# Achieving Sustainable Development Goals: Key skills and traits for complex problem-solving

Author: Sam Gels
University of Twente
P.O. Box 217, 7500AE Enschede
The Netherlands

Faculty of Behavioural, Management and Social Sciences (BMS)
Master's in Business Administration (BA)
Date: 15/11/2024

**Graduation Committee members:**
**Dr. D.H. van Dun**
**Dr. R.B Rajah**

## ABSTRACT

The Sustainable Development Goals (SDGs) were introduced in 2015 to achieve a better and more sustainable future by addressing global challenges such as poverty, inequality, and climate change by 2030. However, despite all efforts, reports show that the current progress on the SDGs is insufficient, stalling or even declining on its targets. Therefore, this study aims to provide more guidance for individuals and organizations to improve their approaches to tackling complex problems like the SDGs, and to enhance their role in contributing to the global progress on the SDGs targets. The main objective of this research is to identify skills that contribute to Complex Problem-Solving (CPS) in the context of SDG 9 and to understand how these skills can be practically applied by individuals to achieve sustainable development. To achieve this, 18 interviews were conducted with managers with experience in projects related to SDG 9 from the industry, energy, and infrastructure sectors. While the research primarily aimed to identify essential skills for CPS, the data revealed that managers also emphasized the importance of key individual traits alongside these skills that contribute for CPS. Additionally, the results identify core skills for complex problem-solving as technical and subject-related skills, communication skills, collaboration skills, relationship building and maintenance, and mobilization skills, which according to managers are vital in one's approach for CPS in the context of SDG 9 Furthermore, leadership skills and traits also emerged from the collected data as well as other key skills relevant for CPS. The findings suggest that a combination of these skills and traits, supported by technical knowledge aligned with the technical demands linked with SDG 9, is crucial for effectively addressing complex sustainability challenges. These insights bridge the gap between current literature and their practical implementation in addressing the SDGs by focusing on the role of individual skills in CPS. Additionally, these findings offer practical guidance for individuals, leaders, and organizations to enhance their approach to CPS related to SDG 9.

**Keywords**

Complex problem-solving, CPS, individual skills and traits, leadership skills, skills development, Sustainable Development Goals, SDG 9, sustainable development

# Table of content

# 1. Introduction

Although significant progress has been made in improving human well-being, the world still faces serious social challenges such as climate change, poverty, and growing inequality (Berrone et al., 2023). To battle these problems, the United Nations (UN) introduced the Sustainable Development Goals (SDGs), offering *"a global framework for every actor pursuing the balance between social, economic, and environmental sustainability"* (Mio et al., 2020, p. 1). The SDGs are a set of objectives adopted by all United Member States in 2015 to *"end poverty, protect all that makes the planet habitable, and ensure that all people enjoy peace and prosperity, now and in the future"* (Morton et al., 2017, p.82). Since the UN member states adopted the 2030 Agenda in 2015 for sustainable development including the 17 SDGs, extensive literature has emerged on their environmental, social, economic, and political implementations and challenges (Leal Filho et al., 2021a). Despite all efforts, the SDG Progress Report indicates that progress is insufficient in 50 percent of the SDG targets, where 30 percent of the SDG targets are even stalling or declining in their progress (United Nations Department of Economic and Social Affairs, 2023).

Although the UN clearly states that the responsibility of implementing the 17 SDGs and its targets lies with the countries themselves, it is also stressed that the new sustainable development agenda cannot be achieved without the help of businesses (Sasaki et al., 2023), which have the resources, power, skills, and technology necessary to have an impact on the SDGs (Christ & Burritt, 2019; Fallah Shayan et al., 2022; Kücükgül et al., 2022). Accordingly, in a report providing business action on the SDGs, Global Reporting Initiative et al. (2015, p. 4) stated that *"the SDGs present an opportunity for business-led solutions and technologies to be developed and implemented to address the world's biggest sustainable development challenges",* and further will allow companies to demonstrate how their actions contribute to sustainable development and enhance the protection of the people and the planet (Global Reporting Initiative et al., 2015). In return, when companies embrace social responsibility and align their values with the SDGs it helps them generate lasting economic and social value, leading to them increasing their competitive advantage and enhancing their financial performance (Lassala et al., 2021).

However, despite the UN's encouragement for businesses to apply their unique resources and capabilities to support the SDGs, companies often face multiple challenges when integrating the 17 SDGs across their operations (Berrone et al., 2023). The relationship between the 17 SDGs is a complex problem for businesses (Fu et al., 2019), where academic literature argues

that businesses struggle to design and implement practices that align with all the various SDGs targets (Türkeli, 2020). Moreover, due to the complex nature of the SDGs, solutions often require collaboration between many different stakeholders, who all have their own interests in achieving their sustainability goals (Dlouhá et al., 2019). Even though the global focus on sustainability in the last years has led to substantial advancement and the creation of new knowledge, it does not seem that the current approaches are sufficient for today's increasingly complex sustainability challenges (Wamsler, 2020). Additionally, sustainability has historically been framed as purely an external challenge, and a new lens is emerging that revolves around the perspective that views climate change as a human problem that is rooted in internal mental states and approaches to transformation (Wamsler et al., 2021). Ives et al. (2020, p. 208) argued that *"our inner worlds, such as our emotions, thoughts, identities, and beliefs, lie at the root of sustainability challenges and are fundamental to the solutions to some of the world's greatest challenges"*. Exactly in this dimension, the contribution of the inner lives of individuals towards sustainability has been neglected and the concept of personal development has only recently received attention within the sustainability literature (Ives et al., 2020; Wamsler, 2020).

Therefore, to bridge the gap between personal development and the progress of the SDGs, individuals must develop skills to transform their personal lives, workplaces, and society to contribute to human well-being in a sustainable way (Ansari & Stibbe, 2009). To further investigate this, in 2021 the Inner Development Goals (IDG) initiative was created with the aim *"to identify, popularize and support the development of relevant abilities, skills and qualities for inner growth, through consciously supportive organizations, companies and institutions, to better address the global challenges"* (Inner Development Goals, 2021, p. 3). In this context, skills are the ability to apply knowledge to achieve tasks successfully and solve complex problems (Margarida et al., 2021). Even though the IDG initiative did not conduct a thorough literature review (Inner Development Goals, 2021), the skills identified do show some resemblance with some of the existing theories in the literature that address individual skills and their role in Complex Problem-Solving (CPS) like the SDGs (Veríssimo et al., 2024). For instance, the theory of complex cognition focuses on skills related to the cognitive processes of an individual (Knauff & Wolf, 2010), while relational coordination focuses on collaborating and communication skills (Bolton et al., 2021). Both theories argue that the development of relevant skills can contribute to CPS. Even though this contributes to the existing literature on identifying the skills required to address complex problems like the SDGs more effectively (Inner Development Goals, 2021), there is still a gap in the current literature on how individual

skills can be developed to contribute to an individual's approach to solving these complex sustainability problems (Christ & Burritt, 2019; Leal Filho et al., 2021b).

It is chosen to limit the focus in this study to just SDG 9 which aims to *"build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation"* (United Nations, 2015, p. 14) since the full SDG agenda is in general found to be too broad for any single company to address (Berrone et al., 2023) and since the relevant individual skills needed for a complex problem can be dependent on the situation and the nature of each problem (Inner Development Goals, 2021). Therefore, the purpose of this study is to first expand on the current literature on individual skills that can contribute to CPS like the SDGs. This will be done by developing a theoretical framework first analyzing SDG 9 and CPS. Additionally, existing literature will be investigated regarding the individual skills that contribute to solving complex problems like the IDG framework (Inner Development Goals, 2021; Mead et al., 2023), complex cognition (Funke, 2010; Knauff & Wolf, 2010), and relational coordination (Bolton et al., 2021; De Pablos-Heredero et al., 2015; Gittel, 2006). Additionally, in order to manage all the different individual skills contributing to CPS, support from management is also needed which have the position to drive significant change in an organization (Chatterjee et al., 2022; Opoku et al., 2024), where their skills also play a role in CPS. This will lead to an overview of which individual skills contribute to CPS for further analysis. The second aim of this study is to create a better understanding of how these contributing individual skills can be implemented in practice to enhance CPS. This leads to the following research question of this study:

*"How may individual skills contribute to solving complex problems in light of SDG 9?"*

This study aims to bridge the gap between existing literature and their practical implications in addressing the SDGs by focusing on the role of individual skills in CPS. The intended theoretical implications of this research are to contribute to existing knowledge on the role of individual skills in CPS and to enhance understanding of the current different theories into one clear framework for the essential skills for individuals to effectively tackle complex problems related to SDG 9. Additionally, the study intends to offer practical guidance for individuals, leaders, and organizations to enhance their approach to CPS related to SDG 9 by providing managers with a comprehensive overview of essential skills, enabling them to reflect on their abilities and identify areas for improvement, especially when resources for skill development are limited.

# 2. Theoretical framework

## 2.1 Sustainable Development Goal 9

As mentioned, the SDGs represent the UN's plan for achieving sustainable development, despite this, it is still needed to have a clearer way to implement and track progress on all 17 SDGs (Kynčlová et al., 2020). Furthermore, the interrelationships between all the 17 SDGs as well as the needed support and collaboration by all different stakeholders further increases the complexity of realizing the SDGs (George et al., 2016; Fu et al., 2019).

Of the 17 SDGs in the UN 2030 Agenda, the most significant for all industry sectors is SDG 9 since it aims for new steps towards inclusive and sustainable industrialization (Velazquez & Velazquez, 2021a). SDG 9 aims to *"build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation"* (United Nations, 2015, p. 14). More in-depth, SDG 9 focuses on the creation of sustainable infrastructure, fostering inclusive and sustainable industrialization, and stimulating innovation which can lead to job creation and economic growth, while also playing an important role in introducing new technologies and enabling the efficient use of resources (Maksakova & Kolomeytseva, 2023; Saieed et al., 2021). With this focus, SDG 9 promotes sustainable development by advancing economic growth while also promoting social inclusion and the protection of the environment (Leal Filho et al., 2021a; Maksakova & Kolomeytseva, 2023; Velazquez & Velazquez, 2021b).

The overall goal of SDG 9 consists of eight sub-targets, which can be found in Table 1, to contribute to creating the action needed to reach its goal. Looking at the targets for SDG 9, it can be said that targets 9.1, 9.4, and 9.6 are related to building resilient infrastructure. Additionally, inclusive and sustainable industrialization is represented in target 9.2, and financial services in target 9.3. Furthermore, technological innovation is reflected in targets 9.5 and 9.7, where business innovation allows for an increase in competitiveness and corporate sustainability (Velazquez & Velazquez, 2021). Lastly, target 9.8 aims for the improvement of internet and communication technology in the least developing countries. In the scope of this research, it is chosen to limit the focus of SDG 9 to just the targets related to resilient infrastructure, sustainable industrialization, and innovation. Additionally, due to SDG 9 progress in developing countries not being in line with the goal of the research, targets 9.3, 9.6, and 9.7 are also less relevant to this case. Therefore, the research will mainly focus on projects related to targets 9.1, 9,2, 9,4, and 9,5 of SDG 9.

**Table 1.** Targets for achieving SDG 9 (United Nations, 2015, pp. 20-21)

| Targets | Explanation |
|---|---|
| 9.1 | Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all |
| 9.2 | Promote inclusive and sustainable industrialization and, by 2030, significantly raise industry's share of employment and gross domestic product, in line with national circumstances, and double its share in least developed countries |
| 9.3 | Increase the access of small-scale industrial and other enterprises, in particular in developing countries, to financial services, including affordable credit, and their integration into value chains and markets |
| 9.4 | By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities |
| 9.5 | Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending |
| 9.6 | Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological, and technical support to African countries, least developed countries, landlocked developing countries and small island developing States |
| 9.7 | Support domestic technology development, research and innovation in developing countries, including by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities |
| 9.8 | Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020 |

At the moment, the need for sustainable development is no longer only due to the economic benefits of it but also due to an increasing demand for social and environmental development across the world (Calçada et al., 2021). In order to enhance the role of industrialization in the progress toward sustainable development, new infrastructures as well as more efficient use of processes and raw materials must be developed (Calçada et al., 2021). However, the UN's aim to enhance inclusive and sustainable industrialization has, so far, not reached its expected results and the related outcomes are rather disappointing (Velazquez & Velazquez, 2021a). Additionally, problems relating to the process of inclusive and sustainable industrialization have become more complex (Leal Filho et al., 2021a). Overall, SDG 9 is a complex issue that Weber et al., (2021) argue may not be solved through traditional modes of decision-making since the attempts to solve such a complex problem are challenging and will bring, often unexpected, implications with them. Additionally, the complexity of approaching SDG 9

intensifies due to all the different goals, targets, and indicators, where each individual and company has their own set of priorities for development towards the SDGs which are not always aligned with the objective of the UN's 2030 Agenda (Pereira et al., 2021). For instance, with businesses being shareholder value-oriented, the pursuit of SDG 9 could prove challenging if it is not in line with shareholders' expectations and interests of making a profit, especially when the company has limited resources (Kücükgül et al., 2022; van der Waal & Thijssens, 2020). Therefore, the approach to solving sustainability problems related to SDG 9 requires a specific problem-solving mode that fits the complexity, ambiguity, and interdisciplinary nature of the problem. (Weber et al., 2021)

## 2.2 Complex problem-solving

Due to the rapidly advancing technological, social, and economic dimensions in the world, researchers continuously observe the complexity of sustainability, as seen in the SDGs. (Asiimwe & de Kock, 2019**;** Kirschke & Newig, 2017). Consequently, there is an increase in relevance for addressing such complex problems (Hermann & Bossle, 2020; Veríssimo et al., 2024), where according to Veríssimo et al. (2024, p. 1) it covers *"any sector of activity and is an ability to identify and solve problems that are multi-dimensional, ill-defined, and that require considering multiple information and perspectives"*. Ahern et al. (2014) add to this that when complex projects, such as major infrastructure projects, cannot be fully specified and planned in advance they should not be approached in traditional ways, rather they require a unique solution tailored to the problem. Therefore, problem-solving methods focusing on understanding and providing solutions to a challenge in a quick and effective manner are considered one of the most important skills necessary in the future (Veríssimo et al., 2024). Arguably, one of the most commonly studied 21st-century skills is CPS skills (Nicolay et al., 2023).

CPS is seen as the core process through which new knowledge emerges during the delivery of complex problems or projects (Ahern et al., 2014), which can be considered challenging and requires a high level of cognitive processes and thinking skills from individuals (Hagemann & Kluge, 2017; Wu & Molnár, 2022). CPS *"takes place for reducing the barrier between a given start state and an intended goal state with the help of cognitive activities and behaviour"* (Funke, 2012, p. 682). According to Nicolay et al. (2023), a complex problem can be characterized as a problem with multiple interrelated variables where the connection between them may be unclear or change over time, which requires the individual or organization to pursue different targets and goals simultaneously. This is also in line with Hagemann & Kluge

(2017), where working with complex problems can be characterized by their elements of interconnectedness, continuously changing aspects, non-transparency, and multiple goals that often conflict with one another. The process of CPS can be split into two phases, knowledge acquisition and knowledge application (Greiff et al., 2015; Wu & Molnár, 2022). During the knowledge acquisition phase of CPS, the problem solver understands the complex problem itself and stores all the information, which is later applied to bring about the transition from a given state to the goal state during the knowledge application phase of CPS (Wu & Molnár, 2022). When approaching CPS a sequence of observations and decisions are needed to discover and implement the solution to the problem (Veríssimo et al., 2024), where the problem-solver needs to explore, understand, and control the environments of the unknown problem, non-transparent in nature, and consist of several interconnected elements (Molnár et al., 2022). This approach to CPS is connected with the problems companies face when implementing SDGs into their practices, where they require an approach of collaboration across departments and need to balance their own objectives and priorities to navigate through and understand the complexity of the problem in order to explore potential solutions (Kücükgül et al., 2022; Pereira et al., 2021; Weber et al., 2021)

In order to solve these complex problems a combination of skills and competencies are needed that contribute to CPS (Hermann & Bossle, 2020). Following the research of Nicolay et al. (2023), the authors found that flexibility in approach and strategy application and adaptation to task demands seem crucial for successful CPS performance. Additionally, from the literature, the application of cognitive processes skills like information storage, retrieval, and application emerges (Dindar et al., 2020; Hagemann & Kluge, 2017). It is also important to note, that even when individuals take the same strategy towards CPS, the results could be very different based on the difference in individual skills applied during the process (Chen et al., 2019).

### 2.3 The role of inner development and skills in complex problem-solving

When facing complex problems, according to the Inner Development Goals (2021) there is a need for several cognitive and emotional skills that go beyond what individuals are taught in schools and higher education that are needed for CPS. For this, inner development will play a vital role in driving positive global change, and the need for personal development and transformation to enhance one's contribution to the SDGs is growing in interest (Mead et al., 2023). The idea that effective action towards the SDGs and CPS will depend on the inner development and transformation of individuals is reflected in the so-called 'Inner Development Goals' (Mead et al., 2023).

The IDG originated from a need to focus more attention on developing skills among actors working with complex problems in particular those named in the UN Agenda 2030 as the 17 SDGs (Inner Development Goals, 2021). The IDG framework was created due to the belief that there is a lack of proper insights into the abilities, qualities, or skills individuals need to develop to effectively address complex problems like the SDGs (Kemp & Edwards, 2022; Inner Development Goals, 2021). More in-depth, following the IDG approach, when faced with complex tasks, there is a need for a range of cognitive and social skills like critical thinking, problem-solving, and other personal and social capabilities required to navigate and lead in a complex world (Inner Development Goals, 2021; Mead et al., 2023; Shtaltovna et al., 2024). Further, while discussing individual skills that contribute to CPS a distinction can be made between hard and soft skills. Hard skills indicate specific technical skills related to knowledge, education, and work experience that allow one to perform a particular job (Farao et al., 2023), while soft skills *"indicate all the competencies that are not directly connected to a specific task; they are necessary in any position as they mainly refer to the relationships with other people involved in the organization"* (Cimatti, 2016, p. 98). In the literature, soft skills are also known under many different names such as 21st-century skills, general skills, or personal skills (Borges & Gratão de Souza, 2024), and the development of soft skills closely apply to individual skills related to CPS as identified by the IDG framework. Therefore, in this paper, the focus will be on soft individual skills that can contribute to CPS rather than focusing on just technical skills that could play a role in CPS.

While focusing on the soft skills that play a role in CPS, the exploration by the Inner Development Goals (2021) initiative led to the finding of 23 skills and abilities which are divided into 5 main categories as displayed in Table 2. The IDG framework suggests that these 23 skills and abilities are essential for addressing the SDGs. Even though analyzing each skill and ability of the IDG individually is beyond the scope of this research, it offers valuable insight into the skills that may contribute to CPS, and therefore the explanation of the skills can be found in Appendix A.

**Table 2.** The 5 main categories in the IDG framework are explained as well as the 23 skills connected to the categories (Inner Development Goals, 2021, pp. 13-22).

| Categories | Explanation | Skills and abilities |
|---|---|---|
| Being | Cultivating our inner life and developing and deepening our relationship to our thoughts, feelings and body help us be present, intentional and non-reactive when we face complexity | Inner compass,<br>Integrity and Authenticity,<br>Openness and Learning mindset,<br>Self-awareness, |

| | | |
|---|---|---|
| | | Presence |
| Thinking | Developing our cognitive skills by taking different perspectives, evaluating information and making sense of the world as an interconnected whole is essential for wise decision-making | Critical thinking<br>Complexity awareness<br>Perspective skills<br>Sense-making<br>Long-term orientation and visioning |
| Relating | Appreciating, caring for and feeling connected to others, such as neighbors, future generations or the biosphere, helps us create more just and sustainable systems and societies for everyone | Appreciation<br>Connectedness<br>Humility<br>Empathy and Compassion |
| Collaborating | To make progress on shared concerns, we need to develop our abilities to include, hold space and communicate with stakeholders with different values, skills and competencies | Communication skills<br>Co-creation skills<br>Inclusive mindset and Intercultural competence<br>Trust<br>Mobilization skills |
| Acting | Qualities such as courage and optimism help us acquire true agency, break old patterns, generate original ideas and act with persistence in uncertain times | Courage<br>Creativity<br>Optimism<br>Perseverance |

According to Ankrah et al. (2023), research shows that the personal skills needed for CPS can be developed. Furthermore, the work of the IDG framework contributes according to Kemp and Edwards (2022) to a broader understanding of CPS, while focusing on building the needed skills to minimize and adapt to risk caused by climate change and its many challenges and complexities that must be addressed (Shtaltovna et al., 2024). Overall, the IDG framework identifies growth areas that allow us to better handle CPS and enhance our effectiveness as change agents and leaders creating a more sustainable future (Ankrah et al., 2023).

However, due to the novelty of the IDG framework and the limited academic justification due to not conducting a thorough literature review (Inner Development Goals, 2021), there is still a lack of understanding and validation of the framework (Ankrah et al., 2023; Kemp & Edwards). Additionally, similar frameworks have a broader scope of the individual skills and qualities that are important for complex problem-solving, and according to the authors, the IDG framework should be used as a starting point for exploring these skills and qualities. To bridge this gap, it is possible to investigate similar already existing academic theories regarding individual skills and competencies that could contribute to CPS like complex cognition (Knauff & Wolf, 2010) and relational coordination (Bolton et al., 2021), but it is also needed to look into how these individual skills should be managed during CPS (Shtaltovna et al., 2024). By

judging and comparing this framework with other relevant existing theories it is possible to better understand the IDG framework and its connection to CPS, where the similarities and differences can be analyzed. This approach will be central in the rest of the research, where it will analyze how individual skills identified in the IDG framework, complex cognition theory, relational coordination theory, and leadership skills are related to CPS.

### 2.4. The role of complex cognition in complex problem-solving

In current years, the world is faced with very complex problems like climate change, globalization, and fostering peace, which in nature are problems that are not easy to solve (Knauff & Wolf, 2010). This results in firms needing to respond quickly to changes in their environment and constantly seek new opportunities to learn and improve, with one way to advance relevant capabilities by developing individuals' skills of problem-solving (Mohaghegh & Furlan, 2020). As mentioned, to contribute to solving these complex problems, similar to the sustainability challenges relevant to this research, the use of complex cognition can contribute to CPS, which can be defined with the help of Knauff & Wolf (2010, p. 100) as:

*"All mental processes that are used by individuals for deriving new information out of given information, with the intention to solve problems, make decision, and plan actions. The crucial characteristic of "complex cognition" is that it takes place under complex conditions in which a multitude of cognitive processes interact with one another or with other noncognitive processes".*

With mental activities, the same authors mean activities similar to the ones mentioned in the IDG framework under 'Thinking – Complex Skills' such as critical thinking, reasoning, problem-solving, and decision-making that require the combination and interaction of processes like perception, learning, memory, and emotion. This is in correspondence with the research of Mainer et al. (2019), who argued that CPS reflects complex cognition in the form of higher-order thinking skills that are needed to deal with the dynamic, unique, and interactive tasks of an individual. Critical thinking and problem-solving are two of those higher-order thinking skills, where *"critical thinking involves a self-directed, skillful analysis of information, beliefs, or knowledge, with an awareness of the potential flaws in human reasoning, while problem-solving is the process of identifying solutions to complex issues, often requiring interaction and various tools and resources"* (Shtaltovna et al., 2024, p. 75). Additionally, Funke (2010) argued that the interesting aspect of complex cognition is that it is strongly connected to emotion and motivation, whereas in the cognitive processes, individuals

do not differentiate between cognition, emotions, and motivation where actions are integrated and vary depending on the individual's levels of willpower and emotional engagement. This, in turn, partly relates to the IDG framework under 'Being – Relationship to Self', where the emotions and motivations of an individual can help them in facing complexity. Research done by Guo et al. (2020) even found that the climate change perception and cognitive value of a farmer have a relationship with their sustainable livelihood capacity, meaning their ability to respond to unforeseen challenges and enhance their current and future capabilities (Islam & Ryan, 2016).

### 2.5. The role of relational coordination for complex problem-solving

Nowadays, individuals tackling increasingly complex problems in an organization require the ability to coordinate across different organizations, disciplines, and sectors (Bolton et al., 2021). Additionally, due to the increase in complexity, companies are emphasizing the importance of having individuals with strong communication and cooperation skills (Estriegana et al., 2021). Furthermore, teamwork has become a crucial management strategy, where failing to adopt effective teamwork when addressing complex problems is often seen as a key reason for the unsuccessful implementation of organizational changes (De Pablos-Heredero et al., 2015). A similar view can be found back in the relational coordination theory, which according to Bolton et al., (2021, p. 2):

*"Proposes that relationships characterized by shared goals, shared knowledge, and mutual respect tend to support frequent, timely, accurate, problem-solving communication and vice versa, enabling stakeholders to effectively coordinate their work".*

The relational coordination model is based on two types of dimensions; the relational dimension refers to shared objectives, shared knowledge, and mutual respect, and the communication dimension refers to the frequent, accurate, timely orientation to problem resolution (Gittel, 2006; Sánchez et al., 2021). The combination of both dimensions is the basis for the relational coordination model (Sánchez et al., 2021). The author Gittel (2006) suggests that through relationships, others can influence the development of our own identities, and relationships of shared goals, shared knowledge, and mutual respect help to build a collective identity, which can in turn increase the effectiveness of coordination of work between individuals. Moreover, in a case study done by Gittel (2006), the author found that when employees have a positive relationship with each other regarding shared goals, shared knowledge, and mutual respect, this enables the individuals to coordinate effectively and

engage in frequent, timely, problem-solving communication. The high quality of communication helps organizations to better react and adapt to their complex environment, where relational coordination can contribute to their CPS (Sánchez et al., 2021).

Additionally, research done by Rhee et al. (2020) found that relational coordination and communication competencies are essential to product and process innovation and to the organizational overall innovativeness, where such practices are becoming even more crucial due to today's complexity. More in-depth, Rhee et al. (2020) found that practices with a relational focus such as team-based training, cross-divisional knowledge sharing, and participative decision-making, contribute to the development of skills and knowledge required for CPS tasks. For instance, when employees frequently engage in collective brainstorming and decision-making activities during team-based training sessions, Rhee et al. (2020) found that these activities likely increase the collaborative problem-solving skills and knowledge of the individuals Likewise, the relational coordination theory possesses some similarities with the IDG framework under 'Relating — Caring for Others and the World' and 'Collaborating – Social Skills', where it is argued that empathy, mutual respect, teamwork, and communication skills will contribute to better complex problem solutions.

This idea that relating and collaborating contribute to CPS is also reflected in almost all organizations that use teams to approach CPS nowadays since such complex problems, like the SDGs, exceed the cognitive capacity of any individual and require a team where individuals share differences in expertise with each other (Byrne & Eddy, 2022). Furthermore, when collaborating with diverse and complementary skills in teams towards CPS it is necessary to transfer knowledge among the team to enhance the collaboration success (Duva et al., 2024). Additionally, following the findings of Maharjan et al. (2019), the effective collaboration of teams was strongly associated with co-operativity, communication, and information sharing.

### 2.6 The role of leadership in solving complex problems like SDG 9

So far, it has been discussed which individual's skills are essential resources for an organization to approach CPS in light of SDG 9, which can also contribute to business strategies, achievement of business strategies, and improve business performance (Farao et al., 2023). However, the achievement of SDG 9 will also require leadership to fulfill its goals in the 2030 Agenda (van Norren & Beehner, 2021), and scholars have emphasized the need to develop the capacities of an organization by improving management skills (Guarini et al., 2021). According to Farao et al. (2023), in order to manage all these factors and individual skills leadership is

needed that can manage sustainable strategies by guiding and inspiring employees towards greater environmental awareness and achievement of company goals. Furthermore, Chatterjee et al. (2022) suggest that the commitment of top management and the leader's ideology play a significant role in Corporate Social Responsibility. This is again confirmed by Opoku et al. (2024) who found that top management plays a substantial role in leading sustainable development. However, the same author also argues that other management positions can also crucially contribute to sustainability development since they understand the details of everyday operations and execution and observe complex problems more directly than just senior management. Furthermore, SDG 9 can offer a basis of objectives that can guide management skills and capacities for sharing knowledge and shaping action to promote sustainable change by 2030 (Andenoro et al., 2023).

Due to the given the magnitude of changes in the environment, leadership competencies for CPS should be adapted to the new reality (Ngayo Fotso, 2021). Therefore, van Laar et al. (2017, p. 577) identified core leadership skills for the 21st century that go beyond digital skills and technical skills, with "*information management, communication, collaboration, creativity, critical thinking, and problem-solving*". Additionally, van Laar et al. (2017, p. 577) identified 5 more contextual skills in "*ethical awareness, cultural awareness, flexibility, self-direction, and lifelong learning"*. Both the core leadership skills and the contextual skills are mostly in line with what we have already found about skills contributing to CPS within the IDG framework, complex cognition, and relational coordination. According to Shtaltovna et al., (2024), for 21st-century leaders developed and trained cognitive skills are essential for decision-making, strategy formulation, and driving sustainable practices to enhance SDG applications. Additionally, those who possess advanced cognitive skills can foster the right action towards the achievement of goals relevant to SDG 9 (Shtaltovna et al., 2024). Furthermore, Huber et al. (2020) found that leadership assistance has a strong effect on relational coordination, where management can promote practices such as team-based training, cross-divisional knowledge sharing, and participative decision-making in order to contribute to the development of skills and knowledge required for CPS (Huber et al., 2020; Rhee et al., 2020). By looking at the role of management for CPS in light of SDG 9, the last dimension of the IDG framework 'Acting – Enabling Change' is also touched upon, where management possesses the resources and authority to implement practices and policies towards enhancing SDG 9 implementation. This leads us to the total identified skills that contribute to CPS which are presented in Table 3.

**Table 3.** Overview skills contributing towards CPS

| Theoretical framework | IDG Framework | IDG skills |
|---|---|---|
| Complex cognition | Being* | Inner compass |
| | | Integrity and Authenticity |
| | | Openness and Learning mindset |
| | | Self-awareness |
| | | Presence |
| | Thinking | Critical thinking |
| | | Complexity awareness |
| | | Perspective skills |
| | | Sense-making |
| Relational coordination | Relating | Appreciation |
| | | Connectedness |
| | | Humility |
| | Collaborating | Communication skills |
| | | Co-creation skills |
| | | Inclusive mindset and Intercultural competence |
| | | Trust |
| | | Mobilization skills |
| Management competencies | Acting | Courage |
| | | Creativity |
| | | Optimism |
| | | Perseverance |

**Note(s):** The 'Being' part of the IDG Framework is included with an * since even though complex cognition can be considered a combination of being and thinking, in the context of this research 'Being' also refers to non-skills that contribute to CPS on their own, without an individual needed to actively think about them.

# 3. Methodology

## 3.1 Research Design

In order to answer the research question, a qualitative research approach took place. The research focused on how individual skills can contribute to solving complex problems like SDG 9, since this exact relationship still was unclear, qualitative research was chosen to expand and investigate this relationship (Edmondson & McManus, 2007). Additionally, qualitative research enabled the exploration of this relationship by collecting managers' subjective experiences on the use of individual skills that contribute to solving complex sustainability problems (Mwita, 2022). Moreover, it provided more flexibility in identifying other potentially relevant skills that did not emerge in the theoretical framework (Mwita, 2022). The primary goal of the research was therefore to collect the experiences and reflections of the managers on the use of individual skills to solve complex problems, where the theoretical background took

on a supportive role to better understand the context of which and how individual skills are contributing to CPS.

### 3.2 Sampling strategy and sample description

The data needed for this study was gathered by conducting semi-structured interviews, where managers were approached through their relationships with the consultancy firm 'HillFive' and employees' individual networks. HillFive specializes in achieving continuous productivity optimization for their clients operating in the energy, industry & infrastructure sectors. HillFive is actively operating within projects related to SDG 9 as discussed earlier in the theoretical framework, for instance, but not limited to, building renewable energy parks, optimizing industrial processes, and developing sustainable infrastructure. HillFive consists of around 20 consultants who provide their expertise to their clients under the motto: *"Developing a change strategy on paper is a profession, but the real challenge lies in actually implementing it sustainably and successfully"*. In qualitative research, the concept of saturation is essential to ensure the validity of the research, while also optimizing time and resource allocation by avoiding redundant data collection (Rahimi & khatooni, 2024). A study done by Hennink and Kaiser (2022) found that in the analysis of qualitative research, saturation was reached between 9 and 17 interviews. In this research, it was chosen to use a sample size of 18 interviews by interviewing managers from all different companies within the HillFive network. These interviewees were selected based on their roles in their respective organizations which include tasks or responsibilities that contribute to solving complex problems in light of SDG 9. Additionally, to improve the quality of the data sample and the experiences the interviewees had on the application of individual skills for CPS, only managers with at least 3 or more years of experience related to projects to SDG 9 were selected. This leads us to the following three sample criteria that were used to find the appropriate data sample:

1) The Manager is working in a company related to the energy, industry, and infrastructure sector
2) The manager is currently working or has experience working on projects related to targets 9.1, 9,2, 9,4, and 9,5 of SDG 9 as described in Table 1.
3) The manager has 3 or more years of experience in working on relevant projects to this research.

In order to ensure that each manager met the sample criteria, they were first selected by the individuals of HillFive based on their relevant position and organization. The researcher then

used available information on LinkedIn to verify that the managers had at least three years of experience working on projects related to targets 9.1, 9.2, 9.4, and 9.5 of SDG 9. This led to a sample size of 18 relevant managers for this research, of which the demographics can be found in Table 4.

**Table 4.** Demographics sample size

| Manager | Gender | Industry | Position |
|---|---|---|---|
| Manager 1 | Female | Energy | Energy & Climate strategist |
| Manager 2 | Male | Industry | Logistics Manager |
| Manager 3 | Male | Energy | Head of Business Acceleration Team |
| Manager 4 | Male | Energy | Head of Customer Operations |
| Manager 5 | Male | Energy | Manager Customer Relations |
| Manager 6 | Male | Industry | Business Development Director |
| Manager 7 | Male | Industry | Maintenance Manager |
| Manager 8 | Male | Energy | Head of Global Procurement Solutions & Analytics Excellence |
| Manager 9 | Female | Industry | Program manager Sustainability |
| Manager 10 | Female | Energy | Director Business/B2B |
| Manager 11 | Male | Energy | Program Manager |
| Manager 12 | Male | Industry | LCA & Sustainability Specialist |
| Manager 13 | Male | Industry | General Manager & Plant Director |
| Manager 14 | Male | Industry | Director |
| Manager 15 | Male | Industry | HR Director |
| Manager 16 | Male | Infrastructure | Business Unit Manager Projects |
| Manager 17 | Female | Industry | Sustainability manager |
| Manager 18 | Male | Infrastructure | Head of sustainability |

### 3.3 Data collection

A common approach to data collection in qualitative research is interviews, where in this research semi-constructed interviews were chosen in order to collect the data (Thelwall & Nevill, 2021). To ensure that all participants felt comfortable and could express their experiences accurately the interviews were conducted in Dutch, the native language of all 18 managers interviewed. The Dutch interview guide for the semi-constructed interviews can be found in Appendix B. On average the interviews lasted between 60 and 90 minutes, in which managers were asked to elaborate on their individual approach toward sustainability. Additionally, managers were asked to recall specific projects related to SDG 9 in which they participated and to elaborate on the challenges they faced during these projects. This provided a basis for exploring and identifying the individual skills that they deem crucial in addressing these complex challenges and investigating their preferences for skills and why they are effective according to them. By exploring these cases it was possible to further inquire about

desirable initiatives and procedures to develop or adopt certain individual skills that contribute to solving problems related to SDG 9. Since the information discussed during the interviews can sometimes be sensitive for the individual or the organization participating in the research, it is ensured that the managers felt open to sharing their experiences in tackling these complex problems by making the collected data anonymous. As well, at the start of the interview, it was stated that the participants are always in a position to not share sensitive information and can refuse to answer the question. In order to let the managers reflect on their own experiences in CPS the Critical Incident Technique (CIT) of Flanagan (1954) was applied, which is a well-established qualitative research method that can contribute to exploring significant experiences to better understand behaviors (Simmons & Martin, 2010). According to Gremler (2015), the strengths of CIT are its ability to gather data from the respondent's perspective, it is explorative and contributes towards theory building, it is flexible, and it enables a rich data set of firsthand experiences through recalling specific events. By applying the CIT, it is possible to gain an understanding of CPS by investigating projects related to SDG 9 and the role of individual skills from the perspective of the managers based on their own experiences (Simmons & Martin, 2010).

### 3.4 Data analysis

The data collected was analyzed in two different parts. First, the most common method used in qualitative research, Grounded Theory, was applied in the analysis (Gupta & Malodia, 2023). Grounded theory is designed to *"support the generation of a theory explaining a phenomenon experienced by a group of participants"* (Connor et al., 2024, p. 277). Grounded theory involves the use of inductive processes to generate concepts from the qualitative data collected (Brunson & D'Souza, 2021). During the data analysis, the data was coded and categorized with the help of the findings of Gioia et al. (2013), where first-order concepts were constructed that emerged from the 18 interviews. Afterward, in the many first-order concepts, the differences and similarities were analyzed in order to reduce the number of categories in second-order themes, where the emerging themes helped describe and explain the phenomena that are observed (Gioia et al., 2013). In the analysis, thematic coding was applied as constructed by Braun & Clarke (2006), where the first-order concepts in the interview transcripts were interpreted and organized based on themes made beforehand relating to the theoretical background of individual skills that contribute to CPS. Additionally, emerging themes from the transcript were coded as well, if found applicable and relevant by the researcher. Lastly, these second-order themes were divided into aggregate dimensions forming the basis of the data

structure. With the help of the data structure presented in the results part, allowed for a graphic representation of how the structure progressed from the original raw data in the interviews.

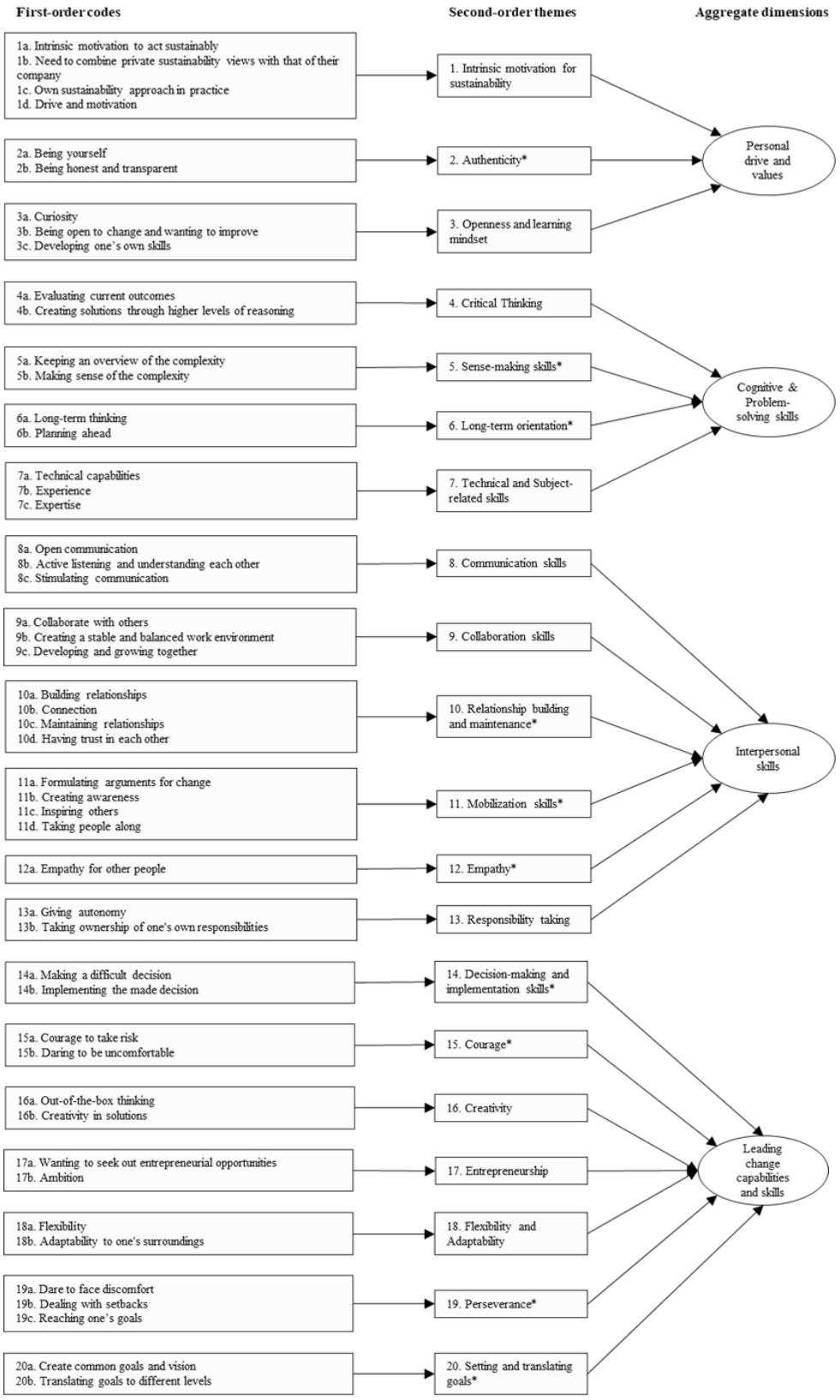
### 3.5 Ethical Conduct

While conducting this research the ethical aspects matter significantly, where this research should comply with the ethical, legal, and professional standards of behavior in order to not cause any damage to the participants (Miller et al., 2024). Therefore, during this research, the interviews and their potentially sensitive data were approached with caution. Before conducting the research, it was ensured that the research was accepted by the ethics committee of the University of Twente, further assuring the ethical aspects of the research. Additionally, the interviews were recorded only with the permission of the interviewee and made anonymous to protect sensitive data potentially leading back to the individual or the company employing the individual.

## 4. Results

The 18 interviews led to the following results, where the first-order codes and the second-order themes are placed into aggregated dimensions based on the results of the interviews and theories established in the theoretical framework, providing an overview of which individual skills may contribute to solving complex problems in light of SDG 9. During the data collection, 50 first-order codes were identified, which led to 20 second-order themes and in the end four aggregate dimensions of which an overview can be found in Table 4. To further contribute to the explanation of each of the 50 first-order codes, Appendix C is also presented below which displays examples of the quotes acquired in the interviews that are directly assigned to the first-order quotes. In addition to skills, traits that contribute to CPS were also identified, along with leadership skills specifically discussed during the interviews as relating to just leaders. The rest of the chapter will investigate how these skills, traits, and methods are applied in practice to solve complex problems in the four different dimensions that were identified during the data analysis stage. Furthermore, during the interviews, it became clear that in order to solve complex problems related to sustainability a combination of multiple skills and qualities is necessary to develop effective solutions, which will also be discussed later in this chapter.

**Figure 1.** Data structure




**Note(s):** Found skills and traits with an * behind them, where during the interviews mainly discussed as a leadership skill for CPS, where the other skills and traits were discussed as both crucial for employees as well as leaders.

## 4.1 Personal drive and values

The first dimension identified the effect of personal drive and values on complex problem-solving related to SDG 9, in which the following three themes are identified: *Intrinsic motivation for sustainability, Authenticity, and Openness and learning mindset*. It is important to note that these themes are not necessarily skills, which was the main focus of the research. Instead, they represent traits and motivations that contribute to an individual's ability to engage in CPS.

### *4.1.1 Intrinsic motivation for sustainability*

The data showed that intrinsic motivation for sustainability directly influences how strongly an individual or company pursues sustainability initiatives. All the managers mentioned that sustainability plays at least some role in their personal lives. Their actions range from smaller efforts like recycling and being aware of their energy usage at home to more significant changes like adopting a vegetarian lifestyle or refusing to travel by plane. However, some managers still draw a clear distinction between their personal and professional approaches to sustainability, saying that in their personal lives, they do not always choose the most sustainable actions but rather focus on specific areas they personally want to prioritize in their behavior. For instance, Manager 3 highlighted this distinction by emphasizing that sustainability is a very important topic for him, but also noted that *"I'm not some kind of climate activist or fanatic in the sense that I don't fly anymore, for example"*. Moving on, several managers have stated that their approach towards sustainability is based on their own desire to do something good or to make a positive impact on a larger scale. As a result, many managers emphasized their preference to align their own motivation to act sustainably with the goals of the company they represent. For instance, due to the importance of sustainability for Manager 3, he stated *"I very consciously joined an organization with a socially relevant role 15 or 14 years ago"*. Additionally, intrinsically motivated managers take pride in their work and when their company performs well in sustainability aspects, for instance, Manager 12 stated: *"We have been named in the top 5 most sustainable companies again this year. So, that's super cool that I work here"*. Additionally, Manager 15 stated that working on sustainability during work can also contribute to one's personal approach to sustainability outside of work, displaying that the relationship between personal conviction towards sustainability and work can also be turned around. Furthermore, having intrinsic motivation for sustainability can also contribute to solving complex sustainability problems, since it can cause a higher level of engagement and motivation to come up with more sustainable solutions that go beyond what is expected by the

company or customer. As Manager 9 pointed out, the excitement of employees based on their own motivation to make sustainability efforts contributes to the success of these initiatives. Furthermore, Manager 5 noted that collaborating and engaging in discussion about what drives someone can further improve one's motivation for sustainability, which in turn strengthens the commitment of employees to achieve sustainability goals.

### *4.1.2 Authenticity*

Following, authenticity plays a crucial role in addressing sustainability issues as reflected by multiple managers. Additionally, authenticity can support managers in translating their intrinsic motivation into a way of effectively leading sustainability initiatives, as highlighted by Manager 3, who explained the importance of guiding a team based on one's own convictions, passions, and authenticity. In the same context, Manager 9 also discussed the importance of being authentic and stated *"Just be who you are"* much rather than attempting to be someone you are not. Furthermore, results showed that inspiring others is most effective when done in an authentic way, where the arguments are based on one's own convictions and motivations, which creates more credibility and trust. Furthermore, Manager 8 believed authentic individuals are more convincing and better at communicating because they genuinely believe in what they are saying.

Additionally, Manager 8 insisted that being authentic also requires honesty and transparency in one's action, for instance, Manager 10 highlighted that by *"stating my intention of the things I do, indicating which interest I am prioritizing for now, over the other interest"*. Furthermore, as a manager, being open and vulnerable by discussing challenges can enhance discussions and motivate others to engage more in sustainability efforts. By doing so, managers can become more approachable to their employees, as highlighted by Managers 2 and 8 as important. This environment of trust and approachability through authenticity should be, according to Manager 13, combined with being present on the work floor to further enhance communication. Manager 16 nicely summed up what authenticity in leadership is all about, describing leaders as credible individuals who people enjoy listening to and are inspired to follow. Even when there are doubts, an authentic leader who communicates in an honest and transparent way based on their own convictions can still address these concerns and inspire individuals to move forward with them.

### *4.1.3 Openness and learning mindset*

Lastly, several managers stressed the importance of an open attitude and learning mindset in order to adapt to changes and improve the achievement of sustainability initiatives. Manager

10 explained that being curious can be divided into two types, *"on content and on what drives people and systems"*. In this case, curiosity based on content indicates the willingness to explore new solutions and challenge established methods, going beyond current approaches to discover different solutions. Secondly, Manager 5 also mentioned the importance of being curious about what drives a party and *"to look at each other's business with an open mind, because then sometimes you can discover really great things"*. He further elaborated by explaining that when individuals engage and discover together, they develop a genuine curiosity about each other's businesses, resulting in approaching things with a more open mind and more listening to each other's concerns. This results in a deeper understanding of each other's needs and fosters collaboration between the two parties.

Additionally, Manager 6 noted that willingness to change is essential for operational improvement and the commitment to sustainability. In this approach of wanting to improve, Manager 15 emphasized the need to learn from the made mistakes and to *"record it properly and make sure it doesn't happen again next time"*. A practical example of this learning process is shared by Manager 5, who highlighted the value of sharing failures in a constructive way. He explains how, after a failed project, the team would come together to openly discuss what went wrong, with the goal being not to assign blame to anyone from the project team but rather learn from the experience. Even though it can sometimes be difficult to admit one's mistakes Manager 5 stated that these discussions were very informative for improving their future performance. Furthermore, in order to stimulate this culture of continuous improvement Managers 4 and 13 highlighted the key role of employee development in this process. This is reinforced by Manager 5, who explained that in order to keep developing team members' competencies and skills his preference is to continuously talk about growth opportunities and specific training they would like to attend. Similarly, Manager 4 expected his employees they consistently work to improve their skills and performance to further drive both individual and organizational progress.

#### *4.1.4 Summary*

To summarize, *Personal drive and values* are more related to traits and motivation rather than skills for solving complex sustainability problems. However, these traits and motivations are at the foundation of one's approach to CPS and when present in an individual can further enhance the application of their individual skills relevant to CPS.

Firstly, intrinsic motivation for sustainability is found to directly influence the pursuit of sustainability initiatives, and managers who align their personal attitude towards sustainability with their company's sustainability goals are better motivated to inspire their teams and drive sustainability efforts that go beyond what is expected from them. Therefore, intrinsic motivation for sustainability can foster higher engagement and innovation for creating sustainable solutions.

Additionally, authenticity is found crucial in leading and communicating sustainable efforts, where managers have stressed the importance of guiding teams based on personal convictions, honesty, and transparency. Being authentic enhances trust, communication, and credibility as a leader, which requires openness and vulnerability in order for a leader to be more approachable and inspire others to participate in reaching sustainable solutions.

Lastly, an open attitude and learning mindset are crucial for overcoming change and improving sustainability efforts. Being curious about improvement and what drives people can lead to discovering new solutions and further enhancing collaboration. Also, managers have emphasized the importance of learning from mistakes and promoting continuous improvement, where skills development and open dialogue about failures are key in driving sustainable change.

## 4.2 Cognitive & Problem-solving skills

The second dimension identifies the impact of cognitive and problem-solving skills on addressing complex challenges related to SDG 9, in which the following four themes are identified: *Critical thinking, Sense-making skills, Long-term orientation, and Technical and subject-related skills*.

### *4.2.1 Critical thinking*

To explain the concept of critical thinking, two different themes were identified during data analysis: the evaluation of current outcomes and the creation of solutions through higher levels of reasoning. For the evaluation of current outcomes, Manager 10 emphasized the need to test and check the found solutions continuously. Along those lines, Manager 12 noted that through the evaluation of completed tasks, valuable lessons are learned on what could have been done better to improve the outcomes the next time. Additionally, according to Manager 14, evaluating current outcomes while collaborating can contribute to testing different outcomes and finding the one solution that fits best, which further stimulates innovation. Furthermore, evaluation processes help managers address the complexity of projects related to SDG 9 and

track progress to ensure alignment with the different desired outcomes of all stakeholders. So, by integrating these evaluation processes organizations can better assess their outcomes and adjust them where necessary to better fit their wanted results and contribute to their sustainability objectives.

Furthermore, under critical thinking, the ability to create solutions through higher levels of reasoning is also discussed. This aspect is essential for effectively addressing complex sustainability problems, as Manager 1 emphasized that when working in the energy sector often involves large multidisciplinary projects that require collaboration between various fields, such as technical, legal, and economic. She also stated that *"it's important to pull these different disciplines apart sometimes to see how it works and from which approach or angle to look at it"*. She elaborated that it is important to know the basics of each of these disciplines in order to ask the right questions to engage the technicians, economic, and legal experts to find the fitting solution. Consequently, in order to create the right solutions, Manager 10 stressed the importance of being able *"to soak up"* all the related information and turn that into something logical. She highlighted that these skills are increasingly more important, especially due to the energy transition or when an organization is innovating because it is preferred to be able to adapt quickly to one's environment, and that requires individuals who can quickly take in all kinds of different information streams and in return process that quickly into something logical.

### *4.2.2 Sense-making skills*

As mentioned, addressing sustainability issues is very complex and requires leaders to navigate multiple challenges at the same time. According to Manager 10, this emphasized the need for a leader to keep looking from a broader perspective and assess whether a problem requires immediate attention or is just *"a drop in the ocean"*. This view helps leaders to keep an overview of all the problems in an organization and contribute to their understanding of the bigger picture so they can prioritize the problem that needs the most urgent focus. The importance of maintaining a broader perspective is emphasized by Manager 15, who highlights the need for leaders to consistently *"stay in the helicopter"*. By avoiding getting too involved in individual issues, leaders can prevent becoming too focused on the details and losing sight of the bigger picture. By staying in their helicopter view, they keep an overview of ongoing challenges and can effectively manage their people. Furthermore, in order to tackle complexity, Manager 1 stated that the focus should be on *"not being afraid of all the different things you have to do and just peel them off and do them one by one"*, meaning individuals should focus on breaking down the complexity related to SDG 9 projects into manageable tasks. Moreover,

in this approach, Manager 2 pointed out that personal strengths, like flexibility or being able to solve difficult and complex problems, will contribute towards making sense of the complexity.

*4.2.3 Long-term orientation*

Next up, multiple managers identified that having a long-term orientation can further enhance sustainability approaches, which is especially important for leaders. Manager 10 stressed the need for future leaders to *"dare to think for the long-term against all trends"* since both the shareholder model and the political systems tend to be short-term focused. She mentioned that this topic is crucial for sustainability in general, but also applies to the SDGs and their need for a focus on the long-term. Another argument for the benefits of a long-term orientation comes from Manager 8, who highlighted the need to create collaborations that focus on a relationship that is sustainable in the long-term and will provide value for both parties involved. Additionally, supporting long-term orientation requires the development of a clear plan, where Manager 2 emphasized the importance of communication to ensure the plan is effective and aligned with the long-term goals. This is in line with Manager 12 who stated that communication is important, but even more important is planning. Due to projects requiring different external parties to work together and verify each other's parts it takes a significant amount of time to implement these projects successfully. Therefore, planning becomes essential in order to avoid delays and ensure the projects stay on track. So, when tackling sustainable issues, it is essential to not limit one's focus on short-term success, but rather also plan for the long-term to achieve meaningful and lasting results in the future as well.

*4.2.4 Technical and Subject-related skills*

The last theme identified for the cognitive and problem-solving skills is technical and subject-related skills, which are often mentioned by managers as a prerequisite before being able to tackle complex sustainable challenges. Manager 10 emphasized that while the willingness to tackle sustainability issues is important when working in the energy transition, it is not sufficient on its own, and having technical skills to back this up is essential. Furthermore, Manager 14 explained that due to the technical nature of industry projects as a leader, one should have a solid understanding of the relevant technologies in order to effectively communicate and collaborate with all parties when discussing these challenges. Manager 14 further highlighted the need to have technical personnel who understand the context required, like mechanical engineers or other technical experts, to contribute to the success of technical projects related to the industry sector. Manager 16 added that in a technical field like the infrastructure sector, the primary concern is with hard skills, for instance, employees should be

familiar with contract management, scope management, and be able to come up with technical solutions. However, as highlighted by Manager 14 technical skills require to be combined with a basis of technical knowledge in general, where a foundation of technical knowledge is essential as it directly contributes to the development of technical skills.

Similarly, expertise beyond just technical abilities is equally important according to Manager 1, where deep knowledge of the subject is necessary when strategizing energy and climate policies since *"a good story does not sell itself on its own"*. When faced with questions or resistance, one should fully understand the subject to convincingly communicate one's ideas and plans. Manager 8 confirmed the need for expertise, saying that progress cannot be achieved without expertise in the relevant topics.

Lastly, developing technical abilities and expertise often comes through experience, which is another key aspect of having technical and subject-related knowledge. Manager 13 recognized that experience has played a significant role in his success, as lessons learned at previous companies have helped him identify which practices are effective and which are not. Furthermore, Manager 12 recognized the value of having an expert on the team with over 20 years of experience since *"she has so much inside knowledge that she can also share with us again, which means we are immediately aware of developments"*.

#### *4.2.5 Summary*

To summarize, *Cognitive and problem-solving skills* are also essential for addressing complex problems related to SDG 9. Firstly, critical thinking is mentioned as an important skill for both employees as well as for leaders in addressing complex sustainability issues. By continuously evaluating current outcomes and creating solutions through higher-level reasoning and including multiple disciplines, improved solutions can be created that are both effective and innovative.

Additionally, sense-making skills and having a long-term orientation are both identified as essential leadership skills. Sense-making skills allowed leaders to maintain a broad overview in order to prioritize tasks and break down the complexity into smaller manageable parts. Also, managers stressed the importance of maintaining a long-term orientation to develop sustainable solutions and collaborations that are profitable in the long-term, even though this can sometimes conflict with short-term financial pressures and political systems.

Lastly, many managers identified that having technical and subject-related knowledge is a prerequisite for tackling complex sustainability issues and driving change. Additionally, during

the interviews, it was found that in the energy, industry, and infrastructure sectors, technical and subject-related knowledge significantly impacts the ability to contribute to CPS. This finding is particularly relevant due to the technical and complex nature of innovation and sustainability projects related to SDG 9. It is also important to note that in order to develop technical and subject-related skills a foundation of relevant knowledge is essential, and individuals can only develop their technical skills if the underlying knowledge for it is present.

## 4.3 Interpersonal skills

Interpersonal skills play a significant role in solving complex problems related to SDG 9. Unlike the previously discussed abilities, which focus primarily on individual skills and one's relationship to oneself, interpersonal skills emphasize interacting effectively with others. The identified themes from the data analysis are *Communication skills, Collaboration skills, Relationship building and maintenance, Mobilization skills, Empathy, and Responsibility taking*. These abilities enable individuals to work and communicate successfully in teams to drive sustainable goals together.

### *4.3.1 Communication skills*

One of the most commonly mentioned skills by managers in tackling complex challenges associated with SDG 9 is communication skills. To start off, Manager 2 stated that when creating new industrial processes and technologies *"you will have to be able to communicate well"* and it is crucial that there is clear communication to ensure everyone understands what is expected from them and what they need to deliver for the project, contributing to more alignment between teammates and avoiding mistakes. Manager 12 also emphasized that it is helpful when an individual clearly knows what is expected from them, which can only be achieved through clear communication. Furthermore, according to Manager 10, clearly communicating expectations helps to *"hold each other accountable for things [...] which is also very important"*. Additionally, in order to have clear communication, Managers 4 and 12 stressed the importance of having a culture in the organization where everyone is open to communicating with each other and individuals can always ask others to think along and help with their challenges. A practical implementation of effective communication is brainstorming together, where Manager 10 noted, that sometimes just by asking a few simple questions one can encourage others to think differently about tackling their challenges. Manager 16 also saw brainstorming sessions without strict agendas as an opportunity to stimulate communication, address any collaboration and communication challenges that are occurring, and see where they are missing out on potential opportunities.

A key component of having a culture of open communication in an organization is the ability to actively listen and understand each other struggles. This is also pointed out by Manager 1, who emphasized the importance of communication in general but stated explicitly that in order to come up with sustainability initiatives it is essential to keep listening to each other. Reinforcing this statement is Manager 14, who claimed that keeping balance in the team through making sure people keep listening to each other is *"the essence when it comes to innovating"*. Furthermore, Manager 8 credited this to having good social skills, which enable colleagues to genuinely support one another and gain a deeper understanding of each other's backgrounds. Additionally, Manager 1 highlighted the value of communication in holding each other accountable.

On the other hand, actively listening and understanding each other is not only crucial when working in a team but is also a key approach when working with customers or other external parties. While collaborating with a customer Manager 6 provided a fitting example of this, whereby listening to the customer's concerns regarding the carbon emissions of their products and the unclarity of their obligations to meet their reporting requirements he was able to understand their concerns and come up with solutions together, resulting in a very satisfied customer experience. Moreover, Manager 5 stressed the importance of communication and active listening with the external party, in this case, farmers whose land they were building on, where they failed to listen enough to the farmers' concerns resulting in the unnecessary destruction of drainages in the ground. Therefore, adopting new technologies or creating more sustainable solutions requires managers to balance many different stakeholders' interests, where communication skills are crucial to CPS in projects related to SDG 9.

### *4.3.2 Collaboration skills*

Another important theme identified by many managers is the role of collaboration in driving sustainable innovation, where managers highlighted the need to work together in order to create better solutions. Co-creation can play a crucial role in sustainability progress as shown by Manager 8 who stated: *"With more and more big companies with whom we closely collaborate, we also seek innovation and try to come up with green things together"*. However, Manager 15 pointed out that effective collaboration for sustainability initiatives often requires cross-departmental cooperation, and without it, sustainability progress will be hindered.

Furthermore, the focus on developing and growing together is essential for the long-term success of sustainability initiatives, where Manager 6 observed that with innovation projects

*"the system now is much more working together in development versus taking incremental steps independently"*. This approach can lead to the sharing of knowledge and resources in order to develop more innovative solutions. Manager 10 confirmed the contribution of collaborative efforts stating that when parties stop continuously stimulating one another to work together this can lead to a stagnation of innovation.

To ensure that collaboration happens throughout the organization and with external parties it is essential to create a stable and balanced work environment. Firstly, Manager 11 stressed that it is important to stay calm in order to navigate all the challenges that may arise during the collaboration efforts in order to motivate individuals to participate in challenging projects. Moreover, Manager 11 created a program within the organization to help employees create awareness and provide insights into possible sustainability initiatives within the organization or in their private lives, further enhancing their collaboration skills in relevant SDG 9 projects. Secondly, Manager 8 highlighted the importance of balancing green initiatives with the need to create a business case in order to ensure that the sustainability goals are aligned with the business strategy, further enhancing collaboration. Overall, collaboration, maintaining balance, and encouraging collective growth are vital components in achieving innovation and sustainable initiatives.

*4.3.3 Relationship building and maintenance*

Building and maintaining strong relationships is crucial for enhancing communication, collaboration, and trust in a team. In order to build and maintain relationships Manager 9 preferred to have genuine, face-to-face contact with people on the work floor, making individuals feel more connected to their managers and more comfortable reaching out to them when necessary. The approach of Manager 5 focused on investing time into relationships to *"get people to do their jobs with a smile"*. A practical example of investing time into relationships is that Manager 5 organized team-building days where they visit clients and do fun activities together, which creates positive energy across the team. Furthermore, according to Manager 3, *"Leaders need to be prepared for a world that is changing faster and faster, becoming more and more complex. In which relationships, […], are becoming increasingly important"*. Additionally, Manager 5 stressed the importance of sustaining relationships with others by creating an enjoyable and sociable working environment to ensure that individuals are motivated to collaborate.

Additionally, creating meaningful relationships where team members feel connected to one another is also crucial for the functioning of the team. Manager 11 pointed out that connection can be built up by talking with each other on a human level about concerns and anxieties, in order to better understand and support one another. Manager 14 added to this by highlighting he feels it is his responsibility to seek out connections and similarities between his team members to further improve collaboration. Furthermore, Manager 2 mentioned building an environment of trust as a precondition for better communication and collaboration, where individuals feel comfortable and can be themselves. Manager 10 added that transparency and honesty can only occur in an environment where trust has been established, further encouraging better communication and collaboration

*4.3.4 Mobilization skills*

Mobilization skills are essential in driving sustainable change as a leader and can refer to the ability to inspire and motivate individuals or groups to take action toward a common goal. These skills are crucial in taking individuals along with one's goals, engaging stakeholders, and driving the change necessary to tackle complex sustainability problems. As Manager 1 stated, even though one can have everything legally and digitally in order, to achieve progress *"people need to get moving"*. Additionally, Manager 5 highlighted the benefit of motivating enough people to move towards the same goal in order to create the momentum needed to overcome resistance or setbacks. He further elaborated that one way to get people involved and motivated is by listening and understanding their concerns regarding the change and trying to take away their concerns.

Alongside listening and understanding concerns against change, it is also key to be able to formulate the right arguments in order to convince someone to move towards sustainable goals. Manager 5 indicated the importance for a leader to formulate arguments for change by continuously explaining the objectives and convincing the people why it has to be done or what the benefits of the change will be. Similarly, Manager 10 approach in taking people along focused on explaining in which direction they were going and why. This explanation of goals is also something that Manager 9 showed, with her preference for explaining the reason why they needed to change something by demonstrating and backing it up through the use of calculations. Furthermore, since the complexity of projects related to SDG 9, Manager 11 emphasized the importance of creating awareness through argumentation in creating an understanding of why sustainability matters, especially for those in the organization who are not familiar at all with those practices and objectives.

Additionally, a key component of creating engagement for change is the ability to inspire others. A popular and effective way to inspire others that have been mentioned during the interviews by Managers 2, 12, and 16 is to lead by example, with the example by Manager 2 of *"If we want our people to work better together, we will have to set an example ourselves that we can work together"*. According to Manager 9 another way to inspire people of why change is necessary is by making results and improvements visible in numbers, so progress becomes easily trackable.

### *4.3.5 Empathy*

Empathy also plays a significant role in addressing sustainability challenges, as it allows leaders to connect with diverse stakeholders and understand their concerns. Manager 2 highlighted the importance of immersing oneself in another person's perspective which encourages leaders to consider the impact of their actions on others, for example by asking oneself questions like *"What would you do if it was your farm?"*. Empathy goes beyond just acknowledging someone's feelings, as Manager 11 described, it involves stepping into the shoes of the other person and asking the right questions to fully understand their situation and interests. Manager 5 even stated: *"To me, the leader of the future is really someone who has empathy for people"*. This ability to understand and relate to the experiences and struggles of others is crucial in creating solutions that are not just innovative but also minimize the impact the solutions have on other parties.

### *4.3.6 Responsibility taking*

Responsibility-taking is also an important interpersonal skill when it comes to solving sustainability problems, as it encourages accountability and makes sure individuals are committed to their tasks and promises they make for driving change. Manager 3 identified this as ownership, *"in the sense of taking responsibility for what you represent, including your tasks"*. Manager 6 further explained that ownership helps to keep everyone focused on the agreed targets and helps them in reporting on their carbon footprint and incidents. In this case, ownership results in a feedback loop where everyone involved is held accountable in order to ensure the agreed-upon targets are reached.

In addition to responsibility taking, giving autonomy is also crucial in creating a sense of ownership. Manager 4 aimed to give autonomy to his team members as much as possible, stressing that a leader should understand when someone needs more autonomy based on whether they are highly competent and motivated. Manager 11 is in line with this statement, who noted that successful companies often make use of self-organization, where power is

distributed among employees who even better know what it takes and requires to change. Therefore, combining responsibility taking with giving autonomy can contribute to the accountability of individuals but also allow them to engage more in the process of change which can be crucial in addressing the complexity of sustainability issues.

#### *4.3.7 Summary*

To summarize, *Interpersonal skills* are also crucial for solving complex sustainability problems. Additionally, communication, collaboration, relationship building and maintenance, and mobilization skills are identified as essential in this approach, where without these skills being present, tackling sustainability issues will become very challenging.

By creating a culture focused on open communication and actively understanding and listening to each other's concerns, organizations can limit misunderstandings and break down communication barriers between team members but also for customers. Therefore, open communication results in more collaboration and feedback between units that contribute to tackling complex sustainability problems more effectively. Additionally, communication also contributes towards collaboration, another crucial aspect of sustainable innovation. Managers highlighted the importance of co-creation and cross-departmental collaboration to develop the most effective solutions and innovations. In order for this to happen, leaders should create a stable and balanced work environment.

Furthermore, building and maintaining positive relations with colleagues, customers, or other external partners can further enhance communication, collaboration, and trust in an organization, since creating an enjoyable work environment motivates individuals to collaborate with each other and trust is the foundation for better communication and transparency in the workplace. Additionally, mobilization skills helped leaders to inspire and motivate individuals or groups to take action towards common goals. Effective leaders engaged their stakeholders, address their concerns, and formulate convincing arguments for why the change should happen. Another key component in inspiring individuals to participate in sustainable change is leading by example and making the improvements and progress visible to everyone.

Lastly, empathy allowed leaders to understand stakeholders' concerns when making decisions. By understanding others’ perspectives, empathy is important for creating solutions to complex sustainability problems while considering their impact on everyone involved. Additionally,

responsibility-taking of tasks encourages accountability and commitment, which are essential for driving change.

## 4.4 Leading change capabilities and skills

Lastly, leading change capabilities and skills can further address the challenges related to complex sustainability problems. The themes identified from the data analysis are *Decision-making and implementation skills, Courage, Creativity, Entrepreneurship, Flexibility and adaptability, Perseverance, and Setting and translating goals*. Courage, creativity, and decision-making skills are crucial for leaders to take steps and find innovative solutions. Entrepreneurship further drives new approaches, while flexibility and perseverance help leaders navigate uncertainty. Setting clear objectives and translating them into actionable steps on all different organizational and knowledge levels makes sure that the goals are reached. Together, these skills contribute to leaders in coming up with effective solutions for the complex problems related to sustainable development.

### *4.4.1 Decision-making and implementation skills*

When discussing leadership skills with guiding everyone through the complex problems related to sustainable development, a crucial skill for a leader is that of making a decision and implementing it throughout the organization. To start, when making a decision Manager 1 pointed out that it is not always practical for everyone to have a say in the decision when things need to be done, since there is always someone who disagrees for one or another reason. This is confirmed by Manager 3 stating that it is not always necessary to include everyone in every meeting and decision, which otherwise could feel like a waste of time. When not including everyone in the made decisions, which is sometimes necessary, Manager 5 highlighted that leaders must make *"decisions that sometimes not everyone likes"* and that not everyone will be happy with one's decision, but sometimes just need to move on and decide in which direction to go. Following Manager 10, an approach that helped is to ensure to acknowledge all the different shareholders' interests of everyone, but clearly state and communicate which interest is prioritized and decided on.

Additionally, after making the decision it is the leader's responsibility to ensure it is properly implemented. Manager 8 main concern when implementing decisions was making sure that *"developing leaders know how to turn that urgency into action"*. Manager 4 stated that it is important when implementing a clear objective to explain to everyone what the changes mean and what is expected from everyone. Additionally, Manager 6 stressed the need to ensure

decisions are implemented in a responsible manner now and in the future, since the world will not become more stable geopolitical or technical-wise.

### *4.4.2 Courage*

Firstly, a common leadership trait mentioned during the interviews for achieving sustainable development is courage, which in this case can be divided into the courage to take risks and daring to put oneself in uncomfortable positions. The first one is nicely summed up by Manager 8 who stated: *"I think leadership is very much about daring to take risks precisely when necessary",* which is confirmed by Manager 3 who stated that sometimes a leader just needs to have the courage to make a difficult decision. Additionally, leading is all about uncertainties, especially in a change or a transition, since according to Manager 11 *"As a leader, you need to understand that 80% of transformation is about uncertainty"*, so sometimes it is crucial for a leader to dare to just make the best decision despite all the uncertainty.

Furthermore, courage can also mean taking on a situation where one is not comfortable, according to Manager 3 sometimes a leader must have the courage to make difficult decisions even if this means taking on a conflict with someone if necessary. Similarly, Manager 8 stated the need to have the courage as a leader to speak the truth, be direct, and have an open conversation about it with each other. Additionally, when trying to innovate, according to Manager 16 it is also important to not take on comfort and to have the courage to speak up when needing help from others.

### *4.4.3 Creativity*

Another necessary competency for creating innovative solutions to solve complex problems is creativity, while creativity can be developed as a skill it is mostly a trait certain individuals possess. This is supported by Managers 5 and 6 who stated when innovating, just optimizing the existing is not good enough and one should really have to think outside the box and make a move in a different direction in order to find new and better ways to do something. Furthermore, when innovating and designing a new project according to Manager 14 *"you need someone who is, well, a bit more creative and who thinks about how it can be done differently"*. This is in line with the preference of Manager 15 of having personnel that can come up with creative solutions and look for solutions from all different kind of directions. Additionally, following Manager 1, being able to come up with creative solutions can also contribute to better decision-making where it is possible to find a solution that works for multiple disciplines like legal, economic, and sustainable at the same time.

*4.4.4 Entrepreneurship*

Another important aspect of leading innovation and sustainable development is entrepreneurship and the motivation to seek out entrepreneurial opportunities to find new solutions which also requires a leader to have the ambition to do better.

Manager 5 highlighted the need to seek out entrepreneurial opportunities, where he stressed an approach to start acting on the opportunities and focus on learning from them and adjusting if necessary. He further elaborated, that due to their position at the forefront of the energy transition and their important role as grid operators, they cannot just sit back but have to actively seek out these opportunities since otherwise nothing will be achieved. Additionally, according to Manager 12, seeking out entrepreneurial opportunities is a key aspect of being pioneers in sustainability and being at the front of the market, where trying out and learning from multiple opportunities can help mitigate future market uncertainty. The importance of entrepreneurship is also highlighted by Manager 2, who states "*You can be very good at communicating and take everything and everybody into account, however, if it lacks entrepreneurship, it just becomes a very cozy tea party, right?"*. Furthermore, Manager 6 saw the value of seeking out entrepreneurial opportunities together with their clients, where they think along with the client and put in more responsiveness by not making them wait and constantly coming up with new ideas for them, which is noticed and appreciated by their clients. In addition to seeking out entrepreneurial opportunities, Manager 2 described entrepreneurship with the help of the question *"Do you work for something because you love working on this product and have the ambition to do it better tomorrow?".* He further explained ambition as being willing to work harder for one's goals and having the ambition to think about it and think better or differently.

*4.4.5 Flexibility and adaptability*

Being flexible and adaptable to one's surroundings also plays a significant role in approaching complex sustainability challenges, where Manager 6 stated that *"the world is not going to become more stable geopolitically and technically […]. So, I think being flexible and keeping a company flexible is a very important value".* In addition, Manager 2 stressed that when operating and optimizing the supply chain, flexibility is often very useful since one should be able to respond to all sudden changes in the environment like fluctuations in demand or planning the most sustainable route when delivering all packages. This is also highlighted by Manager 12, who described flexibility as a key factor for dealing with the increasing amount of data and automatization, as well as having a flexible approach while dealing with change.

As already briefly mentioned, individuals should be able to adapt to one's surroundings. However, this does not just mean being able to adapt to challenges in the environment, but also being able to quickly react to and adapt to changing customer demands. In addition to this, Manager 6 stated the need for an approach that constantly thinks along with the clients and puts in an extra bit of responsiveness to better meet customers' demands. Lastly, Manger 8 justified the need for adaptability since *"no organization is the same and you have to be able to adapt accordingly",* where not being able to accept the reality and adapt to it will cause further problems in meeting customers' demands.

*4.4.6 Perseverance*

Perseverance is another valuable skill in tackling complex sustainability problems, mainly mentioned during the interviews in the context of leadership. The first aspect of perseverance identified is the willingness to face discomfort and embrace uneasy situations. The need to be able to face discomfort in establishing change and sustainable development is highlighted by Manager 10 who stated *"If, in a transformation as a leader, you are not comfortable in discomfort, you are going to have a very tough time"*. She further elaborated that when a leader is willing to ask simple, yet unanswerable questions, it can lead to a particular discomfort causing people to hopefully regain that composure and contribute to the progress again.

Additionally, dealing with setbacks is a must when developing solutions to complex problems, Manager 5 highlighted an approach for dealing with setbacks where *"we just have to try things from time to time and then it's not bad at all to find out that maybe it wasn't the right way, but we did learn [...] that we need to take another turn"*. Moreover, Manager 11 emphasized the need for a leader to have enormous resilience, since a leader should have the courage to act differently sometimes and make mistakes. The key point is to keep on trying to find better solutions despite encountering many challenges along the way.

Furthermore, when asked about reaching one's goals Manager 1 answered with *"I think maybe most important of all is perseverance"*, where perseverance is *"falling and getting up again"* which is not always enjoyable, but it is necessary. Also, Manager 9 illustrated that even after finding a solution, the implementation of the solution also requires perseverance and overcoming many hurdles.

*4.4.7 Setting and translating goals*

The last identified skill contributing to solving complex sustainability problems revolves around leadership, who should have the ability to create a common goal and vision as well as the skill to translate set goals into ranging complexity depending on the organizational level.

First, creating a common goal and vision is essential, Manager 1 emphasizes the need, where *"everyone has to start looking in the same direction"*, which is very difficult and requires a leader to make everyone feel understood. This is in line with Manager 5 who also highlighted the importance of working towards a common purpose. He further elaborated that by focusing on the bigger picture and the common goals leaders can align their team members with each other, enhancing their collaboration.

Furthermore, after setting common goals it is of great importance that these goals are translated into different complexities for different levels in the organization. This need is acknowledged by Manager 9, who admits she sometimes struggles with translating goals into a for everyone understandable language, however, she highlighted that this *"would be helpful, and it should be the way things are done"*. As a solution, Manager 13 suggested that leaders should translate goals into targets that become progressively more concrete at every lower level in the organization. This approach will ensure that everyone can understand and work towards the common goals by following the targets that are set to their level in the organization.

*4.4.8 Summary*

In short, *Leading change capabilities and skills* are crucial for individuals who want to drive change and find innovative and sustainable solutions to complex problems. Decision-making and implementation skills in combination with courage and creativity are essential for leaders to come up with effective solutions for sustainable development. Leaders should acknowledge different stakeholders' interests, but in the end, make a decision on which interest to prioritize and communicate this clearly to everyone involved in the change. Leaders should recognize the interests of different stakeholders, but in the end, they must decide which interest to prioritize and clearly communicate this decision to everyone involved in the change. Additionally, courage is a crucial trait for leadership when making decisions. Leaders must sometimes take risks despite uncertainties and embrace uncomfortable situations by speaking the truth and having open, honest conversations. Furthermore, when coming up with solutions creativity is also a necessary trait, whereby thinking differently and outside of the box individuals can come up with unique and novel solutions to complex sustainability problems.

Entrepreneurship further drives new approaches, while flexibility and perseverance help leaders navigate uncertainty. Setting clear objectives and translating them into actionable steps on all different organizational and knowledge levels makes sure that the goals are reached. Together, these skills contribute to leaders in coming up with effective solutions for the complex problems related to sustainable development.

Moreover, seeking out entrepreneurial opportunities and having an ambition to do better further drives the development of new sustainable approaches. In this approach, flexibility and adaptability are essential for an organization to remain resilient in an uncertain geopolitical and technological environment while being able to respond to complex changes in the environment and to customers' demands.

Additionally, perseverance is crucial in overcoming the challenges related to complex sustainability problems, where leaders should be willing to face discomfort and deal with setbacks adequately. This approach includes continuously trying out new opportunities and learning from mistakes in order to achieve sustainable development. To further achieve sustainable development leaders should be able to set and translate goals to different levels of complexity throughout the organization for everyone to understand the objectives and be able to contribute to reaching them.

### 4.5 Approach to solving complex problems with the combination of multiple skills

So far, many skills have been discussed that contribute to solving complex problems related to innovation and sustainable development. However, due to the complexity of the discussed SDG 9 projects in the energy, industry, and infrastructure sectors, during the interviews and data analysis it became apparent that many managers brought forward the need to combine different skills with each other to successfully overcome these complex problems. Manager 1 elaborated that solving complex sustainability problems cannot be achieved by using a single element or skill. Instead, it requires a combination of multiple skills that reinforce and compliment each other to drive sustainable development.

For instance, Manager 6 emphasized that he prefers someone who understands both finance and technical matters, and who can also communicate well. He further highlighted that engaging in sustainability and innovation requires an approach where both technical and financial aspects are considered since that is also the way it works in the world balancing the costs and benefits of a project.

Furthermore, an ideal leader should have both the technical skills of an engineer and the leadership qualities to guide teams effectively. Manager 16 elaborated on this by saying that a leader should be able to translate very technical solutions, ideas, and innovations with social skills like speaking from the heart and with a passion to clearly communicate this with the client and to understand each other's interests. Additionally, Manager 3 sketched that an ideal leader has knowledge of the content in order to improve current approaches, but also can drive change through communication and convincing individuals to participate in the change.

Moreover, Manager 2 pointed out that while entrepreneurship is necessary for driving innovation and creating new solutions, it should always go hand in hand with interpersonal skills like teamwork, communication, and collaboration to ensure progress is made without having to sacrifice relationships or long-term collaboration partners.

Additionally, the results showed that all interpersonal skills identified need a foundation of open and clear communication to fully contribute to solving complex problems. For instance, without effective communication, collaboration with others in a balanced and stable environment seems impossible. Secondly, without effective communication, it is challenging to drive change, since it is necessary to communicate clear arguments for change in order to create awareness and inspire individuals to take action. Also, effective communication and listening to each other can contribute to the understanding of other stakeholders' interests, which in combination with empathy can ensure that one's decision-making does not have a negative impact on others. One of the most important impacts of effective communication is its role in building and maintaining relationships, where open communication and active listening create an environment of trust. This trust is essential for individuals to be authentic, honest, and transparent, which further causes an environment where people feel safe and like they can speak up and effectively contribute to solving complex sustainability problems.

Furthermore, decision-making and implementation skills and setting and translating goals are also important aspects of solving complex sustainability problems, which can be supported by traits such as courage and creativity. Leaders must recognize and prioritize different stakeholders' interests in making decisions, setting goals, and communicating them clearly. To support this process, courage helps leaders take risks and face uncomfortable situations arising from prioritizing one interest over another, while creativity allows for the ability to come up with innovative and unique solutions.

In summary, leaders who develop sustainable and resilient infrastructure, promote sustainable industrialization, adopt sustainable technologies and industrial processes, and upgrade their technological capabilities through innovation must be able to combine multiple skill sets like technical and financial knowledge, interpersonal skills, and leadership skills to navigate and solve the increasingly complex challenges they face.

# 5. Discussion

The goal of this qualitative study is to find how individual skills may contribute to solving complex problems in light of SDG 9 while focusing on the energy, industry, and infrastructure sectors. Multiple crucial skills are identified that contribute to sustainable development and CPS. However, next to finding skills, managers also discussed the importance of knowledge and individual traits in order to achieve the solution to complex sustainability problems.

First of all, technical and subject-related skills are a prerequisite for tackling complex sustainability challenges, and developing these and applying other skills requires a foundation of technical knowledge in order to understand the technical and complex aspects of projects related to SDG 9. The technical skills relate to the knowledge, education, and work experience of an individual that allow them to perform certain technical tasks (Farao et al., 2023). While the objective of the research initiative revolved around identifying the importance of soft skills and not technical skills, the results of the study revealed that when working on complex projects related to SDG 9, technical skills are indeed important and also require attention for their contribution toward CPS. This is in line with the technological shift relating to SDG 9, where initiatives become more technical in nature and must focus on technical skills while also addressing the ethical and sustainable impacts of innovations (Costa, 2024). Due to the technical nature of energy, industry, and infrastructure projects, technical skills might be more relevant in the context of CPS for SDG 9 than other SDGs with fewer technical targets.

Furthermore, while the research focused on identifying skills essential for CPS, it also highlights individual traits that are significant in addressing CPS, which all overlap with some of the skills and qualities mentioned by Inner Development Goals (2021). Moreover, while identifying all these relevant skills and traits for CPS a few were emphasized by Managers as the core in finding and developing solutions for complex problems, where without having these skills achieving sustainability regarding complex problems will be extremely challenging.

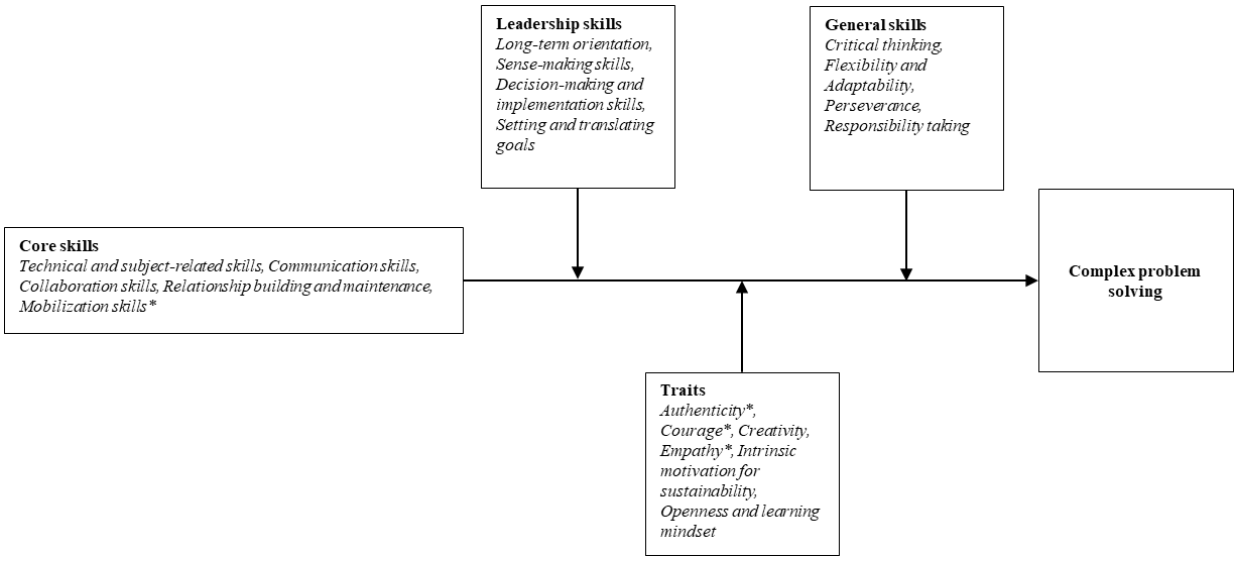
Furthermore, the study highlights leadership skills, selected based on the context in the interviews, where managers discussed these skills being relevant to mainly individuals in a

leading position, which add to the found leadership skills and traits during the literature review (van Laar et al., 2017; Guarini et al., 2021; Inner Development Goals, 2021). The other general skills were identified as being important for so well employees as leaders in solving complex sustainability problems. While the observed traits, leadership skills, and general skills all contribute to CPS, they most effectively contribute toward solving complex problems when the core skills are present.

In addition, it is very crucial to combine different skills and traits with each other for CPS (Hermann & Bossle, 2020). Therefore, to effectively solve complex problems, the focus should not be on a single skill or trait. Instead, it requires a combination of various skills and traits that complement each other and enhance the ability to solve these complex problems.

Referring back to the research question: *"How may individual skills contribute to solving complex problems in light of SDG 9?"*. The answer is that rather than just skills on their own, it is the combination of traits, leadership skills, and general skills that reinforce the core skills that truly contribute to solving complex problems and achieving the SDG 9 goals, of which an overview of their relationship with each other and CPS is presented in figure 2. Furthermore, the following section will discuss how these findings relate and contribute to the conducted literature review and existing literature on individual skills contributing to CPS.

**Figure 2. Overview identified skills and traits contributing to CPS**




**Note(s):** Found skills and traits with an * behind them were still identified as leadership skills or traits but placed in a better fitting category for them according to the researcher.

## 5.1 Theoretical implications

The results found in this study are mainly in line with the literature used in previous chapters. The results indicate that, in addition to skills, an individual's knowledge and traits also contribute to complex problem-solving. These results are built on the existing evidence of complex cognition, where individuals use mental processes to create new information out of given information to contribute to CPS (Knauff & Wolf, 2010). While the research of complex cognition mainly focused on the mental processes needed for CPS, these results show that an individual's knowledge, especially technical knowledge and skills, plays a crucial role in CPS. Newfound literature already highlights the necessity of applying knowledge to perform tasks effectively and solve complex problems (Margarida et al., 2021). Furthermore, both knowledge acquisition and application are essential for understanding and responding to these complex problems (Greiff et al., 2015; Wu & Molnár, 2022), where new literature also supports that having the relevant knowledge beforehand significantly enhances the stages of knowledge acquisition and application in complex problem-solving (Greiff & Neubert, 2014; Weise et al., 2020). Additionally, new literature also suggests that knowledge plays a critical role in developing skills for complex problem-solving, where applying theoretical and technical knowledge to practical challenges can enhance critical thinking and problem-solving skills that align with the technical nature of SDG 9 related projects (David, 2024; Costa, 2024). Based on these findings, for future quantitative research, it is proposed that the level of an individual's knowledge has a positive effect on developing and applying skills relevant to solving complex sustainability problems.

Additionally, the results show traits that contribute to CPS that are in line with the findings of Inner Development Goals (2021). While the primary focus of the IDG framework was not on traits but rather on the cognitive and social skills necessary for CPS (Inner Development Goals, 2021; Mead et al., 2023; Shtaltovna et al., 2024), this study contributes to the theory by acknowledging the differences between skills and traits that enhance CPS. New literature confirms the positive effect of traits on CPS, where a study by Mai et al. (2022) revealed that leadership traits, such as the courage to take risks, are essential for business innovation. Furthermore, research by Walumbwa et al. (2008) emphasizes the importance of authenticity in leadership, highlighting qualities such as self-awareness, relational transparency, ethical behavior, and consistency in actions and values in order to create an environment of trust and engagement (Karlsson, 2024), which is more in line with the results of this study. Based on

these findings it is proposed that leadership traits but also traits in general have a positive effect on one's ability in CPS.

Furthermore, the results also identified leadership skills for CPS, which expands on the literature reviewed in this study. The theory suggested that leadership skills for the 21st century were information management, communication, collaboration, creativity, critical thinking, and problem-solving (Laar et al., 2017). However, the results contribute to this theory by recognizing these skills as traits, general skills, and core competencies crucial for CPS, not exclusively skills and traits just for individuals in leadership positions. Additionally, Inner Development Goals (2021) identified skills and traits like authenticity, courage, empathy, long-term orientation, sense-making skills, and mobilization skills as crucial skills and traits for CPS, while these results distinguish them as specific leadership skills necessary for CPS in context of SDG 9. These skills and the other leadership skills identified in this study relate better with the main responsibilities of leaders and with the findings of Ashley-Osuzoka (2024), who stated that effective leaders should have a clear vision and guide their followers in implementing this vision by setting goals that translate into organizational performance and growth. Therefore, it is proposed that the presence of a larger number of identified leadership skills has a positive impact on solving complex problems.

Additionally, this study identified core skills that contribute to CPS. However, the literature reviewed did not indicate that one skill contributes more to CPS than another. Therefore, in this stage, no ranking of importance in skills for CPS was observed. However, these findings support the relevance of relational coordination for CPS, as four out of five identified skills are directly related to strong communication, cooperation, and the positive impact of relationships as seen in the relational coordination theory (Gittell, 2006; Bolton et al., 2021; Estriegana et al., 2021). These skills enable people to participate and contribute effectively towards CPS. The finding of core skills can also partly be explained by the research of Sinaga et al. (2024) which found that communication and collaboration skills to be the most important problem-solving skills. Another skill that was deemed crucial for problem-solving by Sinaga et al. (2024) was critical thinking, which is a contradiction with the finding of this study, which classed critical thinking under general skills for CPS. Furthermore, the findings of this study expand on the importance of communication and collaboration skills by adding technical and subject-related skills, relationship building and maintenance, and leadership skills to mobilize individuals to the list of the most important skills to achieve CPS. Based on these findings, it

is proposed that there is a difference in impact between skills and traits on solving complex problems, where the core skills contribute more to CPS than others.

In addition, the findings showed that it is very crucial to combine different skills and traits to successfully overcome complex problems. This is also what the literature suggested, where when faced with complex challenges, there is a need for both cognitive and social skills and other personal and social capabilities required to lead and solve complex problems (Inner Development Goals, 2021; Mead et al., 2023; Shtaltovna et al., 2024). Additionally, the literature also identified the distinction between hard and soft skills and that they are both needed to contribute to CPS (Cimatti, 2016; Farao et al., 2023). Therefore, it is proposed that the combination of skills and traits can complement and enhance each other's impact on CPS, where more research is needed to determine the connection between different skills and traits and their combined effect on CPS.

### 5.2 Practical implications

The findings from this study can help individuals, leaders, and organizations improve their approach to solving complex problems related to SDG 9, based on the presence and application of identified skills, knowledge, and traits.

Firstly, it is important to recognize that the identified traits are harder to develop, as they are inherent and often already present in an individual’s character (Anaya & Pérez-Edgar, 2019; Etkin et al., 2022). However, the findings can help guide individuals by highlighting which traits are contributing to CPS and which traits they therefore should try to develop further and implement more in their practices.

As for the core skills, managers should create a stable and balanced work environment, so communication can flow freely throughout the organization and contribute to effective collaboration, a key aspect in developing solutions and innovations for complex problems (Mickel, 2024). Being honest and transparent in one’s communication and being able to justify why a certain interest is chosen over another interest will create an environment of trust. Establishing trust in an organization will contribute to building and maintaining relationships and create a positive culture where individuals feel more committed to the organization and its goals (Yeung & Lau, 2024). Other ways managers prefer to develop relationships that contribute to better communication, collaboration, and mobilization skills are through genuine face-to-face contact and investing time in relationships through activities like team-building days and having positive communication with each other (Mickel, 2024). Creating an enjoyable

and safe work environment by providing open feedback and coaching and fostering a culture where individuals feel safe in admitting their mistakes and learning from them (Atkinson et al., 2022), where individuals feel that they can be themselves and speak up when necessary further motivation individuals to collaborate and find solutions for complex sustainability problems.

Furthermore, developing technical and subject-related skills requires the acquisition of relevant knowledge first as a foundation to further learn and develop technical skills (David, 2024). Additionally, to achieve this it helps to gain experience and expertise in the relevant field and learn from the experience of others. The identified leadership skills, such as setting and translating goals as well as decision-making and implementation skills, can be further developed through experience. As leaders gain practical experience, they learn which approaches are effective and which are not. Furthermore, these skills can further be developed by active listening to and understanding the concerns of others. When making decisions, openly and honestly communicating the reasons behind one's choice over other options helps build trust, inspires others to follow, and contributes to effective leadership in solving complex problems.

Lastly, the findings of this study offer managers an overview of which skills and traits contribute to CPS. This overview allows managers to reflect on their own abilities, identify shortcomings in their approach, and identify areas for improvement. Furthermore, it is important to state that when managers have limited resources for the development of relevant skills and traits, it is most effective to focus first on enhancing the core skills since this study identifies them as contributing the most to CPS.

## 6. Limitation and future recommendations

While this study offers valuable insights into the skills and traits contributing to complex problem-solving in the context of SDG 9, several limitations should be acknowledged:

The first limitation is that the study was conducted with a sample size of 18 interviews, which lacked diversity between the represented industries. From the selected industries only 2 candidates were interviewed from the infrastructure sector, while the industry sector accounted for 9 candidates and the energy sector accounted for 7 candidates.

In the future, studies should include a larger and more diverse sample size, where different sectors are better represented to increase the generalizability of the results. With the study focusing on CPS in light of SDG 9, collecting data from just two infrastructure managers can

lead to an underrepresentation of projects related to creating sustainable and resilient infrastructure compared to the other sub-targets of SDG 9 like promoting inclusive and sustainable industrialization of which 9 managers shared their experiences.

Furthermore, candidates were selected based on initial screening by employees of HillFive based on their relevance to the study and afterward were confirmed relevant by the researcher based on their LinkedIn profile and the organization they worked in, which could have led to some selection biases where only candidates were invited based on their positive relationship with HillFive employees.

So, in the future, participants should be recruited more objectively on their relevance to the study rather than existing connections and relationships. This approach should focus on looking beyond just personal networks to ensure the best fitting candidates are found for the relevancy of the study.

An additional limitation is that the research only focuses on candidates in the industry, energy, and infrastructure sectors and due to the complex technical nature of these sectors and SDG 9, the results could be hard to recreate in other industries or for the other 16 SDGs with all their own different complex problems and challenges.

In the future, research should include other industries and SDGs to determine if different skills and traits are needed in these sectors to solve complex sustainability problems. As well to see if maybe other core skills are identified that better contribute to solving the unique challenges each SDGs and industries bring with them.

Another limitation of the research is that even though it identifies some core skills that are the most important for CPS, this was not part of the intended focus of this study. This results in some gaps in the results about how all the found skills and traits are interconnected and can complement and enhance each other for CPS.

Another limitation of the research is that, while it identifies core skills essential for CPS, this was not the primary focus of the study. Consequently, the findings do not fully explore the interconnections between these skills and traits, or how they can complement and enhance each other in the context of CPS. This creates some uncertainty in the results about how all different skills and traits correspond to each other for effective CPS

In the future, research should aim to explore the specific interconnections among the identified skills and traits in this study. By conducting another study, these skills and traits should be

further investigated on how they reinforce each other. This can lead to the development of an improved framework about the relationships between all the identified skills and traits, and their collective impact on CPS.

The last limitation of this research is that the participants might have had biases or personal interests that influenced the information they shared during the interview. Some candidates might have withheld some interesting information for this research due to confidentiality concerns or because they wouldn't like to share shortcomings and challenges that would make themselves or the organization look bad. This could affect the accuracy of the data collected.

In the future, researchers should aim to be more sensitive to participants' concerns and develop a better sense of timing and approach for asking difficult questions. This would help participants to feel more comfortable in answering questions about their shortcomings or challenges. Experience plays an important role in this, where experienced researchers are better at creating an environment where participants feel like being open and trusting the interviewer.

# 7. Conclusion

This study aimed to explore the role of individual skills on CPS in light of SDG 9, by investigating the energy, industry, and infrastructure sectors. The research identified vital core skills that stand at the foundation of one's approach to CPS and can enhance the application of other important skills and traits for CPS. Findings suggest that technical and subject-related skills are found to be prerequisites for tackling complex sustainability challenges, emphasizing the need for a solid foundation of technical knowledge before engaging in complex projects. In addition to the core skills, the study revealed other important skills and traits that further enhance one's capabilities to address CPS. Moreover, managers emphasized that while technical skills are crucial, one's approach should focus on the combination of various skills and traits that can complement each other for achieving sustainable development rather than applying a single skill or trait on its own.

Furthermore, the theoretical implications of this research contribute to the existing literature by combining different theories into one clear framework for understanding the role of individual skills and traits for CPS. Additionally, the results provide practical insights for individuals, leaders, and organizations to enhance their approach to CPS and realize more progress in achieving their own sustainability goals. In conclusion, this study underlines the importance of an integrated approach that combines technical knowledge, individual skills, and

traits to effectively tackle complex sustainability challenges and achieve the targets of SDG 9. By bridging the gap between current literature and practice, the research offers valuable guidance for individuals and organizations in improving their approach to solving complex sustainability problems.

## References


Ahern, T., Leavy, B., & Byrne, P. J. (2014). Knowledge formation and learning in the management of projects: A problem solving perspective. *International Journal of Project Management*, *32*(8), 1423–1431. https://doi.org/10.1016/j.ijproman.2014.02.004

Anaya, B., & Pérez-Edgar, K. (2019). Personality development in the context of individual traits and parenting dynamics. *New Ideas in Psychology*, *53*, 37–46. https://doi.org/10.1016/j.newideapsych.2018.03.002

Andenoro, A. C., Brown, D., Cerialo, K., & McManus, R. M. (2023). Fostering leadership learning for applied problem-solving: Navigating the crossroads of the sustainable development goals and immersive experiential learning. *New Directions for Student Leadership*, *2023*(179), 59–71. https://doi.org/10.1002/yd.20569

Ankrah, D., Bristow, J., Hires, D., & Artem Henriksson, J. (2023). Inner Development Goals: From inner growth to outer change. *Field Actions Science Reports*, *Special Issue 25*, 82–87. http://journals.openedition.org/factsreports/7326

Annosi, M. C., Mattarelli, E., Dentoni, D., & Messeni Petruzzelli, A. (2024). The micro-foundations of ambidexterity for corporate social performance: A study on sustainability managers' response to conflicting goals. *Long Range Planning*, *57*(1), 102412. https://doi.org/10.1016/j.lrp.2023.102412

Ansari, W. E., & Stibbe, A. (2009). Public Health and the Environment: What Skills for Sustainability Literacy – And Why? *Sustainability*, *1*, 425–440. https://doi.org/10.3390/su1030425

Ashley-Osuzoka, J. (2024). *Leadership and Strategic Management: The Impact of Effective Leadership Skills on Organizational Performance*. https://doi.org/10.20944/preprints202409.1484.v1

Asiimwe, M. M., & de Kock, I. H. (2019). An analysis of the extent to which industry 4.0 has been considered in sustainability or socio-technical transitions. *South African Journal of Industrial Engineering*, *30*(3), 41–51. https://doi.org/10.7166/30-3-2245

Atkinson, A., Watling, C. J., & Brand, P. L. P. (2022). Feedback and coaching. *European Journal of Pediatrics*, *181*(2), 441–446. https://doi.org/10.1007/s00431-021-04118-8

Berrone, P., Rousseau, H. E., Ricart, J. e., Brito, E., & Giuliodori, A. (2023). How can research contribute to the implementation of sustainable development goals? An interpretive review of SDG literature in management. *International Journal of Management Reviews*, *25*(2), 318–339. https://doi.org/10.1111/ijmr.12331

Bolton, R., Logan, C., & Gittell, J. H. (2021). Revisiting Relational Coordination: A Systematic Review. *The Journal of Applied Behavioral Science*, *57*(3), 290–322. https://doi.org/10.1177/0021886321991597

Borges, G. G., & Gratão de Souza, R. C. (2024). Skills development for software engineers: Systematic literature review. *Information and Software Technology*, *168*, 107395. https://doi.org/10.1016/j.infsof.2023.107395

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*, 77–101. https://doi.org/10.1191/1478088706qp063oa

Brunson, R. K., & D'Souza, A. (2021). Grounded Theory. In *The Encyclopedia of Research Methods in Criminology and Criminal Justice: Volume II: Parts 5-8* (pp. 195–199). https://doi.org/10.1002/9781119111931.ch35

Byrne, N., & Eddy, E. (2022). The importance of shared cognitions of team member expertise when building a high-performing team. *Team Performance Management: An International Journal*, *29*(1/2), 45–62. https://doi.org/10.1108/TPM-06-2022-0048

Calçada, D. B., Rezende, S. O., & Dwarkasing, A. (2021). Development of New Skills: Innovation and Sustainability in Industry 4.0. In W. Leal Filho, A. M. Azul, L. Brandli, A. Lange Salvia, & T. Wall (Eds.), *Industry, Innovation and Infrastructure* (pp. 212–221). Springer International Publishing. https://doi.org/10.1007/978-3-319-95873-6_47

Chatterjee, S., Chaudhuri, R., & Vrontis, D. (2022). Investigating the impacts of microlevel CSR activities on firm sustainability: Mediating role of CSR performance and moderating role of top management support. *Cross Cultural & Strategic Management*, *30*(1), 123–141. https://doi.org/10.1108/CCSM-12-2021-0228

Chen, Y., Li, X., Liu, J., & Ying, Z. (2019). Statistical analysis of complex problem-solving process data: An event history analysis approach. *Frontiers in Psychology*, *10*(MAR). https://doi.org/10.3389/fpsyg.2019.00486

Christ, K. L., & Burritt, R. L. (2019). Implementation of sustainable development goals: The role for business academics. *Australian Journal of Management*, *44*(4), 571–593. https://doi.org/10.1177/0312896219870575

Cimatti, B. (2016). Definition, development, assessment of soft skills and their role for the quality of organizations and enterprises. *International Journal for Quality Research 10(1) 97–130*, 97–130.

Connor, J., Flenady, T., Massey, D., & Dwyer, T. (2024). Classic grounded theory: Identifying the main concern. *Research in Nursing & Health*, *47*(3), 277–288. https://doi.org/10.1002/nur.22381

Costa, E. (2024). Industry 5.0 and SDG 9: A symbiotic dance towards sustainable transformation. *Sustainable Earth Reviews*, *7*(1), 4. https://doi.org/10.1186/s42055-024-00073-y

Costa, J., Jr., Diehl, J. C., & Snelders, D. (2019). A framework for a systems design approach to complex societal problems. *Design Science*, *5*. https://doi.org/10.1017/dsj.2018.16

David, W. (2024). *The Impact of Project-Based Learning on Developing Critical Thinking and Problem-Solving Skills*. *3*, 51–56. https://www.researchgate.net/publication/383553743_The_Impact_of_Project-Based_Learning_on_Developing_Critical_Thinking_and_Problem-Solving_Skills

De Pablos-Heredero, C., Haider, S., & Garcia, A. (2015). Relational Coordination as an Indicator of Teamwork Quality: Potential Application to the Success of e-Learning at Universities. *International Journal of Emerging Technologies in Learning (iJET)*, *10*. https://doi.org/10.3991/ijet.v10i2.4102

Dindar, M., Järvelä, S., & Järvenoja, H. (2020). Interplay of metacognitive experiences and performance in collaborative problem solving. *Computers and Education*, *154*. https://doi.org/10.1016/j.compedu.2020.103922

Dlouhá, J., Heras, R., Mulà, I., Salgado, F. P., & Henderson, L. (2019). Competences to Address SDGs in Higher Education—A Reflection on the Equilibrium between Systemic and Personal Approaches to Achieve Transformative Action. *Sustainability*, *11*(13), Article 13. https://doi.org/10.3390/su11133664

Duva, M., Zhao, D., Frank, K. A., & Mollaoglu, S. (2024). Interaction between Project- and Group-Level Knowledge Transfer in Project Team Networks: A Social Influence Analysis. *Journal of Management in Engineering*, *40*(2), 05024001. https://doi.org/10.1061/JMENEA.MEENG-5718

Edmondson, A., & McManus, S. (2007). Methodological Fit in Management Field Research. *Academy of Management Review*, *32*, 1155–1179. https://doi.org/10.5465/AMR.2007.26586086

Eppe, M., Gumbsch, C., Kerzel, M., Nguyen, P. D. H., Butz, M. V., & Wermter, S. (2022). Intelligent problem-solving as integrated hierarchical reinforcement learning. *Nature Machine Intelligence*, *4*(1), 11–20. https://doi.org/10.1038/s42256-021-00433-9

Estriegana, R., Medina-Merodio, J.-A., Robina-Ramírez, R., & Barchino, R. (2021). Analysis of Cooperative Skills Development through Relational Coordination in a Gamified Online Learning Environment. *Electronics*, *10*(16), Article 16. https://doi.org/10.3390/electronics10162032

Etkin, P., De Caluwé, E., Ibáñez, M. I., Ortet, G., & Mezquita, L. (2022). Personality development and its associations with the bifactor model of psychopathology in adolescence. *Journal of Research in Personality*, *97*, 104205. https://doi.org/10.1016/j.jrp.2022.104205

Fallah Shayan, N., Mohabbati-Kalejahi, N., Alavi, S., & Zahed, M. A. (2022). Sustainable Development Goals (SDGs) as a Framework for Corporate Social Responsibility (CSR). *Sustainability*, *14*(3), Article 3. https://doi.org/10.3390/su14031222

Farao, C., Bernuzzi, C., & Ronchetti, C. (2023). The Crucial Role of Green Soft Skills and Leadership for Sustainability: A Case Study of an Italian Small and Medium Enterprise Operating in the Food Sector. *Sustainability*, *15*(22), Article 22. https://doi.org/10.3390/su152215841

Flanagan, J. C. (1954). The critical incident technique. *Psychological Bulletin*, *51*(4), 327–358. https://doi.org/10.1037/h0061470

Fu, B., Wang, S., Zhang, J., Hou, Z., & Li, J. (2019). Unravelling the complexity in achieving the 17 sustainable-development goals. *National Science Review*, *6*(3), 386–388. https://doi.org/10.1093/nsr/nwz038

Funke, J. (2010). Complex problem solving: A case for complex cognition? *Cognitive Processing*, *11*(2), 133–142. https://doi.org/10.1007/s10339-009-0345-0

Funke, J. (2012). *Complex Problem Solving* (pp. 682–685). https://doi.org/10.1007/978-1-4419-1428-6_685

George, G., Howard-Grenville, J., Joshi, A., & Tihanyi, L. (2016). Understanding and Tackling Societal Grand Challenges through Management Research. *Academy of Management Journal*, *59*(6), 1880–1895. https://doi.org/10.5465/amj.2016.4007

Gioia, D., Corley, K., & Hamilton, A. (2013). Seeking Qualitative Rigor in Inductive Research. *Organizational Research Methods*, *16*, 15–31. https://doi.org/10.1177/1094428112452151

Gittell, J. (2006). Relational coordination: Coordinating work through relationships of shared goals, shared knowledge and mutual respect. *Relational Perspectives in Organizational Studies: A Research Companion*, 74–94. https://www.researchgate.net/publication/286629377_Relational_coordination_Coordinating_work_through_relationships_of_shared_goals_shared_knowledge_and_mutual_respect

Global Reporting Initiative, UN Global Compact, & WBCSD. (2015). *SDG Compass, The guide for business action on the SDGs*. https://sdgcompass.org/wp-content/uploads/2015/12/019104_SDG_Compass_Guide_2015.pdf

Greiff, S., Fischer, A., Stadler, M., & Wüstenberg, S. (2015). Assessing complex problem-solving skills with multiple complex systems. *Thinking & Reasoning*, *21*(3), 356–382. https://doi.org/10.1080/13546783.2014.989263

Greiff, S., & Neubert, J. C. (2014). On the relation of complex problem solving, personality, fluid intelligence, and academic achievement. *Learning and Individual Differences*, *36*, 37–48. https://doi.org/10.1016/j.lindif.2014.08.003

Gremler, D. (2015). *The Critical Incident Technique*. https://doi.org/10.1002/9781118785317.weom090062

Guarini, E., Mori, E., & Zuffada, E. (2021). Localizing the Sustainable Development Goals: A managerial perspective. *Journal of Public Budgeting, Accounting & Financial Management*, *34*(5), 583–601. https://doi.org/10.1108/JPBAFM-02-2021-0031

Guo, A., Wei, Y., Zhong, F., & Wang, P. (2022). How do climate change perception and value cognition affect farmers' sustainable livelihood capacity? An analysis based on an improved

DFID sustainable livelihood framework. *Sustainable Production and Consumption*, *33*, 636–650. https://doi.org/10.1016/j.spc.2022.08.002

Gupta, S., & Malodia, S. (2023). Grounded theory: What, why, and how. In *Researching and Analysing Business: Research Methods in Practice* (pp. 77–87). https://doi.org/10.4324/9781003107774-7

Hagemann, V., & Kluge, A. (2017). Complex Problem Solving in Teams: The Impact of Collective Orientation on Team Process Demands. *Frontiers in Psychology*, *8*, 1730. https://doi.org/10.3389/fpsyg.2017.01730

Hennink, M., & Kaiser, B. N. (2022). Sample sizes for saturation in qualitative research: A systematic review of empirical tests. *Social Science & Medicine*, *292*, 114523. https://doi.org/10.1016/j.socscimed.2021.114523

Hermann, R. R., & Bossle, M. B. (2020). Bringing an entrepreneurial focus to sustainability education: A teaching framework based on content analysis. *Journal of Cleaner Production*, *246*, 119038. https://doi.org/10.1016/j.jclepro.2019.119038

Huber, T. P., Rodriguez, H. P., & Shortell, S. M. (2020). The influence of leadership facilitation on relational coordination among primary care team members of accountable care organizations. *Health Care Management Review*, *45*(4), 302–310. https://doi.org/10.1097/HMR.0000000000000241

Inner Development Goals. (2021). *Inner Development Goals: Background, method and the IDG framework* (pp. 1–50). https://drive.google.com/file/d/13fcf9xmYrX9wrsh3PC3aeRDs0rWsWCpA/edit

Islam, T., & Ryan, J. (2016). Chapter 4—Mitigation in the Private Sector. In T. Islam & J. Ryan (Eds.), *Hazard Mitigation in Emergency Management* (pp. 101–124). Butterworth-Heinemann. https://doi.org/10.1016/B978-0-12-420134-7.00004-7

Ives, C. D., Freeth, R., & Fischer, J. (2020). Inside-out sustainability: The neglect of inner worlds. *Ambio*, *49*(1), 208–217. https://doi.org/10.1007/s13280-019-01187-w

Jorna, R. J. (2017). *Sustainable innovation: The organisational, human and knowledge dimension* (p. 370). https://doi.org/10.4324/9781351280365

Karlsson, L. (2024). Effect of Authentic Leadership on Organizational Trust and Commitment in Sweden. *International Journal of Leadership and Governance*, *4*, 1–12. https://doi.org/10.47604/ijlg.2854

Kemp, A. H., & Edwards, D. J. (2022). An Introduction to the Complex Construct of Wellbeing, Societal Challenges and Potential Solutions. In *Broadening the Scope of Wellbeing Science: Multidisciplinary and Interdisciplinary Perspectives on Human Flourishing and Wellbeing* (pp. 1–12). https://doi.org/10.1007/978-3-031-18329-4_1

Ketokivi, M., & Choi, T. (2014). Renaissance of case research as a scientific method. *Journal of Operations Management*, *32*(5), 232–240. https://doi.org/10.1016/j.jom.2014.03.004

Kirschke, S., & Newig, J. (2017). Addressing complexity in environmental management and governance. *Sustainability (Switzerland)*, *9*(6). https://doi.org/10.3390/su9060983

Knauff, M., & Wolf, A. G. (2010). Complex cognition: The science of human reasoning, problem-solving, and decision-making. *Cognitive Processing*, *11*(2), 99–102. https://doi.org/10.1007/s10339-010-0362-z

Kücükgül, E., Cerin, P., & Liu, Y. (2022). Enhancing the value of corporate sustainability: An approach for aligning multiple SDGs guides on reporting. *Journal of Cleaner Production*, *333*, 130005. https://doi.org/10.1016/j.jclepro.2021.130005

Küfeoğlu, S. (2022). SDG-9: Industry, Innovation and Infrastructure. In S. Küfeoğlu (Ed.), *Emerging Technologies: Value Creation for Sustainable Development* (pp. 349–369). Springer International Publishing. https://doi.org/10.1007/978-3-031-07127-0_11

Kynčlová, P., Upadhyaya, S., & Nice, T. (2020). Composite index as a measure on achieving Sustainable Development Goal 9 (SDG-9) industry-related targets: The SDG-9 index. *Applied Energy*, *265*, 114755. https://doi.org/10.1016/j.apenergy.2020.114755

Lassala, C., Orero-Blat, M., & Ribeiro-Navarrete, S. (2021). The financial performance of listed companies in pursuit of the Sustainable Development Goals (SDG). *Economic Research-Ekonomska Istraživanja*, *34*(1), 427–449. https://doi.org/10.1080/1331677X.2021.1877167

Leal Filho, W., Azul, A. M., Brandli, L., Lange Salvia, A., & Wall, A. (2021a). *Industry, innovation and infrastructure* ([2021 edition], 1–1 online resource : illustrations (some color)). Springer.

https://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=2932998

Leal Filho, W., Frankenberger, F., Salvia, A. L., Azeiteiro, U., Alves, F., Castro, P., Will, M., Platje, J., Lovren, V. O., Brandli, L., Price, E., Doni, F., Mifsud, M., & Ávila, L. V. (2021b). A framework for the implementation of the Sustainable Development Goals in university programmes. *Journal of Cleaner Production*, *299*, 126915. https://doi.org/10.1016/j.jclepro.2021.126915

Mahajan, R., Kumar, S., Lim, W. M., & Sareen, M. (2024). The role of business and management in driving the sustainable development goals (SDGs): Current insights and future directions from a systematic review. *Business Strategy and the Environment*. https://doi.org/10.1002/bse.3712

Maharjan, N., Kuroda, K., Okada, M., Nakamura, S., Aburatani, H., Yamaguchi, T., & Ichitsubo, M. (2019). *Generic Skills Assessment Through Implementation of Group Based Learning to Understand SDGs*. https://doi.org/10.7176/JEP

Mai, N. K., Do, T. T., & Phan, N. A. (2022). The impact of leadership traits and organizational learning on business innovation. *Journal of Innovation & Knowledge*, *7*(3), 100204. https://doi.org/10.1016/j.jik.2022.100204

Mainert, J., Niepel, C., Murphy, K. R., & Greiff, S. (2019). The Incremental Contribution of Complex Problem-Solving Skills to the Prediction of Job Level, Job Complexity, and Salary. *Journal of Business and Psychology*, *34*(6), 825–845. https://doi.org/10.1007/s10869-018-9561-x

Maksakova, M. A., & Kolomeytseva, A. A. (2023). EAEU Industrial Development Under SDG-9: Challenges and Possibilities. In E. G. Popkova & B. S. Sergi (Eds.), *Current Problems of the Global Environmental Economy Under the Conditions of Climate Change and the Perspectives of Sustainable Development* (pp. 375–386). Springer International Publishing. https://doi.org/10.1007/978-3-031-19979-0_40

Marbun, S. (2024). *The Trust Paradigm: Building Deeper Professional Relationships*.

Margarida, R., Macias Enrique, F., & Matteo, S. (2021). *A unified conceptual framework of tasks, skills and competences—European Commission*. Joint Research Centre (JRC).

https://joint-research-centre.ec.europa.eu/reports-and-technical-documentation/unified-conceptual-framework-tasks-skills-and-competences_en

Martin. (n.d.). Infrastructure and Industrialization. *United Nations Sustainable Development*. Retrieved 30 January 2024, from https://www.un.org/sustainabledevelopment/infrastructure-industrialization/

Mead, J., Gibbs, K., Fisher, Z., & Kemp, A. H. (2023). What's next for wellbeing science? Moving from the Anthropocene to the Symbiocene. *Frontiers in Psychology*, *14*. https://www.frontiersin.org/articles/10.3389/fpsyg.2023.1087078

Mickel, A. (2024). Positive Communication Practices for Enhancing Collaboration. *International Journal of Business Communication*, *61*. https://doi.org/10.1177/23294884241263552

Miller, S. R., Moore, F., & Eden, L. (2024). Ethics and international business research: Considerations and best practices. *International Business Review*, *33*(1), 102207. https://doi.org/10.1016/j.ibusrev.2023.102207

Mio, C., Panfilo, S., & Blundo, B. (2020). Sustainable development goals and the strategic role of business: A systematic literature review. *Business Strategy and the Environment*, *29*(8), 3220–3245. https://doi.org/10.1002/bse.2568

Mohaghegh, M., & Furlan, A. (2020). Systematic problem-solving and its antecedents: A synthesis of the literature. *Management Research Review*, *43*(9), 1033–1062. https://doi.org/10.1108/MRR-06-2019-0284

Molnár, G., Alrababah, S. A., & Greiff, S. (2022). How we explore, interpret, and solve complex problems: A cross-national study of problem-solving processes. *Heliyon*, *8*(1), e08775. https://doi.org/10.1016/j.heliyon.2022.e08775

Morton, S., Pencheon, D., & Squires, N. (2017). Sustainable Development Goals (SDGs), and their implementation: A national global framework for health, development and equity needs a systems approach at every level. *British Medical Bulletin*, *124*(1), 81–90. https://doi.org/10.1093/bmb/ldx031

Mumford, M. D., Zaccaro, S. J., Harding, F. D., Jacobs, T. O., & Fleishman, E. A. (2000). Leadership skills for a changing world: Solving complex social problems. *The Leadership Quarterly*, *11*(1), 11–35. https://doi.org/10.1016/S1048-9843(99)00041-7

Mwita, K. (2022). Strengths and weaknesses of qualitative research in social science studies. *International Journal of Research in Business and Social Science (2147- 4478)*, *11*. https://doi.org/10.20525/ijrbs.v11i6.1920

Ngayo Fotso, G. M. (2021). Leadership competencies for the 21st century: A review from the Western world literature. *European Journal of Training and Development*, *45*(6/7), 566–587. https://doi.org/10.1108/EJTD-04-2020-0078

Nicolay, B., Krieger, F., Kuhn, J.-T., Graesser, A. C., Ifenthaler, D., Baker, R., & Greiff, S. (2023). Unsuccessful and successful complex problem solvers – A log file analysis of complex problem solving strategies across multiple tasks. *Intelligence*, *101*, 101793. https://doi.org/10.1016/j.intell.2023.101793

Opoku, A., Saddul, K., Kapogiannis, G., Kugblenu, G., & Amudjie, J. (2024). Empowering urban sustainability: Unveiling the crucial role of project managers in attaining Sustainable Development Goal 11. *International Journal of Managing Projects in Business*, *17*(2), 225–246. https://doi.org/10.1108/IJMPB-09-2023-0217

*(PDF) Non-Cognitive Skills and Personality Traits: Labour Market Relevance and Their Development in Education & Training Systems*. (n.d.). Retrieved 27 October 2024, from https://www.researchgate.net/publication/228252134_Non-Cognitive_Skills_and_Personality_Traits_Labour_Market_Relevance_and_Their_Development_in_Education_Training_Systems

Pereira, G., González, A., & Blanco, G. (2021). *Complexity Measures for the Analysis of SDG Interlinkages: A Methodological Approach*. 13–24. https://doi.org/10.5220/0010374600130024

Rahimi, S., & khatooni, M. (2024). Saturation in qualitative research: An evolutionary concept analysis. *International Journal of Nursing Studies Advances*, *6*, 100174. https://doi.org/10.1016/j.ijnsa.2024.100174

Ramírez-Montoya, M. S., Castillo-Martínez, I. M., Sanabria-Z, J., & Miranda, J. (2022). Complex Thinking in the Framework of Education 4.0 and Open Innovation—A Systematic Literature Review. *Journal of Open Innovation: Technology, Market, and Complexity*, *8*(1), 4. https://doi.org/10.3390/joitmc8010004

Rhee, S.-Y., Park, J., & Shin, H.-D. (2020). High-Performance Work Practices and Organizational Innovativeness: The Roles of Relational Coordination Competencies and Market Turbulence as a Mediator or Moderator. *Journal of Open Innovation: Technology, Market, and Complexity*, *6*(3), 83. https://doi.org/10.3390/joitmc6030083

Saieed, A., Luken, R., & Zheng, X. (2021). Tracking progress in meeting sustainable development goal 9 industry-related targets: An index for policy prioritization. *Applied Energy*, *286*, 116490. https://doi.org/10.1016/j.apenergy.2021.116490

Sánchez, C., De Pablos-Heredero, C., Medina, J., Ramírez, R., & Fernandez-Sanz, L. (2021). Relationships among relational coordination dimensions: Impact on the quality of education online with a structural equations model. *Technological Forecasting and Social Change*, *166*. https://doi.org/10.1016/j.techfore.2021.120608

Sasaki, K., Stubbs, W., & Farrelly, M. (2023). The influence of the sustainable development goals on large companies' adoption and implementation of a broader corporate purpose. *Corporate Governance: The International Journal of Business in Society*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/CG-04-2023-0167

Saxena, S. (2019). Sustainable Development Goal 9: Building resilient infrastructure, sustainable industrialization, and fostering innovation. *ABS International Journal of Management*, *7*(2), 21–24. https://absjournal.abs.edu.in/ABS-Journal-Volume-7-isuue-2-December-2019.pdf#page=29

Shtaltovna, Y., Rodriguez Carreon, V., Lindencrona, F., & Donald, W. (2024). Cognitive Skills Within the Inner Development Goals (IDG) Framework: Empowering Sustainable Careers and Sustainable Development. *GiLE Journal of Skills Development*, *4*, 74–94. https://doi.org/10.52398/gjsd.2024.v4.i1.pp74-94

Simmons, D., & Martin, J. (2010, June 20). *Use Of The Critical Incident Technique For Qualitative Research In Engineering Education: An Example From A Grounded Theory Study*. ASEE Annual Conference and Exposition, Conference Proceedings. https://doi.org/10.18260/1-2--15712

Sinaga, O., Saragi, D., Halking, H., & Setiawan, D. (2024). Citizen Project Based on Problem Solving Skills: English. *Randwick International of Education and Linguistics Science Journal*, *5*, 1164–1175. https://doi.org/10.47175/rielsj.v5i3.1068

The Global Goals, 2021. (2021). *Goal 9: Industry, innovation and infrastructure*. The Global Goals. https://globalgoals.org/goals/9-industry-innovation-and-infrastructure/

Thelwall, M., & Nevill, T. (2021). Is research with qualitative data more prevalent and impactful now? Interviews, case studies, focus groups and ethnographies. *Library & Information Science Research*, *43*(2), 101094. https://doi.org/10.1016/j.lisr.2021.101094

Türkeli, S. (2020). Complexity and the Sustainable Development Goals: A Computational Intelligence Approach to Support Policy Mix Designs. *Journal of Sustainability Research*, *2*(1). https://doi.org/10.20900/jsr20200006

United Nations. (2015, September 25). *Transforming our world: The 2030 Agenda for Sustainable Development | Department of Economic and Social Affairs*. https://sdgs.un.org/2030agenda

United Nations. (2023). *Goal 9 | Department of Economic and Social Affairs*. https://sdgs.un.org/goals/goal9

United Nations Department of Economic and Social Affairs. (2023). *The Sustainable Development Goals Report 2023: Special Edition*. United Nations. https://doi.org/10.18356/9789210024914

van der Waal, J., & Thijssens, T. (2020). Corporate Involvement in the Sustainable Development Goals: Exploring the Territory. *Journal of Cleaner Production*, 119625. https://doi.org/10.1016/j.jclepro.2019.119625

van Laar, E., van Deursen, A. J. A. M., van Dijk, J. A. G. M., & de Haan, J. (2017). The relation between 21st-century skills and digital skills: A systematic literature review. *Computers in Human Behavior*, *72*, 577–588. https://doi.org/10.1016/j.chb.2017.03.010

van Norren, D., & Beehner, C. (2021). *Sustainability leadership, UNESCO competencies for SDGs, and diverse leadership models*. *10*, 24–49. https://www.researchgate.net/publication/351495844_Sustainability_leadership_UNESCO_competencies_for_SDGs_and_diverse_leadership_models

Velazquez, L., & Velazquez, L. (2021a). Introduction. In *SDG9 – Industry, Innovation and Infrastructure* (pp. 1–3). Emerald Publishing Limited. https://doi.org/10.1108/978-1-80117-131-120211001

Velazquez, L., & Velazquez, L. (2021b). The Fundamental Concepts of SDG9. In *SDG9 – Industry, Innovation and Infrastructure* (pp. 5–37). Emerald Publishing Limited. https://doi.org/10.1108/978-1-80117-131-120211002

Veríssimo, C., Pereira, L., Fernandes, A., & Martinho, R. (2024). Complex problem solving as a source of competitive advantage. *Journal of Open Innovation: Technology, Market, and Complexity*, *10*(2), 100258. https://doi.org/10.1016/j.joitmc.2024.100258

Walumbwa, F., Avolio, B., Gardner, W., Wernsing, T., & Peterson, S. (2008). Authentic Leadership: Development and Validation of a Theory-Based Measure†. *Journal of Management*, *34*, 89–126. https://doi.org/10.1177/0149206307308913

Wamsler, C. (2020). Education for sustainability: Fostering a more conscious society and transformation towards sustainability. *International Journal of Sustainability in Higher Education*, *21*(1), 112–130. https://doi.org/10.1108/IJSHE-04-2019-0152

Wamsler, C., Osberg, G., Osika, W., Herndersson, H., & Mundaca, L. (2021). Linking internal and external transformation for sustainability and climate action: Towards a new research and policy agenda. *Global Environmental Change*, *71*, 102373. https://doi.org/10.1016/j.gloenvcha.2021.102373

Weber, J. M., Lindenmeyer, C. P., Liò, P., & Lapkin, A. A. (2021). Teaching sustainability as complex systems approach: A sustainable development goals workshop. *International Journal of Sustainability in Higher Education*, *22*(8), 25–41. https://doi.org/10.1108/IJSHE-06-2020-0209

Weise, J. J., Greiff, S., & Sparfeldt, J. R. (2020). The moderating effect of prior knowledge on the relationship between intelligence and complex problem solving – Testing the Elshout-Raaheim hypothesis. *Intelligence*, *83*, 101502. https://doi.org/10.1016/j.intell.2020.101502

Wu, H., & Molnár, G. (2022). Analysing Complex Problem-Solving Strategies from a Cognitive Perspective: The Role of Thinking Skills. *Journal of Intelligence*, *10*(3). https://doi.org/10.3390/jintelligence10030046

Yeung, S., & Lau, K. (2024). Transformative leaders, trust, and relationships linking up to committed organizations. *Corporate Ownership and Control*, *21*, 77–83. https://doi.org/10.22495/cocv21i3art7

# Appendix

Appendix A) IDG framework underlying 23 skills and abilities

| | | |
|---|---|---|
| Being — Relationship to Self | Inner compass | Having a deeply felt sense of responsibility and commitment to values and purposes relating to the good of the whole |
| | Integrity and Authenticity | A commitment and ability to act with sincerity, honesty and integrity |
| | Openness and Learning mindset | Having a basic mindset of curiosity and a willingness to be vulnerable and embrace change and grow. |
| | Self-awareness | Ability to be in reflective contact with own thoughts, feelings and desires; having a realistic self-image and ability to regulate oneself |
| | Presence | Ability to be in the here and now, without judgement and in a state of open-ended presence. |
| Thinking — Cognitive Skills | Critical thinking | Skills in critically reviewing the validity of views, evidence and plans. |
| | Complexity awareness | Understanding of and skills in working with complex and systemic conditions and casualties. |
| | Perspective skills | Skills in seeking, understanding and actively making use of insights from contrasting perspectives. |
| | Sense-making | Skills in seeing patterns, structuring the unknown and being able to consciously create stories |
| | Long-term orientation and visioning | Long-term orientation and ability to formulate and sustain commitment to visions relating to the larger context |
| Relating — Caring for Others and the World | Appreciation | Relating to others and to the world with a basic sense of appreciation, gratitude and joy. |
| | Connectedness | Having a keen sense of being connected with and/or being a part of a larger whole, such as a community, humanity or global ecosystem. |
| | Humility | Being able to act in accordance with the needs of the situation, without concern for one's own importance. |

| | | |
|---|---|---|
| | Empathy and Compassion | Ability to relate to others, oneself and nature with kindness, empathy and compassion and the intention to address related suffering. |
| Collaborating – Social Skills | Communication skills | Ability to really listen to others, to foster genuine dialogue, to advocate own views skillfully, to manage conflicts constructively and to adapt communication to diverse groups. |
| | Co-creation skills | Skills and motivation to build, develop and facilitate collaborative relationships with diverse stake-holders, characterized by psychological safety and genuine co-creation |
| | Inclusive mindset and Intercultural competence | Willingness and competence to embrace diversity and include people and collectives with different views and backgrounds |
| | Trust | Ability to show trust and to create and maintain trusting relationships. |
| | Mobilization skills | Skills in inspiring and mobilizing others to engage in shared purposes. |
| Acting — Driving Change | Courage | Ability to stand up for values, make decisions, take decisive action and, if need be, challenge and disrupt existing structures and views. |
| | Creativity | Ability to generate and develop original ideas, innovate and being willing to disrupt conventional patterns. |
| | Optimism | Ability to sustain and communicate a sense of hope, positive attitude and confidence in the possibility of meaningful change. |
| | Perseverance | Ability to sustain engagement and remain determined and patient even when efforts take a long time to bear fruit. |

Appendix B) Interview guide used for the semi-structured interviews

**Introductie**

- Welkom
    - Bedanken voor de kans en tijd voor het interview
    - Kleine introductie over mezelf, wie ik ben
- Bespreken doel van het onderzoek en het interview
    - Het doel van het onderzoek is het verzamelen van de ervaringen en reflecties van managers over het gebruik van individuele vaardigheden om complexe problemen zoals de SDGs en meer specifiek SDG 9 op te lossen.
    - Introductie SDGs and SDG 9
        - Voorbeelden geven projecten SDG 9
- Deel dat ze altijd ervoor kunnen kiezen om de vraag niet te beantwoorden.
- Geef aan dat de gegevens geanonimiseerd zijn en niet naar hen of hun bedrijf te herleiden zijn
- (Vraag nogmaals toestemming voor het opnemen van het interview)
- Geef aan dat ze zich kunnen terugtrekken uit het onderzoek wanneer gewild
- Loop de algemene opzet van het interview door met ze
    - Eerst introductie tot persoonlijke aanpak SDGs
    - Verdieping in specifieke projecten gerelateerd tot SDG 9 en het toepassen van individuele vaardigheden
    - Afronden van het interview

**Vragen**

**Introductie persoon en persoonlijke verhouding tot de SDGs**

- Vraag om een korte introductie van zichzelf en het bedrijf waarin ze werken
    - Wat is hun functieomschrijving?
        - Wat zijn enkele van uw dagelijkse verantwoordelijkheden?
        - Hoe lang heeft u ervaring met deze baan?
    - Wat voor bedrijf werkt u voor?
        - In welke sector zijn ze actief?
    - Etc.
- Hoe bewust bent u vóór aanvang van het interview persoonlijk van de SDGs in het algemeen?
    - Is uw bedrijf vaak actief in projecten die verband houden met de SDGs in het algemeen?
    - Hoe vaak werkt uw bedrijf tijdens zijn activiteiten met de SDGs in gedachten?
        - Hoe met specifiek SDG 9?
- Hoe zou u uw eigen persoonlijke benadering van duurzaamheid beoordelen?
    - Hoe beïnvloedt dit actief uw dagelijkse beslissingen?
        - Welke specifieke motivaties of emoties kunnen bijdragen aan jouw duurzaamheidsaanpak
- Heeft uw persoonlijke benadering van duurzaamheid invloed op uw werkzaamheden?
    - Bijvoorbeeld besluitvorming?
    - Kunt u zich een voorbeeld herinneren waarin dit het geval was?

- Is het moeilijk om zowel jouw eigen duurzaamheidsaanpak te combineren met die van anderen en het bedrijf waarin u werkt?
    - Zo ja, waarom?
- Voordat we over gaan naar de specifieke projecten is er nog iets wat u wil toevoegen aan uw persoonlijke aanpak tot de SDGs of duurzaamheid wat we tot nu toe nog niet hebben besproken?

**Verdieping specifieke project en toegepaste individuele vaardigheden**

- Zijn er specifieke projecten waarin u aan deel heeft genomen die direct verbonden zijn met complexe problemen als SDG 9 zoals eerder besproken? (waar nodig geef meer context aan SDG 9)
    - Van deze projecten, welke zou u als het meest succesvol beoordelen?
        - Waarom? Waarop is dit gebaseerd?
- Welke problemen kwamen kijken bij dit project?
    - En hoe zijn ze opgelost?
    - Welke individuele vaardigheden zou u hierin als essentieel beoordelen voor een succesvolle aanpak
        - (Refereer terug naar bepaalde vaardigheden uit de theorie/ IDG framework wanneer nodig om het gesprek op gang te krijgen)
        - Waarom juist deze vaardigheden?
            - In welke zin hebben zij positief bijgedragen aan het project
        - Hoe zorgt u ervoor dat deze vaardigheden op de juiste manieren worden toegepast tijdens het project?
            - Zijn hier afspraken of protocollen voor?
            - Ligt het aan persoonlijke voorkeuren of kwaliteiten?
    - Welke rol spelen communicatie en samenwerking tussen teamleden hierin?
        - Hoe belangrijk is het dat alle teamleden die samenwerken soortgelijke waarden en vaardigheden delen
    - Zijn er nog andere individuele vaardigheden die aan het oplossen van zulke projecten bijdragen?

- Van de eerdere besproken projecten is er ook een die minder succesvol liep in de aanpak?
    - Waaraan lag dat?
    - Achteraf gezien, hoe zou dit beter aangepakt konden worden?
        - Ontbraken hier bepaalde individuele vaardigheden?

**Afsluitend deel**

Geef een korte samenvatting van wat tot nu toe is besproken

- Is er een andere vaardigheid die nog niet besproken is die u ook relevant lijkt voor het oplossen van dergelijke complexe problemen?
- Van alle vaardigheden die tijdens het interview zijn besproken, welke zou u het meest belangrijk vinden voor het oplossen van complexe problemen?

    - En waarom?
- Hoe kan een individu de implementatie van deze vaardigheden ontwikkelen of realiseren?
    - Wat is hiervoor nodig?
- Is er nog iets dat u zou willen delen over uw ervaringen met het toepassen van deze individuele vaardigheden, dat interessant of relevant zou kunnen zijn voor dit onderzoek?
    - Zo niet dan zou ik graag dit interview beëindigen

Hartelijk dank voor uw deelname en uw tijd

Mocht u nu of na dit interview nog vragen hebben, hoor ik het natuurlijk graag

Appendix C) Explanation of first-order codes by quotes assigned to them

| First-order codes | Quotes |
|---|---|
| 1a. Intrinsic motivation to act sustainably | "Let's take a moment to think about that collaboration that will give that intrinsic motivation a boost again because everyone wants to achieve the same goal." (Manager 5) |
| | "Still, I want to do it, because I think it's very important because I want to do something good [...] and so on is really the intrinsic motivation." (Manager 16) |
| 1b. Need to combine private sustainability views with that of their company | "I very consciously joined an organization with a socially relevant role 15 or 14 years ago." (Manager 3) |
| | "Well, we have been named in the Top 5 most sustainable company again this year. So again, that's super cool that I work here." (Manager 12) |
| 1c. Own sustainability approach in practice | "Privately, I tried to insulate my house as much as possible. Got solar panels and so on. But I'm not some kind of climate activist or fanatic in the sense that I don't fly anymore, for example." (Manager 3) |
| | "Yes, we do really try to live as consciously and as sustainably as possible, although it is not always easy." (Manager 8) |
| 1d. Drive and motivation | "So, when you are really talking to each other about, well, what drives someone? What does someone still enjoy doing? Yes, and so encouraging people to really keep developing themselves." (Manager 5) |
| | "They were also extremely excited out based on their own motivation to make sustainability efforts here. They were also super happy that this was possible." (Manager 9) |
| 2a. Being yourself | "What I find very important in my daily work and also in the way I lead the team is that you do that from your own convictions and passion. And from a sense of authenticity, which is something I try to give along with people." (Manager 3) |
| | "I think you gain more from having authentic people who communicate from their toes, don't you? Because they fully believe in what they are saying. I think that's more convincing than someone who gives a wonderful rant that is |

| | |
|---|---|
| | completely true, but where you know of yes, you're just saying it because you're in that place and because you have to.” (Manager 8) |
| 2b. Being honest and transparent | “The second, for me after all, is honesty. There's not much point in playing theatrics and wrapping things in sugar, it just is what it is.” (Manager 8) |
| | “Stating the intention. The intention of the things I do. Indicating which interest I am prioritizing for now, over the other interest.” (Manager 10) |
| 3a. Curiosity | “Yes, I think mostly being curious, right? Being curious about what drives a party? I also always call it discovering the business line spots with each other.” (Manager 5) |
| | “Well, is one of those examples where I say hey, be curious about each other's business and yes, be prepared to look at each other's business with an open mind, because then sometimes you can discover really great things.” (Manager 5) |
| 3b. Being open to change and wanting to improve | “You do have to have the willingness to change things. That's not necessarily that it's now the one kind of drive, a drive for better or a drive for good and drive for Green or something. But you do have to be willing to change something, but I often see it even more as a kind of. Yes, as a kind of operational improvement.” (Manager 6) |
| | “And learn from mistakes you make. We observe a mistake that can shoot in all directions. Also in sustainability. But what did we learn from it? Do we then also record it properly and make sure it doesn't happen again next time.” (Manager 15) |
| 3c. Developing one’s own skills | “That always goes hand in hand with employees who need to be able to deliver, so employee development really is a main tool for us.” (Manager 4) |
| | “So that I can also just guarantee that development takes place in a certain way and therefore is at a certain standard in the organization. And with that, you actually guarantee continuity for a large part of your team.” (Manager 13) |
| 4a. Evaluating current outcomes | “And if we have a solution, you have to go test and check it continuously.” (Manager 10) |
| | “As long as you just finish something and then go and evaluate what could have been done better, you learn from that in turn.” (Manager 12) |

| | |
|---|---|
| 4b. Creating solutions through higher levels of reasoning | “It's important to pull these different disciplines apart sometimes to see how it works and from which approach or angle to look at it.” (Manager 1)<br><br>“The ability to soak up information and turn that into something logical. I think those skills are more important than ever. Especially in a transformation, because then you want to go fast and you don't want to have too many people doing a small piece of the stamp, but you need people who can take in the stamps quickly and process that quickly into something logical.” (Manager 10) |
| 5a. Keeping an overview of the complexity | “But if you look again from a larger perspective. Then you could ask yourself the question. Is it a drop in the ocean? Or is it really a problem? And I do think that's the way I work often, where I always put things in perspective with the bigger picture.” (Manager 10)<br><br>“I think, as a leader, you have to make sure that you constantly stay in that helicopter. That you don't go into the depths because the big risk is that you get very involved. And at a certain point, you become part of the whole and then you can no longer get in that helicopter and just manage people.” (Manager 15) |
| 5b. Making sense of the complexity | “I think mostly tackling the complexity, and not being afraid of all the different things you have to do and just peel them off and do them one by one.” (Manger 1)<br><br>“For example, it is very useful if you can be flexible or can solve that very difficult question. That's just personal strengths you can have, which can contribute.” (Manager 2) |
| 6a. Long-term thinking | “What really matters is human contact and creating collaborations with each other that are sustainable, long-lasting and provide value for both parties.” (Manager 8)<br><br>“To future leaders, I hope they dare to think longer term against all trends, and why do I say that? Our political system is four-year-oriented. The shareholder’s model is also short-term. Sometimes you have to dare to go against the current for really longer terms. That is also for topics like sustainability, but actually all SDG goals.” (Manager 10) |
| 6b. Planning ahead | “What else do we expect from you now that we didn't expect from you before?<br><br>Right? What does it include? [...] Yes, there you will have to communicate a lot and have a clear plan.” (Manager 2) |

| | |
|---|---|
| | “In this case, an external party is going to make it, and another external party is going to verify it. Also, communication is important, but I think the most important thing there is planning. Since there is such a big delay on that, it's very important to plan well, because otherwise, you make sure that if it just doesn't work out, you're another month down the line.” (Manager 12) |
| 7a. Technical capabilities | “But if you have really substantive technical people, they are very much in need. Those are good mechanical engineers and those are really smart guys in the class. You just need those too.” (Manager 14) |
| | “We are a technical world that you are primarily concerned with hard skills. Contract management, scope management, technical solutions” (Manager 16) |
| 7b. Experience | “We have an expert on our team who has been doing this profession for over 20 years and [...] she has so much inside knowledge that she can also share with us again, which means we are immediately aware of developments. (Manager 12) |
| | “I think that includes a piece of experience. A piece of experience at my previous companies. What worked, what didn't work.” (Manager 13) |
| 7c. Expertise | “I think you also need content knowledge; a good story doesn't sell itself on its own. That goes well for a while, you come a long way, but real content is also required at some point when you get resistance and then you must be able to know what you're talking about.” (Manager 1) |
| | “And the third component is content expertise, without those three mixed, you won't get anywhere.” (Manager 8) |
| 8a. Open communication | “Yes, then you will have to be able to communicate well and if it is not clear what is expected of you or where the journey is going. Yeah, then it's also not surprising that people deliver something different.” (Manager 2) |
| | “It doesn't matter who you need or who you need to talk to. Everyone is open to speaking to each other and it happens very much of 'hey guys, this is playing now, think along for a minute'.” (Manager 12) |
| 8b. Active listening and understanding each other | “Those are your social skills, so are we still able to have good conversations with each other and give each other something? Do we have the skills to get to know people and the story behind the people, right?” (Manager 8) |

| | |
|---|---|
| | “You always have to ensure balance in your team. You have to make sure people keep listening to each other. I think that is the essence when it comes to innovating.” (Manager 14) |
| 8c. Stimulating communication | “Of course, we had the experience here that we had to invest very much in people, project management, right? So that you especially hold each other accountable for things [...] that is also very important.” (Manager 1) |
| | “I introduce brainstorming to a lot of contracts, also literally in the plans. [...] I don't want an agenda. I just want to talk about how things are going. Where are we seeing opportunities that we are letting slip? Where do we notice that our communication, our interaction, our cooperation is stagnating, why might that be?” (Manager 16) |
| 9a. Collaborate with others | “With more and more big companies with whom we closely collaborate, we also seek innovation and try to come up with green things together.” (Manager 8) |
| | “It does depend on a piece of cooperation, sometimes across departments. If you have a department that won't cooperate then you just have a problem.” (Manager 15) |
| 9b. Creating a stable and balanced work environment | “If I'm in the room with people who only want green, I will be the one who says 'Yes, wait a minute, you also have a business case to make, right?' So that balance is very important.” (Manager 8) |
| | “Besides, I have also been through a few things in my career, so I also don't get nervous so easily and I can stay calm.” (Manager 11) |
| 9c. Developing and growing together | “So, the system now is much more working together in development versus taking incremental steps independently.” (Manager 6) |
| | “To still demonstrate to continue stimulating each other, because if you stop stimulating each other innovation stops.” (Manager 10) |
| 10a. Building relationships | “Getting people to do their jobs with a smile and putting time into that, you know, quarterly I have a teambuilding day [...]. But I always find that it is so valuable to spend one day a quarter with each other like this and so much good energy is created by this again.” (Manager 5) |
| | “Having more physical contact with people, I mean just walking up to them properly and genuinely” (Manager 9) |

| | |
|---|---|
| 10b. Connection | “I bring people together in conversations, [...] on a human level to talk about anxiety. Those are no different here than at a bakery, so you have to learn about each other and must be able to connect through that.” (Manager 11) |
| | “My role is often to make sure of where can we find each other and to seek a connection. And trying to find the nuances: ‘Okay, you're right, but it's not urgent now and it can be done later’.” (Manager 14) |
| 10c. Maintaining relationships | “But certainly, leaders need to be prepared for a world that is changing faster and faster, becoming more and more complex. In which relationships, let me put it very generally, are becoming increasingly important.” (Manager 3) |
| | “Yes, and making sure it is sociable and nice to be able to work together on things for the future. That to me is a leader I would love to work for at least.” (Manager 5) |
| 10d. Having trust in each other | “Yes, do people feel comfortable, are people able to be themselves? Yes, those are all open doors, but those are preconditions, right? To build an environment with trust, so people start better working together or start communicating.” (Manager 2) |
| | “Yes, and that again is daring to be transparent, right? Transparency can only come with trust.” (Manager 10) |
| 11a. Formulating arguments for change | “That was very important to keep bringing people along with your objective and convincing people that it is indeed useful and will contribute”. (Manager 5) |
| | “I think what helped a lot was that I took time to explain what my goal is and why we do it, which I was also able to demonstrate through our calculations.” (Manager 9) |
| 11b. Creating awareness | “So that's that awareness, isn't it? [...] I am working on that, and I also teach my two daughters about what that is, right? And how can you be smart about it?” (Manager 5) |
| | “Who are completely unaware, so creating awareness around the subject. That has been at the core of my work.” (Manager 11) |
| 11c. Inspiring others | “Leading by example will make people follow. If we want our people to work better together, we will have to set an example ourselves that we can work together.” (Manager 2) |

| | |
|---|---|
| | “Making results and improvements visible in numbers. [...] That is at least a very nice way to display why change is necessary” (Manager 9) |
| 11d. Taking people along | “You can have it all digitally in order or legally in order, but people need to get moving.” (Manager 1) |
| | “Making sure that you gather people around you, [...], that gather enough critical mass together to still get back out of that slump.” (Manager 5) |
| 12a. Empathy for other people | “I personally think it is an important aspect to immerse yourself in another person. So that question, can you justify it towards the farmer? What would you do if it was your farm, right?” (Manager 2) |
| | “To me, the leader of the future is really someone who has empathy for people” (Manager 5) |
| 13a. Giving autonomy | “So, I always look at, does someone need autonomy? Is someone highly competent and highly motivated? Then I can delegate a lot of tasks to someone, so giving autonomy was our highest goal.” (Manager 4) |
| | “So, companies that are successful, say in a different way of managing, they are looking at self-organization. So I give a lot of power to the workplace, people who actually already know how to change and what it requires to change.” (Manager 11) |
| 13b. Taking ownership of one's own responsibilities | “Ownership, in the sense of taking responsibility for what you represent, including your tasks.” (Manager 3) |
| | “Keeping everyone focused on the agreed targets. So, we have to make sure that we can report properly on our carbon footprint and also on our incidents and so on. And that's also the feedback loop to everyone responsible for that, either personally or in a position.” (Manager 6) |
| 14a. Making a difficult decision | “We're not going to get everyone happy, but we have to move on, so we're going in that direction [...] So also taking decisions that sometimes not everyone likes.” (Manager 5) |
| | “I hear your interest, but I choose this interest now.” (Manager 10) |
| 14b. Implementing the made decision | “Implementing an assignment with a clear objective from the company, that can include explaining what the changes mean.” (Manager 4) |
| | “I hope many developing leaders know how to turn that urgency into action.” (Manager 8) |

| | |
|---|---|
| 15a. Courage to take risk | “But I think leadership is very much about daring to take risks precisely when necessary.” (Manager 8) |
| | “As a leader, you need to understand that 80% of transformation is about uncertainty.” (Manager 11) |
| 15b. Daring to be uncomfortable | “Have the courage to make difficult decisions sometimes. To take on conflict with someone if necessary.” (Manager 3) |
| | “Not taking on comfort, for example, by doing something innovative or saying, ‘I just don't know, can you help me, can you brainstorm?'” (Manager 16) |
| 16a. Out-of-the-box thinking | “We really need to think out of the box and it is difficult to get everybody to go along with us.” (Manager 5) |
| | “Optimizing the existing, that's not good enough. You really have to [...] think out of the box. You have to make a move just in a different way” (Manager 6) |
| 16b. Creativity in solutions | “Then you need someone who is, well, a bit more creative and who thinks about how it can be done differently.” (Manager 14) |
| | “What you really want is that people also come up with creative solutions. That you also try to have people say ‘If it can't go left then maybe it can go right'.” (Manager 15) |
| 17a. Wanting to seek out entrepreneurial opportunities | “So, if you compare it to the energy transition, we need to start doing things and learning from them and then adjusting if necessary.” (Manager 5) |
| | “You don't know where the market is going, you never know, so certainly if we are pioneers in sustainability and you want to be at the front of the market, then you have to go in the right direction.” (Manager 12) |
| 17b. Ambition | “There was passion and ambition and there was entrepreneurship in that. Do you work for something because you love working on this product and have the ambition to do it better tomorrow?” (Manager 2) |
| | “Because we have the ambition to do so, but also because we see that we have to. We feel the urgency and we also strongly believe in the innovation that we can facilitate with our smart R&D people and together with our customers.” (Manager 8) |

| | |
|---|---|
| 18a. Flexibility | “And yes, if you work in the supply chain, then flexibility, you know, is often useful. Because yes you will have to respond right?” (Manager 2) |
| | “But I do think an important one is that the world is not going to become more stable geopolitically and technically, etc. So, I think being flexible and keeping a company flexible is a very important value.” (Manager 6) |
| 18b. Adaptability to one's surroundings | “Thinking along with your client and really putting that extra bit of responsiveness in when we want to build something new.” (Manager 6) |
| | “Then I think adaptability, right? Because no organization is the same and you have to be able to adapt accordingly. You always have to accept reality, be able to accept or leave.” (Manager 8) |
| 19a. Dare to face discomfort | “But because you ask the simple questions, to which there are no answers, that leads to a pretty particular discomfort. And from there, you hope people regain their composure.” (Manager 10) |
| | “If, in a transformation as a leader, you are not comfortable in discomfort, you are going to have a very tough time.” (Manager 10) |
| 19b. Dealing with setbacks | “I think we just have to try things from time to time and then it's not bad at all to find out that maybe it wasn't the right way, but we did learn [...] that we need to take another turn.” (Manager 5) |
| | “Is having enormous resilience, because you must have the courage to be different every now and then and make mistakes.” (Manager 11) |
| 19c. Reaching one’s goals | “Yes, and I think maybe most important of all is perseverance. At least you have to really bite into it and it's falling and getting up again. It's not fun, but sometimes you just have to do that.” (Manager 1) |
| | “Then you have supposedly found a solution, but how can you bring it into reality? Then you really have a lot of hurdles to overcome.” (Manager 9) |
| 20a. Create common goals and vision | “But what makes it difficult, is that everyone has to start looking in the same direction. Everyone has to be understood.” (Manager 1) |

| | |
|---|---|
| | “Be willing to work with each other and see a common purpose in it, right? In this, there could be all other secondary goals of business objectives but keep seeing the bigger picture and pursuing the common goal together. Well, that makes sure we are all looking in the same direction and start working together. (Manager 5) |
| 20b. Translating goals to different levels | “I have a lot of trouble switching down in terms of getting things across in a for everyone understandable language. [...] But at least I know that it would be helpful, and it should be the way things are done.” (Manager 9) |
| | “I think you have to set a target or objective and at every lower level, you want that objective to be more concrete.” (Manager 13) |