Green project management competencies and sustainable development goals (SDGs): Empirical evidence

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A B S T R A C T

This study assesses the green project management competencies of students in the College of Business at Prince Sattam bin Abdulaziz University. This study uses a structured questionnaire to evaluate ten competencies: teamwork, leadership, communication, conflict management, achievement motivation, cognitive skills, adaptability, self-control, negotiation, and social awareness. The Principal Component Analysis (PCA) and Cronbach Alpha results revealed that effective communication was the strongest competency, explaining 71.6% of the variance, followed by leadership (65.3%) and teamwork (60.6%). Self-control demonstrated the highest reliability ($\alpha = 0.966$), emphasizing students' ability to manage stress effectively. Conflict management explained 48.9% of the variance, while adaptability accounted for 57.4%, reflecting students' resilience and flexibility. Cognitive skills explained 51.7%, highlighting critical thinking and problem-solving abilities. Negotiation explained 63.8%, emphasizing stakeholder collaboration, and social awareness accounted for 50.1%, reflecting cultural sensitivity and empathy. Achievement motivation explained 54.8%, underscoring students' proactive and goal-oriented behaviors. These findings provide valuable insights into strengths and gaps in student competencies, offering a basis for targeted improvements. Green project management competencies are vital for advancing Sustainable Development Goals (SDGs). Green project management competencies are integral to advancing the Sustainable Development Goals (SDGs). Cognitive skills, teamwork, and communication enhance critical thinking and innovation, supporting SDG 4 (Quality Education). Leadership and adaptability drive sustainable initiatives, aligning with SDG 8 (Decent Work and Economic Growth) and SDG 9 (Industry, Innovation, and Infrastructure). Additionally, teamwork and social awareness foster inclusive urban development (SDG 11), while self-control and resilience enable effective climate action (SDG 13). By aligning academic training with industry demands, this study supports the global sustainability agenda and Saudi Vision 2030. The study provides policymakers in Saudi Arabia with valuable insights into aligning educational strategies with industry demands, highlighting key gaps in green project management competencies. By addressing these gaps, policymakers can enhance curriculum design to develop sustainability-focused skills, advancing Saudi Vision 2030 goals for workforce readiness, economic growth, and global sustainability leadership.

1. Introduction

Green project management competencies are increasingly recognized as essential for addressing sustainability challenges in diverse industries. These competencies encompass the knowledge, skills, and attitudes necessary to integrate environmental, social, and economic considerations into project planning, execution, and evaluation. As industries worldwide transition

toward more sustainable practices, the ability to lead and manage projects with sustainability in mind has become a vital requirement. However, there is a significant gap in equipping university students, particularly those in business disciplines, with these essential competencies. Despite advancements in project management frameworks, such as the PMCD Framework and the PMBOK® Guide (PMI, 2017, 2021), educational institutions have yet to fully integrate the principles of green project management into their curricula. This disconnect limits the readiness of graduates to effectively contribute to Sustainable Development Goals (SDGs) such as SDG 13 (Climate Action), SDG 11 (Sustainable Cities and Communities), and SDG 8 (Decent Work and Economic Growth).

The literature consistently highlights gaps in critical green project management competencies, such as teamwork, leadership, adaptability, and cognitive skills, which are essential for achieving sustainable outcomes. For instance, Ahadzie et al. (2008) and Dainty et al. (2004) highlight the importance of teamwork and leadership in fostering collaboration and driving performance in sustainability-focused projects. Silvius and Schipper (2014) emphasize the need for systems thinking and adaptability to address the dynamic challenges of green initiatives. Despite these findings, studies reveal that students often lack proficiency in these areas, with deficiencies in negotiation, conflict management, and communication further exacerbating the gap between academic training and workplace demands (Zaharim et al., 2012; Musa et al., 2012). These shortcomings not only hinder individual employability but also impede collective efforts toward achieving global sustainability targets.

The importance of green project management competencies extends beyond employability, playing a critical role in the realization of the SDGs. Educational institutions are uniquely positioned to bridge this gap by equipping students with the necessary skills to navigate the complexities of sustainability-focused projects. Aligning curriculum with competencies such as self-control, social awareness, and achievement motivation can foster a new generation of project managers capable of balancing environmental, social, and economic objectives. For instance, PMI's frameworks advocate for adaptable and principle-based approaches to project management, which are crucial for addressing the multifaceted nature of sustainability challenges (PMI, 2017, 2021). Integrating these principles into educational frameworks would support SDG 4 (Quality Education) by promoting critical thinking, problem-solving, and practical application skills among students.

This study focuses on evaluating the green project management competencies of students at Prince Sattam bin Abdulaziz University, assessing their alignment with the SDGs. By exploring ten critical competencies—including teamwork, leadership, adaptability, and negotiation—the research aims to identify areas of strength and weakness. Through this analysis, the study seeks to contribute to enhancing educational strategies for sustainability, providing actionable insights for curriculum developers, educators, policymakers, and industry stakeholders. The findings have implications for aligning academic training with the demands of sustainable industries, thereby supporting the global sustainability agenda and Saudi Vision 2030. By addressing the identified gaps, this study not only enhances the employability of graduates but also positions them as agents of change, capable of driving innovation and sustainability in their respective fields.

2. Literature review

Mahajan, Gupta, and Misra (2022) found differing priorities between students, faculty, and employers, with employers emphasizing digital and problem-solving skills, while educators and students value teamwork and communication. Studies by Banasik and Jubb (2021) and Oraison, Konjarski, and Howe (2019) highlight gaps in curricula, particularly in leadership, digital, and practical competencies. Rizwan et al. (2021) and Yusuf and Jamjoom (2022) identify deficits in soft skills and graduate readiness for sustainable employability. Al Mallak et al. (2020) report low competence in ethical skills, while Aldossari (2020) notes cultural factors influencing career perceptions. Ebaid (2021) and Alzuoud and Gaudel (2020) emphasize the need to align education with workplace demands, critical for Saudi Vision 2030.

The Project Management Institute (PMI), a globally recognized authority in project management, published The Project Manager Competency Development (PMCD) Framework and the Guide to the Project Management Body of Knowledge (PMBOK® Guide). The Project Management Institute (PMI) continuously updates its frameworks and guidelines to align with the evolving practices in project management, as evidenced by the recent revisions to the Project Manager Competency Development (PMCD) Framework and the Guide to the Project Management Body of Knowledge (PMBOK® Guide). These updates highlight PMI's commitment to addressing the dynamic and complex nature of contemporary project management environments.

2.1 Project Manager Competency Development (PMCD) Framework

The Third Edition of the PMCD Framework, published in 2017, extends its applicability beyond project managers to include program and portfolio managers. This expansion acknowledges the interdependence among these roles within organizations. The framework categorizes competencies into three core dimensions:

1. Knowledge Competencies, which emphasize understanding key project management principles and practices.
2. Performance Competencies, which focus on the practical application of knowledge to achieve project goals effectively.

3. Personal Competencies, which address the behaviors and attitudes that foster project success.

The PMCD Framework provides detailed guidance on evaluating and developing these competencies, with practical examples for demonstrating proficiency. By aligning with PMI's broader standards, such as the PMBOK® Guide – Sixth Edition, the framework ensures consistency and coherence across PMI's professional guidelines. This comprehensive approach facilitates tailored competency development for individuals and organizations, supporting career progression and enhancing project management effectiveness (PMI, 2017).

2.2 A Guide to the Project Management Body of Knowledge (PMBOK® Guide)

The Seventh Edition of the PMBOK® Guide, released in 2021, represents a paradigm shift from earlier editions by prioritizing principles and outcomes over prescriptive processes. Key innovations in this edition include:

1. Principle-Based Structure, introducing 12 foundational principles that guide effective project management across diverse methodologies.
2. Performance Domains, replacing the traditional knowledge areas with eight domains that encapsulate activities critical to project outcomes.
3. Tailoring, emphasizing the need to adapt project management practices to the specific context and requirements of each project.
4. Integration of Agile and Hybrid Approaches, acknowledging the growing significance of adaptive methodologies in modern project environments.
5. Focus on Value Delivery, shifting the emphasis from delivering outputs to achieving outcomes that add value for stakeholders and organizations.

These updates promote a holistic and flexible approach to project management, accommodating the diverse and evolving challenges faced by project managers. The Seventh Edition serves as a vital resource, enabling professionals to adopt best practices tailored to their unique project contexts while ensuring effective value delivery.

Together, the PMCD Framework and the PMBOK® Guide exemplify PMI's dedication to advancing project management knowledge and practice. The PMCD Framework offers a structured pathway for competency development, while the PMBOK® Guide provides a versatile and principle-driven methodology. Both resources are indispensable for project management professionals aiming to achieve excellence in their fields by adopting practices aligned with current industry standards and future demands (PMI, 2021).

2.3 Green project management competencies and SDGs

Green project management competencies are essential for students in the College of Business as they prepare future professionals to integrate sustainability into business and project practices. These competencies encompass the ability to plan, execute, and oversee projects that prioritize environmental sustainability while balancing social and economic considerations. By mastering these skills, students not only contribute to sustainable development but also enhance their employability in a job market increasingly focused on green practices. As industries worldwide transition toward sustainability, graduates equipped with green project management skills are well-positioned to lead initiatives that emphasize environmental responsibility, resource efficiency, and stakeholder collaboration. These efforts are closely aligned with the objectives of SDG 9: Industry, Innovation, and Infrastructure, which emphasizes the importance of fostering sustainable industrial growth, resilient infrastructure, and innovative practices to address global challenges. By equipping students with green project management competencies, they are empowered to contribute to building industries that minimize environmental impacts, adopt advanced technologies, and support inclusive economic development, thereby driving progress toward a more sustainable and equitable future.

The integration of green project management competencies into education is a transformative approach that directly supports SDG 4: Quality Education, ensuring students gain inclusive and equitable learning experiences that emphasize critical thinking, problem-solving, and adaptability. These competencies are essential for navigating the multifaceted challenges of the modern workforce, enabling students to contribute meaningfully to projects that align with global sustainability objectives. By fostering analytical and innovative capabilities, high-quality education prepares graduates to address complex sustainability issues across diverse industries, ensuring they are equipped to meet the demands of an increasingly dynamic and globalized economy. In addition, green project management competencies significantly advance SDG 8: Decent Work and Economic Growth by enhancing the employability of graduates in green industries such as renewable energy, sustainable construction, and corporate social responsibility. Educational institutions play a critical role in equipping students with the tools to lead sustainability-focused initiatives, thereby fostering productive employment and promoting sustainable economic growth. Graduates with these competencies are not only better prepared for the workforce but also serve as agents of change, driving innovation and advancing sustainable practices in their respective fields.

Furthermore, these competencies support SDG 11: Sustainable Cities and Communities by enabling graduates to engage in sustainable urban development projects, including the creation of green infrastructure and eco-friendly housing. Their skills in collaboration, conflict resolution, and strategic planning allow them to address community needs while promoting sustainability. Finally, green project management competencies are pivotal in achieving SDG 13: Climate Action. These skills empower students to lead initiatives that mitigate environmental impacts, enhance resource efficiency, and build resilience against climate change. By linking education, employment, and sustainability, green project management competencies bridge critical gaps in global development. They equip graduates to foster a greener and more equitable future, positioning them as key contributors to achieving the Sustainable Development Goals and advancing a global sustainability agenda.

2.4 Related previous studies

2.4.1 Teamwork and Collaboration

Teamwork and collaboration are foundational competencies in green project management, enabling effective engagement in multidisciplinary and diverse teams to achieve sustainable outcomes. Ahadzie, Proverbs, and Olomolaiye (2008) emphasize that contextual behaviors, such as interpersonal facilitation and team dedication, are crucial for successful project execution, especially in sustainability-focused projects. Boyatzis (2011) highlights that emotional and social intelligence are key to fostering collaboration, enabling project managers to build trust, resolve conflicts, and align team efforts towards common goals. Similarly, Fisher (2011) highlights the importance of people skills, such as empathy and adaptability, in managing team dynamics and ensuring effective communication in collaborative environments. Dainty et al. (2004) further identify team leadership and composure as critical to high-performing project teams, where collaboration drives superior results. The integration of soft skills, including teamwork, into project management education has been highlighted by Chepkemoi et al. (2021), who stress that fostering collaboration among team members contributes significantly to project success, particularly in road construction projects where sustainability is a key focus. Additionally, Silvius and Schipper (2014) emphasize that collaborative approaches in green project management not only enhance team performance but also ensure alignment with environmental and social sustainability goals. Project-based learning, as discussed by Musa et al. (2012), provides students with opportunities to develop these skills through real-world projects, enhancing their ability to collaborate effectively and resolve complex issues in green project management. Zaharim et al. (2012) also highlight teamwork as a valued competency by employers, essential for fostering innovation and meeting sustainability objectives.

2.4.2 Leadership

Leadership competency is an indispensable skill in green project management, as it empowers students to guide diverse teams and effectively address the multidimensional challenges of sustainability. Ahadzie, Proverbs, and Olomolaiye (2008) emphasize that leadership behaviors, such as aligning team goals with project objectives and maintaining team motivation, are crucial for navigating the complexities of sustainability projects. Dainty et al. (2004) further highlight that leadership is one of the strongest predictors of project success, particularly in fostering team collaboration and high performance. Building on this, Boyatzis (2011) highlights the importance of emotional intelligence in leadership, noting that socially aware leaders can establish trust and create environments conducive to innovation and sustainability. Recent studies expand this perspective, emphasizing the role of transformational leadership in green project management. Silvius and Schipper (2014) argue that leaders must adopt a sustainability-focused mindset, integrating environmental and social considerations into decision-making processes. Alshammari (2020) highlights that effective green leadership requires not only vision but also the ability to manage stakeholder relationships in a way that balances sustainability with project performance. Fisher (2011) supports this by illustrating that inspiring team commitment and fostering trust are critical leadership behaviors for sustainable initiatives. Additionally, leadership competency is enhanced through real-world practice. Musa et al. (2012) advocate for experiential learning methods like project-based learning, which allow students to cultivate decision-making and adaptability, while Zuo et al. (2018) emphasize that leadership in sustainability projects involves the capacity to innovate and inspire teams toward shared environmental goals.

2.4.3 Effective communication

Effective communication is an essential competency in green project management, enabling the clear exchange of information, ideas, and goals among team members and stakeholders to ensure project success. Ahadzie, Proverbs, and Olomolaiye (2008) emphasize that communication is a foundational skill for project managers, as it supports collaboration and decision-making within teams, especially in sustainability-driven projects. Dainty et al. (2004) highlight that effective communication is vital for fostering teamwork, resolving conflicts, and ensuring alignment with project objectives. Boyatzis (2011) emphasizes the importance of emotional intelligence in communication, particularly the ability to empathize and understand others' perspectives, which fosters mutual understanding and trust in project teams. Fisher (2011) identifies communication as a key people skill, noting that project managers who articulate clear expectations and listen actively are more likely to lead successful teams and projects. Furthermore, Zaharim et al. (2012) found that communication skills are highly valued by employers, as they directly impact the ability to convey sustainable practices effectively to diverse audiences . Musa et al. (2012) advocate for experiential learning methods like project-based learning to enhance communication skills among students, preparing them to excel in real-world, sustainability-oriented project environments.

2.4.4 Conflict Management

The ability to manage conflict effectively is an indispensable competency in green project management, ensuring that differences within teams or among stakeholders are handled constructively to sustain collaboration and progress toward shared sustainability goals. According to Ahadzie, Proverbs, and Olomolaiye (2008), conflict resolution behaviors, such as fostering open dialogue and mediating disputes, play a significant role in enhancing team dynamics and boosting performance, particularly in complex, multidisciplinary projects. This aligns with Dainty et al. (2004), who assert that conflict management not only preserves team cohesion but also sustains motivation, an essential element in navigating the demanding nature of green project management. From another perspective, emotional intelligence is deeply interwoven with conflict resolution. Boyatzis (2011) suggests that self-awareness and empathy are vital tools for addressing disputes effectively, allowing project leaders to mediate differences while maintaining harmony within teams. Fisher (2011) reinforces this by emphasizing the importance of a pragmatic approach to conflict management, which can strengthen stakeholder relationships and align team objectives. In the workplace context, Zaharim et al. (2012) note that employers regard conflict resolution as an invaluable skill, as it supports decision-making and stakeholder engagement in sustainability projects. The educational aspect is equally significant. Musa et al. (2012) advocate for conflict management training through project-based learning, enabling students to simulate real-world scenarios where negotiation and problem-solving are vital. Moreover, recent research by Chepkemoi et al. (2021) indicates that successful conflict management in green projects directly correlates with achieving sustainability objectives, especially in high-stakes sectors like construction. Silvius and Schipper (2014) also emphasize the role of inclusive conflict resolution in aligning project activities with environmental and social sustainability goals.

2.4.5 Achievement Motivation

Achievement motivation is a critical competency in green project management, as it drives individuals to set and achieve high standards, particularly in addressing the complex goals of sustainability. Ahadzie, Proverbs, and Olomolaiye (2008) highlight the importance of motivation in fostering proactive behaviors that ensure the successful execution of green projects, emphasizing its role in overcoming challenges and maintaining focus on project objectives. Dainty et al. (2004) note that high-performing project managers often exhibit strong personal motivation, which inspires teams to align their efforts with the overarching sustainability goals. Fisher (2011) emphasizes that motivated leaders serve as role models for their teams, promoting a culture of excellence and persistence in green project management environments. Boyatzis (2011) ties achievement motivation to emotional intelligence, suggesting that individuals driven by a desire for achievement are more likely to take initiative, innovate, and adapt to challenges in sustainability-focused projects. Furthermore, Musa et al. (2012) advocate for incorporating project-based learning to nurture achievement motivation in students, enabling them to tackle real-world sustainability challenges with a results-oriented mindset. Zaharim et al. (2012) add that motivation is a key soft skill valued by employers, enhancing employability in green industries.

2.4.6 Cognitive Skills

Cognitive skills are fundamental in green project management, enabling individuals to analyze complex situations, make informed decisions, and devise innovative solutions to sustainability challenges. Ahadzie, Proverbs, and Olomolaiye (2008) highlight that cognitive competency, such as critical thinking and problem-solving, are essential for project managers to navigate the intricacies of sustainable projects, particularly in balancing environmental, social, and economic considerations. Dainty et al. (2004) emphasize that cognitive abilities, including strategic planning and foresight, are predictive of high performance in project management, especially when addressing the dynamic requirements of sustainability-focused projects. Boyatzis (2011) ties cognitive skills to emotional intelligence, suggesting that individuals who integrate analytical thinking with empathy are better equipped to align team efforts and stakeholder interests toward sustainability goals. Recent literature highlights the importance of cognitive skills in aligning project objectives with sustainability. Alshammari (2020) emphasizes the need for systematic thinking in managing complex sustainability projects in Saudi Arabia, where project managers must consider environmental, economic, and cultural factors simultaneously. Chepkemoi, Kalio, and Mwanzia (2021) argue that cognitive skills are crucial for addressing resource management challenges, particularly in the construction sector, where sustainable practices are increasingly prioritized. Silvius and Schipper (2014) discuss the role of systems thinking in enabling managers to identify interconnections between project components and broader ecological goals, ensuring the successful integration of sustainability into projects. Zuo, Zhao, and Gan (2018) highlight that innovative thinking and problem-solving are critical in green building projects, facilitating optimal resource utilization and environmental stewardship. Musa et al. (2012) advocate for experiential learning approaches, such as project-based learning, to develop cognitive skills among students, preparing them to excel in real-world sustainability initiatives. Zaharim et al. (2012) further indicated to the importance of cognitive skills for employability, as they enable graduates to meet the analytical demands of green industries.

2.4.7 Adaptability

Adaptability stands as a cornerstone competency in green project management, equipping individuals with the flexibility to tackle dynamic challenges and adjust to the evolving demands of sustainability-focused projects. As highlighted by Ahadzie, Proverbs, and Olomolaiye (2008), the capacity to adapt enables project managers to navigate uncertainties and recalibrate strategies, ensuring successful outcomes in multifaceted green initiatives. Dainty et al. (2004) further argue that adaptability

in decision-making is not just beneficial but essential, particularly for aligning environmental goals with stakeholder expectations in rapidly changing project landscapes. Recent insights emphasize the multi-dimensional nature of adaptability in green project settings. Alshammari (2020) illustrates the importance of cultural adaptability in projects involving diverse stakeholders, suggesting that project managers must tailor strategies to align with local sustainability priorities. Similarly, Zuo et al. (2018) highlight the necessity of adaptability in green building projects, where shifting regulations and technological advancements demand quick and informed adjustments. Boyatzis (2011) ties adaptability to emotional and social intelligence, illustrating how project managers can reconfigure their communication and leadership styles to meet team needs. On an educational front, Musa et al. (2012) recommend experiential learning as an effective tool for fostering adaptability among students, preparing them for the unpredictable nature of sustainability projects. Chepkemoi, Kalio, and Mwanzia (2021) also note that adaptability is crucial in the construction sector, where projects often face resource limitations and external pressures. Employers recognize this competency as essential; Zaharim et al. (2012) assert that adaptability is integral to thriving in green industries, where constant innovation and change define the landscape.

2.4.8 Self-Control

Self-control plays an integral role in green project management, enabling project leaders to stay composed and make sound decisions under pressure. Research conducted on sustainable project environments highlights that self-control allows managers to manage high-stakes situations effectively, ensuring stability within teams and alignment with sustainability objectives (Ahadzie et al., 2008). For example, studies in sustainable construction show that self-control helps leaders balance the emotional demands of managing diverse teams while adhering to tight deadlines (Dainty et al., 2004). Further investigations underline the value of self-regulation in fostering collaborative workspaces. Silvius and Schipper (2014) observed that project leaders with emotional resilience were more adept at navigating conflicts and maintaining focus on environmental goals, even when dealing with resource constraints. In a similar vein, Chepkemoi et al. (2021) documented that self-control facilitates effective stakeholder engagement in resource-intensive projects, such as road construction, where sustainability targets can introduce added complexities. Educational strategies also highlight the importance of cultivating self-control. Experiential learning approaches, such as scenario-based training, have been recommended for their ability to simulate real-world stressors, helping students develop this competency before entering the workforce (Musa et al., 2012). Moreover, industry-focused analyses emphasize that self-control is not only a personal asset but also a sought-after skill for leadership roles in green industries (Zaharim et al., 2012).

2.4.9 Negotiation

In green project management, negotiation is a key skill that underpins the ability to align diverse perspectives and secure solutions that prioritize sustainability. This competency serves as a bridge between stakeholders' differing interests, fostering collaboration while balancing the imperatives of cost, quality, and environmental impact. As highlighted by Alshammari (2020), effective negotiation is particularly critical in sustainability-driven projects where the competing demands of profitability and environmental responsibility often converge. Negotiation, in such contexts, ensures that compromises are reached without undermining key sustainability objectives. In addition to resolving conflicts, negotiation is instrumental in shaping stakeholder relationships. Zuo, Zhao, and Gan (2018) emphasize that in green building projects, negotiation facilitates partnerships that optimize resource utilization and promote long-term environmental goals. Furthermore, Chepkemoi, Kalio, and Mwanzia (2021) assert that the ability to navigate complex stakeholder dynamics through negotiation is indispensable in construction projects, where sustainability goals demand adaptability and a focus on shared outcomes. Beyond the technical realm, negotiation also draws heavily on interpersonal skills. Emotional intelligence, as discussed by Boyatzis (2011), enhances the ability of project managers to approach negotiations with empathy and active listening. This is echoed in Silvius and Schipper's (2014) observation that understanding stakeholder priorities through open dialogue leads to agreements that support both ecological and social objectives. Experiential learning approaches, such as project-based scenarios, are critical in cultivating negotiation skills among students, preparing them for the complexities of sustainability-focused industries (Musa et al., 2012).

2.4.10 Social Awareness

The ability to comprehend and navigate social and cultural dynamics is a cornerstone of effective green project management. Social awareness, in particular, equips project managers with the skills to engage diverse stakeholders, address community concerns, and ensure projects align with societal values. Studies have shown that socially aware managers are better equipped to foster stakeholder collaboration, a critical factor in sustainability-driven initiatives (Ahadzie et al., 2008). In construction projects, for instance, understanding local cultural and social nuances can help project managers anticipate potential conflicts and develop inclusive strategies that benefit both the organization and the community (Dainty et al., 2004). Recent literature adds further depth to the discussion. Zuo et al. (2018) highlight that social awareness is important in green building projects, where stakeholder alignment and community buy-in are essential for long-term success. Additionally, Silvius and Schipper (2014) argue that socially aware project managers are better positioned to integrate sustainability objectives with stakeholder expectations, fostering trust and mutual respect. Training programs incorporating project-based learning have also been instrumental in developing this competency among students (Musa et al., 2012). These programs simulate real-world scenarios, allowing students to hone their ability to understand and address diverse perspectives. Social awareness is not only

essential for project success but also for career advancement. Chepkemoi, Kalio, and Mwanzia (2021) note that employers in green industries prioritize candidates with strong interpersonal skills, particularly those who can navigate complex stakeholder relationships. As the global push for sustainability intensifies, the demand for socially aware project managers will continue to grow, reinforcing the critical role of this competency in green project management.

3. Research methodology

3.1 Research design and instrument

A structured questionnaire survey served as the primary tool for data collection in this study. The survey focused on assessing green project management competencies among students from the College of Business at Prince Sattam bin Abdulaziz University, with an emphasis on their alignment with sustainable development goals. The questionnaire design was guided by an extensive review of relevant literature, evaluating ten dimensions of green project management soft skills: teamwork and collaboration, leadership, effective communication, conflict management, achievement motivation, cognitive skills, adaptability, self-control, negotiation, and social awareness. These competencies were adapted from the PMCD Framework (PMI, 2017) and supplemented with insights from prior research (e.g., Ahadzie et al., 2008; Boyatzis, 2011; Golemon et al., 2004; Dainty et al., 2004; Zaharim et al., 2012; Musa et al., 2012; Edum-Fotwe & McCaffer, 2000; Fisher, 2011; Hyväri, 2006; Belassi & Tukel, 1996; Chepkemoi et al., 2021; Silvius & Schipper, 2014; Alshammari, 2020; Zuo et al., 2018).

To ensure validity, the survey was reviewed and refined by three experienced educators with over fifteen years of expertise in career guidance, incorporating their feedback before finalizing the instrument. The questionnaire comprised two sections: the first gathered demographic details, including gender, age, major, GPA, and career aspirations, while the second assessed the importance of ten green project management skills using a five-point Likert scale (1 = very unimportant to 5 = very important).

3.2 Data collection and sample

The study sample comprised 140 students enrolled in the College of Business Administration at Prince Sattam bin Abdulaziz University. Data collection was conducted during the second semester of the 2023–2024 academic year using Google Forms survey links disseminated through various online platforms. Prior to administering the survey, participants were informed about the purpose of the study, and assurances were provided regarding the confidentiality and anonymity of their responses. The questionnaire included sections on demographic information, as well as items related to technological skills and employability challenges. While usable responses were obtained from the distributed questionnaires, the exact response rate could not be determined due to the reliance on social media platforms for survey distribution, which made it challenging to track the total number of recipients.

3.3 Data analysis

Following data screening and cleaning procedures, the analysis was conducted using IBM SPSS version 26.0 and Microsoft Office Excel 16. Statistical techniques employed in this study included descriptive statistics (mean, standard deviation, minimum, maximum, frequency, and percentages), Principal Component Analysis (PCA), and Cronbach's alpha for reliability assessment.

4. Results and discussions

The Principal Component Analysis (PCA) for each dimension is depicted in Table 1. Table 1 shows that green project management competencies are essential for students in the College of Business, equipping them to integrate sustainability into business and project practices effectively. These competencies enable future professionals to plan, execute, and oversee projects that balance environmental, social, and economic considerations. Mastery of these skills not only enhances employability but also positions graduates to lead initiatives prioritizing resource efficiency, environmental responsibility, and stakeholder collaboration. The study identified ten critical competencies using Principal Component Analysis (PCA), each contributing significantly to green project management. Teamwork and Collaboration accounted for 60.6% of the variance (eigenvalue: 3.031), with high factor loadings for fostering strong relationships (.691) and planning collaboratively (.882). This highlights the students' ability to work cohesively in team environments, a foundational skill for managing sustainability-focused projects. Similarly, Leadership explained 65.3% of the variance (eigenvalue: 1.960), emphasizing accountability (.821) and stakeholder relationships (.868), crucial for driving high-performance outcomes. Effective Communication emerged as the most robust competency, with an eigenvalue of 3.580 and 71.6% variance explained. Students excelled in articulating project communications (.870) and resolving misunderstandings (.777), ensuring stakeholder alignment—a key aspect of sustainability goals. Conflict Management highlighted the ability to address disputes proactively, contributing 48.9% of the variance (eigenvalue: 2.934). High factor loadings, such as fostering trust among stakeholders (.841), shows the importance of resolving conflicts to maintain project cohesion. Achievement Motivation (54.8% variance explained, eigenvalue: 2.192), Cognitive Skills (51.7%, eigenvalue: 2.587), and Adaptability (57.4%, eigenvalue: 1.724) reflect the students' proactive mindset, critical thinking abilities, and resilience.

Table 1
The Principal Component Analysis (PCA)

Factor/Item description	Factor loadings	Eigen value	Variance explained
F1: Teamwork and Collaboration		3.031	60.628
• Builds and maintains strong relationships among team members.	.691		
• Understands and appreciates the roles and contributions of all team members.	.788		
• Collaboratively identifies and plans project tasks with others.	.882		
• Shares expertise and knowledge with colleagues to enhance collective performance.	.781		
• Strives to foster agreement and consensus during team decision-making processes.	.737		
F2: Leadership		1.960	65.326
• Demonstrates positive expectations and delivers high-performance results.	.729		
• Establishes effective relationships with stakeholders to drive project success.	.868		
• Takes responsibility and accountability for achieving project objectives	.821		
F3: Effective Communication		3.580	71.608
• Clearly understands and articulates the content of project-related communications.	.870		
• Ensures formal communication lines are clear and effective throughout the project lifecycle.	.910		
• Actively seeks opportunities to provide project updates and direction to relevant stakeholders.	.860		
• Adapts communication styles to suit the audience and context.	.807		
• Uses communication channels to build team cohesion and resolve misunderstandings.	.777		
F4: Conflict Management		2.934	48.900
• Recognizes and addresses potential conflicts proactively within the project.	.709		
• Maintains composure and self-control in high-pressure situations.	.627		
• Works to prevent conflicts by ensuring stakeholder interests are considered and balanced.	.737		
• Resolves disputes effectively, ensuring mutually satisfactory outcomes.	.477		
• Cultivates trust and fair treatment among project stakeholders to mitigate disagreements.	.841		
• Considers cultural and contextual factors when managing conflicts.	.748		
F5: Achievement Motivation		2.192	54.804
• Displays flexibility and adaptability in response to changes within the project.	.600		
• Maintains a proactive and positive attitude towards resolving key challenges.	.813		
• Asserts ideas and decisions confidently when required.	.759		
• Actively listens to and values input from stakeholders and team members.	.771		
F6: Cognitive Skills		2.587	51.740
• Evaluates projects holistically to identify potential challenges and solutions.	.554		
• Utilizes complex problem-solving strategies to address project needs effectively.	.756		
• Incorporates lessons learned into current projects to enhance outcomes.	.782		
• Seeks and applies opportunities to optimize project efficiency and success.	.620		
• Synthesizes multiple perspectives to develop a comprehensive understanding of project issues.	.844		
F7: Adaptability		1.724	57.476
• Responds effectively to shifting project demands and environmental changes.	.693		
• Demonstrates resilience and flexibility in overcoming obstacles.	.759		
• Embraces innovative approaches to achieve project goals.	.817		
F8: Self-Control		3.636	90.890
• Maintains a calm and composed demeanor during challenging situations.	.955		
• Regulates emotional responses to foster a productive project environment.	.972		
• Demonstrates patience and steadiness under pressure.	.940		
• Manages stress constructively to focus on achieving project objectives.	.946		
F9: Negotiation		1.916	63.850
• Facilitates fair and balanced agreements among project stakeholders.	.833		
• Advocates effectively for project needs while considering stakeholder perspectives.	.712		
• Strives to find win-win solutions to conflicting interests.	.845		
F10: Social Awareness		5.512	50.112
• Understands and respects the diverse cultural and social backgrounds of team members.	.805		
• Recognizes the social dynamics within the project team and adapts interactions accordingly.	.857		
• Builds trust and rapport by showing empathy and consideration for others' needs	.766		

Self-Control demonstrated the highest factor loadings (.955 to .972) across its items, explaining 90.8% of the variance (eigenvalue: 3.636), showcasing the ability to manage stress and maintain composure under pressure. Negotiation explained 63.8% of the variance (eigenvalue: 1.916), highlighting students' capabilities to mediate agreements and advocate effectively. Finally, Social Awareness contributed 50.1% variance (eigenvalue: 5.512), emphasizing cultural sensitivity (.805) and empathy (.766). When students possess green project management competencies, they significantly contribute to achieving key Sustainable Development Goals (SDGs). For instance, SDG 4 (Quality Education) is advanced through cognitive skills, teamwork, and communication, which foster critical thinking, collaboration, and effective knowledge sharing. These abilities prepare students with inclusive, high-quality education that promotes innovation and equips them to address complex sustainability challenges. Similarly, SDG 8 (Decent Work and Economic Growth) is supported by leadership, adaptability, and achievement motivation, which enhance employability, drive productivity, and enable students to lead green initiatives. These skills align project outcomes with environmental and social priorities, creating job opportunities and contributing to economic growth.

Further, SDG 9 (Industry, Innovation, and Infrastructure) benefits from leadership and negotiation competencies, empowering students to manage industrial and infrastructure projects that prioritize sustainability. These abilities foster innovative approaches to building resilient infrastructure and environmentally responsible practices. SDG 11 (Sustainable Cities and Communities) is achieved through teamwork, conflict management, and social awareness, enabling collaboration on green housing and urban planning while addressing community needs. Additionally, SDG 13 (Climate Action) relies on self-control, adaptability, and cognitive skills for effective decision-making, resilience, and strategic planning to mitigate climate risks and implement sustainable solutions. Integrating these competencies into education equips students to drive sustainable development and align with the global sustainability agenda. These findings illustrate that green project management competencies are not only vital for employability but also for fostering a sustainable and equitable future.

Table 2
Cronbach Alpha

Factor/Item description	Items	Mean	SD	Cronbach α value
F1: Teamwork and Collaboration	5	4.566	.452	.833
F2: Leadership	3	4.445	.586	.731
F3: Effective Communication	5	4.094	.789	.899
F4: Conflict Management	6	3.923	.980	.775
F5: Achievement Motivation	4	4.221	.679	.714
F6: Cognitive Skills	5	4.513	.521	.753
F7: Adaptability	3	4.224	.736	.630
F8: Self-Control	4	4.446	.583	.966
F9: Negotiation	3	4.090	.824	.674
F10: Social Awareness	3	4.302	.590	.734

Table 2 presents the Cronbach's alpha values, means, and standard deviations for ten green project management competencies, indicating their internal consistency and reliability. Teamwork and Collaboration scored the highest mean (4.566) with a strong reliability coefficient (α = .833), reflecting the students' proficiency in collaborative tasks and relationship-building. Effective Communication demonstrated excellent reliability (α = .899) and a mean of 4.094, emphasizing its importance in fostering clarity and cohesion in projects. Self-Control achieved the highest reliability (α = .966) with a mean of 4.446, showcasing students' ability to manage stress and maintain composure under pressure. Competencies like Leadership (α = .731, mean = 4.445) and Cognitive Skills (α = .753, mean = 4.513) also demonstrated strong reliability and high scores, highlighting their significance in driving project success. While Conflict Management (α = .775, mean = 3.923) and Achievement Motivation (α = .714, mean = 4.221) scored moderately, they remain essential for balancing stakeholder interests and proactive problem-solving. Adaptability (α = .630, mean = 4.224) and Negotiation (α = .674, mean = 4.090) showed slightly lower reliability but are vital for responding to dynamic project needs and mediating agreements. Social Awareness (α = .734, mean = 4.302) highlights students' cultural sensitivity and empathy, supporting inclusivity in sustainability efforts. Overall, the results demonstrate the competencies' reliability and their alignment with green project management objectives.

Based on the above discussions, Table 3 summarizes how green project management competencies contribute to the achievement of Sustainable Development Goals (SDGs). Combining the alignment in Table 3 and the statistics in Table 1, the alignment between Green Project Management (GPM) competencies and various Sustainable Development Goals (SDGs), highlights how these competencies contribute to global sustainability objectives. Teamwork and Collaboration (with a high factor loading of .882 in task planning) significantly support SDG 4 (Quality Education) by promoting collaborative learning and skill development, and SDG 13 (Climate Action) by enabling effective teamwork in climate-focused projects. Leadership (Eigenvalue 65.326) plays a pivotal role in SDG 8 (Decent Work and Economic Growth) by guiding green initiatives that foster economic growth and innovation. Similarly, Effective Communication (with a factor loading of .910) facilitates SDG 9 (Industry, Innovation, and Infrastructure) through clear and effective communication, strengthening relationships in green industries and sustainable infrastructure projects. Conflict Management competencies, such as resolving disputes (factor loading of .841), align with SDG 11 (Sustainable Cities and Communities) by addressing urban development challenges, while Achievement Motivation drives SDG 8 and SDG 11 by encouraging productivity and results-driven approaches in both green industries and urban planning. Cognitive Skills, which include strategic problem-solving (with factor loading .844),

support SDG 9 by fostering innovation in sustainable industrial practices. Adaptability, Self-Control, Negotiation, and Social Awareness further contribute to all SDGs, emphasizing resilience, stakeholder collaboration, and inclusivity in sustainable practices across sectors. Together, these competencies play an integral role in achieving the SDGs and advancing global sustainability.

Table 3
Consistency between GPM Competencies and SDGs

Competency	SDG 4 (Quality Education)	SDG 8 (Decent Work and Economic Growth)	SDG 9 (Industry, Innovation, and Infrastructure)	SDG 11 (Sustainable Cities and Communities)	SDG 13 (Climate Action)
Teamwork and Collaboration	Promotes collaborative learning and skill-building	Enhances team-oriented work in green industries	Facilitates teamwork in sustainable industrial projects	Fosters collaboration in urban planning	Enables teamwork in climate-focused projects
Leadership	Guides peers in project-based education	Leads green initiatives to boost economic growth	Drives innovation and sustainable infrastructure	Directs teams for sustainable urban development	Manages climate adaptation and mitigation projects
Effective Communication	Ensures effective sharing of knowledge	Strengthens stakeholder relationships in green jobs	Communicates project needs in sustainable industries	Engages communities for inclusive urban solutions	Advocates for climate action through collaboration
Conflict Management	Resolves issues in collaborative learning	Maintains harmony in green work environments	Balances stakeholder interests in industrial projects	Mitigates conflicts in urban development projects	Ensures consensus in climate-related initiatives
Achievement Motivation	Encourages academic excellence	Drives productivity and innovation	Inspires achievement in industrial sustainability	Promotes results-driven urban planning	Motivates success in climate action efforts
Cognitive Skills	Develops critical thinking and problem-solving	Tackles complex sustainability challenges	Innovates sustainable industrial practices	Optimizes urban sustainability solutions	Strategically plans for climate resilience
Adaptability	Adapts to diverse educational needs	Navigates dynamic work environments	Adapts to changing industrial requirements	Adjusts to evolving urban sustainability needs	Responds to climate change challenges
Self-Control	Manages stress in academic settings	Ensures composure in high-pressure industries	Maintains focus in critical industrial projects	Handles urban project complexities calmly	Remains composed in climate crisis management
Negotiation	Encourages collaborative decision-making	Balances interests of stakeholders in green jobs	Mediates sustainable solutions in industry	Reaches agreements in urban development projects	Aligns stakeholders on climate initiatives
Social Awareness	Builds empathy and inclusivity in education	Promotes equity in green workplaces	Integrates societal needs in industrial projects	Addresses community needs in urban planning	Engages diverse groups in climate strategies

Source: Created by the authors

5. Conclusion

5.1 Summary

This study aimed to evaluate the green project management competencies of students in the College of Business at Prince Sattam bin Abdulaziz University, focusing on their alignment with the Sustainable Development Goals (SDGs). The findings highlight the key role these competencies play in advancing sustainability objectives. Cognitive skills, teamwork, and communication strongly align with SDG 4 (Quality Education) by fostering critical thinking, collaboration, and innovation—key attributes for addressing complex global challenges. Leadership, adaptability, and achievement motivation enhance students' employability and productivity, thereby contributing to SDG 8 (Decent Work and Economic Growth). Negotiation and leadership skills empower students to implement sustainable industrial practices, supporting SDG 9 (Industry, Innovation, and Infrastructure). Competencies such as teamwork, conflict management, and social awareness enable students to engage in inclusive urban development projects, aligning with SDG 11 (Sustainable Cities and Communities). Finally, self-control and adaptability equip students with the resilience and strategic planning skills necessary for tackling climate challenges, addressing SDG 13 (Climate Action).

5.2 Practical Implications

The results of this study suggest that integrating green project management competencies into the curriculum can significantly enhance students' capacity to contribute to the achievement of the SDGs. Educational institutions can use these findings to design programs that foster the development of skills essential for sustainability. By equipping students with these competencies, universities can enhance their employability and prepare graduates to drive innovation in industries that prioritize sustainability. This alignment of academic training with sustainable industry needs is critical in preparing students to become agents of change, contributing to the global effort to achieve the SDGs.

5.3 Limitations

Despite the valuable insights gained, this study is not without limitations. The reliance on self-reported data introduces the possibility of response biases, as participants may have overstated or understated their competencies. Additionally, the research was confined to a single institution, which limits the generalizability of the findings to broader educational settings or different cultural contexts. Another limitation arose from the online distribution of surveys via social media platforms, making it difficult to track response rates accurately and potentially affecting the representativeness of the sample.

5.4 Opportunities for Future Research

To enhance the scope and applicability of future research, it is recommended to expand the investigation to include multiple educational institutions and diverse cultural contexts. Longitudinal studies could provide valuable insights into how green project management competencies develop over time, offering a more comprehensive understanding of their impact on sustainability goals. Furthermore, incorporating feedback from industry employers would be instrumental in bridging the gap between academic training and workforce demands, ensuring that students acquire the skills necessary to meet the expectations of sustainable industries. These efforts will contribute to the broader integration of sustainability into educational frameworks and better prepare students to support global sustainability initiatives.

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References

Ahadzie, D. K., Proverbs, D. G., & Olomolaiye, P. (2008). Towards developing competency-based measures for construction project managers: Should contextual behaviours be distinguished from task behaviours?. *International Journal of Project Management*, *26*(6), 631-645.

Al Mallak, M. A., Tan, L. M., & Laswad, F. (2020). Generic skills in accounting education in Saudi Arabia: Students' perceptions. *Asian Review of Accounting, 28*(4), 483-504.

Aldossari, A. S. (2020). Vision 2030 and reducing the stigma of vocational and technical training among Saudi Arabian students. *Empirical Research in Vocational Education and Training, 12*(3).

Alshammari, A. M. (2020). The role of project management competencies in driving sustainability in Saudi Arabia. *IOP Conference Series: Materials Science and Engineering, 713*(1), 012041.

Alzuoud, K., & Gaudel, D. R. (2020). The role of core skills development through English language teaching (ELT) in increasing employability of students in the Saudi labor market. *International Journal of English Linguistics, 10*(3), 108-118.

Banasik, E., & Jubb, C. (2021). Are accounting programs future-ready? Employability skills. *Australian Accounting Review, 31*(2), 1–12.

Belassi, W., & Tukel, O. I. (1996). A new framework for determining critical success/failure factors in projects. *International journal of project management*, *14*(3), 141-151.

Boyatzis, R. E. (2011). Managerial and leadership competencies: A behavioral approach to emotional, social and cognitive intelligence. *Vision*, *15*(2), 91-100.

Chepkemoi, J., Kalio, A., & Mwanzia, R. (2021). Influence of project management skills on performance of road construction projects in Machakos County, Kenya. *International Academic Journal of Information Sciences and Project Management, 3*(7), 1-15.

Dainty, A. R., Cheng, M. I., & Moore, D. R. (2004). A competency-based performance model for construction project managers. *Construction Management and Economics*, *22*(8), 877-886.

Ebaid, I. E. (2021). Employers' perceptions of generic employability skills of accounting graduates: Evidence from Saudi Arabia. *Journal of Management and Business Education, 4*(2), 136-149.

Edum-Fotwe, F. T., & McCaffer, R. (2000). Developing project management competency: perspectives from the construction industry. *International journal of project management*, *18*(2), 111-124.

Fisher, E. (2011). What practitioners consider to be the skills and behaviours of an effective people project manager. *International journal of project management*, *29*(8), 994-1002.

Golemon, D., Boyatzis, R., & McKee, A. (2004). *Primal leadership: Learning to lead with emotional intelligence*. Harvard Business Press, Boston, MA.

Hyväri, I. (2006). Project management effectiveness in project-oriented business organizations. *International journal of project management*, *24*(3), 216-225.

Mahajan, R., Gupta, P., & Misra, R. (2022). Employability skills framework: A tripartite approach. *Education + Training, 64*(1), 45-62.

Musa, F., Mufti, N., Latiff, R. A., & Amin, M. M. (2012). Project-based learning (PjBL): Inculcating soft skills in 21st century workplace. *Procedia-Social and Behavioral Sciences*, *59*, 565-573.

Oraison, H., Konjarski, L., & Howe, S. (2019). Does university prepare students for employment? Alignment between graduate attributes, accreditation requirements, and industry employability criteria. *Journal of Teaching and Learning for Graduate Employability, 10*(1), 173–194.

Project Management Institute (PMI). (2017). *Project Manager Competency Development (PMCD) Framework* (3rd ed.). Newtown Square, PA: Project Management Institute.

Project Management Institute (PMI). (2021). *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)* (7th ed.). Newtown Square, PA: Project Management Institute.

Rizwan, A., Alsulami, H., Shahzad, A., & Elnahas, N. (2021). Perception gap of employability skills between employers and female engineering graduates in Saudi Arabia. International Journal of Engineering Education, 37(2), 341-350.

Silvius, A. J. G., & Schipper, R. P. J. (2014). Sustainability in project management: A literature review and impact analysis. *Social Business, 4*(1), 63–96.

Yusuf, N., & Jamjoom, Y. (2022). The role of higher education institutions in developing employability skills of Saudi graduates amidst Saudi 2030 Vision. *European Journal of Sustainable Development, 11*(1), 31-41.

Zaharim, A., Ahmad, I., Yusoff, Y. M., Omar, M. Z., & Basri, H. (2012). Evaluating the soft skills performed by applicants of Malaysian engineers. *Procedia-social and behavioral sciences*, *60*, 522-528.

Zuo, J., Zhao, Z.-Y., & Gan, X. (2018). Green building for sustainable development: A review. *Engineering, Construction and Architectural Management, 25*(6), 748–772.