity	Project risks and mitigations
Confined space work	Working in hydrogen tank => buddy system
Excavations	Trenches for cables => proper filling angle and wall support
Heavy equipment and vehicle operations	Excavator movements => additional watchmen and safety instructors
Hot works	Welding => shielding and barricading
Lifting and hoisting	Lifting hydrogen tank and container => certified equipment and crew
Safe isolation of energy	Connecting to switch gear => certified SME
Scaffolding and other forms of access	Unstable scaffold => certified equipment and crew
Simultaneous operations (SIMOPS)	Excluding tasks => define order and schedule properly
Working at height	Excluding tasks => certified equipment and crew

Table 7 Safety practices

Safe practices	Details applicable to the project	Responsibility/name
Barricades and open holes		
Dropped objects		
Housekeeping		
Line of fire		
Personal protective equipment		
Routine life tasks		

Table 8 Applicable industry standards

Doc. no	Description
DIN, EN, VDE, API, BS, ASME, e.g ISO 22734 Country standards	Control system, piping, etc Hydrogen generators using water electrolysis—industrial, commercial, and residential applications

5 Defining Technical Scope

5.1 Applicable Industry Standards

See Table 8.

Each project shall follow the rules, standards, and customs requirements. The hierarchy shall be defined within the contract to ensure compliance.

In general, the following pyramid or order of precedence should be followed.

- Local law
- International agreed on the law
- Project specification
- Company standards
- Industrial standard
- International standard
- Company rules and regulations
- Maintenance and installation guidelines

In case of doubt or ambiguity, the most stringent regulation should be selected [11].

5.2 Quality Standards, Procedures, and ITPs

See Table 9.

Quality standards are defined as documented requirements, specifications, guidelines, or characteristics that can be utilized consistently to ensure that materials,

Table 9 Quality standards, procedures, and ITPs

Quality standard, procedure, or ITP	Resp. party	Target date	Reviewers	Done? (Y/N)
ITP (Integrity test procedures)				
Device manuals for operation				
Start up procedures				

products, processes, and services [12] are suitable for their intended purpose. Standards offer several benefits to organizations, including facilitating communication, reducing costs, and improving quality.

One significant benefit of using standards is that they provide a common understanding for organizations to communicate effectively with their stakeholders. By following recognized standards, organizations can demonstrate the commitment to quality and transparency, which can enhance their reputation and build trust with customers, partners, and regulators [13].

Furthermore, standards can help organizations reduce costs by providing clear guidelines for processes, materials, and products. Standards can also increase efficiency by streamlining R&D developments, which can save time and money while maintaining product quality.

Moreover, standards can improve quality by providing clear criteria for evaluating performance and ensuring consistency in product outcomes. By adhering to recognized standards, organizations can reduce the risk of defects and improve customer satisfaction.

Utilizing standards provides organizations with a shared vision, understanding, procedures, and vocabulary needed to meet the expectations of their stakeholders. By offering precise descriptions and terminology, standards offer an objective and authoritative basis for organizations and consumers worldwide to communicate and conduct business.

Standards are crucial to the bottom line of every organization, and successful businesses recognize their importance as essential tools for managing quality, safety, intellectual property, and environmental policies. Standardization helps reduce costs by minimizing errors or recalls, reducing redundancy, and shortening time to market, leading to improved competitiveness and increased profitability. However, the appliance of standards needs to be critical review if it does not unnecessarily inflate the cost of the product. Therefore, the selection of applicable standards is crucial for successfully designing the product. Marketing and R&D should work hand in hand together to meet the customer's requirements. E.g., From the original design of the BH, 50% of the components were found from the off-the-shelf market. By implementing these products, they already have their standards and market acceptance, which does not have to be regenerated or reinvented again.

Moreover, adhering to quality standards allows businesses to trade globally, as it helps ensure that products, services, and personnel can cross borders without hindrance, increasing access to new markets and potential customers (World Trade Organization 2017). International standardization also enables products manufactured in one country to be sold and used in another, providing consumers with a wider range of choices and more convenience.

In conclusion, standards play a critical role in driving business success, promoting global trade, and improving the lives of consumers. By reducing costs, minimizing errors, and increasing compatibility, standardization enhances competitiveness, profitability, and convenience for all stakeholders (Tables 10 and 11).

In the context of design and construction, it is imperative that the execution of work should strictly follow the rules and standards specified under section 7.1. In

Table 10 Description of standards

Topic	Standard
Quality management	ISO 9000
	ISO 9001
Auditing	ISO 19011
Environmental management	ISO 14000
	ISO 14001
Risk management	ISO 31011

Table 11 Technical assurance

Critical documents and drawings	Resp. party	Target date	Reviewers	Done? (Y/N)
Design basis (HSSE critical equipment)				
Cause and effect diagrams				
Facilities layout (Plot Plan)				
Hazardous area classification				
Process engineering flow schemes (P&IDs)				
Checklists of functionalities				

compliance with ISO 9000 and the attainment of requisite quality standards outlined in Table 10, it is essential that all work is detailed, described and documented. It is advisable to freeze the design prior to the commencement of work and prepare checklists to guide the construction team in maintaining the desired level of quality. With clear lines of responsibility established and assigned to a dedicated individual, technical integrity will be ensured by the accountable person or entity. These are legal requirements to address grievances in case of failures which require them to be solved by court.

6 Project Management

6.1 Project Budget

See Table 12.

The project budget defines how much money is foreseen to be spent to ensure the project margin.

To give the project manager the flexibility to manage the project [14, 15], there should be given the flexibility to spend more money if needed to maintain the schedule. If there is no flexibility given, it will directly impact the schedule because

Table 12 Project budget

Funding type	Plan ($k)	Actual ($k)	Variance
Pre-investment			
Capex			
Revex			
Contingency			
Totals			<10%?

Table 13 Project schedule

Milestone	Plan date	Actual date	Variance
PDR/IP approved (FID)			
Mobilize contractors install			
Civil works start			
Electrical work starts			
Mechanical completion			
Ready for start-up (RFSU)			
Project closeout			

the project manager must ask permanently for approval. The project execution will be jeopardized as well as in relation to the sub-contractors and customers. The project manager could be seen as having no authority, and therefore, he will not be respected. Ultimately delays cost money; therefore, the project manager should have to flexibility to preferent delays which results in cost overruns [16].

6.2 Project Schedule

See Table 13.

The project shall have clearly defined milestones which are linked to reporting and financial payments. Stakeholders will be aware of what date they will get an update, or they will be mobilized. The Milestones should have a clear, measurable, and agreed task which must be fully filled first to be acknowledged. In case of delays, the schedule can be put under scrutiny by defining the critical path and starting with additional measures to maintain the milestones.

6.3 Management of Change

Throughout the course of project execution, various types of variances may arise. It is crucial that the project manager possesses the expertise to manage such deviations,

either by averting or mitigating their impact on the project. Change requests may originate from both internal and external sources. Requests from within the organization typically do not hold significance for the client and are hence usually free of charge, such as essential software upgrades during the commissioning of the BH. Conversely, external change requests, for instance, those from the client, must be meticulously documented, and a comprehensive understanding of their implications must be established prior to their incorporation into the project:

- Who can request a change?
- Who has the authority to sign the change?
- How will the change be compensated for and implemented?
- What is the agreement mechanism with customers to deal with changes? [2].

6.4 Opportunity Management

Opportunity management refers to the process of identifying, evaluating, and pursuing potential opportunities for a business or organization. Hence, we have found that blue ocean marketing is suitable for this business; it is logical to search systematically for identifying potential opportunities that align with the BH capabilities, evaluating the feasibility of pursuing those opportunities, and then developing and implement strategies to take advantage of them. For instance, during site implementation, the existing fossil fuel system needs to be disposed of; this shall be taken as an opportunity to make more profit.

The key elements of opportunity management include:

- Opportunity identification: This involves actively seeking out potential opportunities that can help the company achieve its objectives and expand the business. This can include analyzing market trends, studying customer needs from given feedback and monitoring industry developments and competition. E.g., if two neighbours can share the same hydrogen tank, it would reduce the system cost and enhance competitiveness.
- Opportunity evaluation: Once potential opportunities have been identified, they need to be evaluated to determine whether they are worth pursuing. This involves assessing the potential risks and rewards associated with each opportunity, as well as analyzing the organization's capabilities and resources to determine whether it has the necessary resources to pursue the opportunity.
- Opportunity selection: Based on the evaluation, the organization selects the opportunities that are most aligned with the product performance without major changes and which would have the greatest potential for success.
- Opportunity implementation: Once an opportunity has been selected, the management should develop an implementation plan to pursue it. This involves identifying the necessary resources, developing a timeline, and establishing clear goals and objectives.

- Opportunity monitoring: Finally, the management shall continuously monitor the progress of the opportunity and make any necessary adjustments to ensure that it remains on track and aligned with the organization's strategic objectives.
- Effective opportunity management requires a proactive and strategic approach to identifying and pursuing potential opportunities, as well as the ability to assess risks and rewards and make informed decisions based on that assessment.

6.5 Risk Management

Risk management is the process of identifying, assessing, and prioritizing potential risks to an organization or project and taking measures to minimize or control their impact. It involves systematically analyzing all possible risks, their likelihood of occurring, and their potential impact on the project or organization. The goal of risk management is to enable the project or organization to deal effectively with potential risks and minimize the likelihood and impact of negative events.

There are several steps involved in risk management, including:

- Risk identification: Identifying all possible risks that could affect the project or organization.
- Risk assessment: Evaluating the likelihood and impact of each identified risk.
- Risk prioritization: Prioritizing risks based on their potential impact and likelihood of occurring.
- Risk mitigation: Implementing strategies to reduce or eliminate the impact of the identified risks.
- Risk monitoring and control: Continuously monitoring and controlling risks to ensure that they do not occur or are handled risks effectively if they occur.

A reference for further reading on risk management is the book "Project Management Body of Knowledge (PMBOK) [6] Guide" by the Project Management Institute. This book provides a comprehensive overview of the various aspects of project management, including risk management, and is widely used as a reference guide by project managers around the world (Table 14).

Effective project management requires a thorough understanding of the risks associated with a project and a well-defined strategy to mitigate them. As noted by project management expert Harold Kerzner, "Risk management is a critical aspect of project management. The objective of risk management is to determine the risks that may affect the project and to develop and implement strategies for addressing them [11, 17]".

To successfully manage project risks, it is essential for the project manager to involve stakeholders in the risk identification process. This ensures that all potential risks are identified and considered from different perspectives. Once identified, the project manager must develop a mitigation strategy to reduce or avoid the risks. The strategy should be comprehensive, including clear steps for implementation and contingency plans in case the risk materializes.

Table 14 Risk management

Risk management	Consequence	Rating (L,M,H)	Resp. Party	Mitigation
No improvement of lightning and earthing protection system				
Concept not sanctioned by TÜV				
Concept not sanctioned by Authorities				
Resources OPS Engineering quality				
Resources construction				
Scope changes				
Delay in delivery				
Minor incidents				
Incomplete cost estimation				
Incomplete concept				
Impact on daily service				
Waste handling				
Language				
Ex-zone changes				
Welding on existing tanks				
Poor weather condition				
Unexploded device detection				

In addition to identifying and mitigating risks, the project manager should also regularly monitor and assess the effectiveness of the risk management strategy throughout the project's lifecycle. As noted by the Project Management Institute, "Risk management is an iterative process that must be continually adapted and improved to ensure that it remains effective and responsive to changing project conditions".

In summary, effective project management requires a proactive approach to risk management that involves identifying, mitigating, and monitoring risks throughout the project's lifecycle. With a well-defined risk management strategy in place, project managers can help ensure the successful completion of their projects.

6.6 Authority Engineering/Permits and Approvals

See Table 15.

For hydrogen installations, it is imperative that they receive the requisite approval of technical and district authorities. These authorities often have limited availability, and therefore, scheduling them with adequate lead time is crucial to ensure that