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Identified necessary skills to establish a center of excellence in vocational education for green innovation

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ABSTRACT

Innovation is critical for any organization to maintain sustainability and to grow. In today's world, where environmental concerns are constantly increasing, companies must adopt greener innovation strategies. These greener ways of innovating promote the monitoring and preserving of our now endangered environment. Current literature lacks data concerning the necessary skills to ease the implementation of green innovations in certain regions, one of them the Vaasa region in Finland. The aim of this study is therefore to identify those skills that can be diffused through necessary educational programs and training. Such necessary skills can be disseminated through the establishment of a Center of Vocational Excellence (CoVE) in a country or region, being this a suitable way by which educational programs and training can be offered. The skills needed for green innovation in the Vaasa region in Finland were collected through two extensive workshops, a series of semi-structured interviews, and a set of questionnaire surveys. This study adopted both qualitative and quantitative methods to meet the expected goals. From the study results, it is noticed that establishing a CoVE can be a good source for the regional companies to get a skilled workforce, which is ultimately essential to adopt a green and sustainable innovation mindset in their products and services development processes. The study is concluded with further research directions.

1. Introduction

Specific and dynamic capabilities are required to ensure green and sustainable innovation with collaborators such as suppliers, customers, higher education institutions, and other relevant actors (Beuter Júnior et al., 2019). To maintain an effective collaborative environment among partners there needs to be external knowledge and competencies. Integration of such knowledge and competencies develops the required new skills to ensure green innovations, which will, in turn, promote sustainable development in a country or region (Zhang et al., 2020). Green innovation is an important concern when it comes to economic, environmental, and social perspectives. Recent evidence has shown that companies have increased their efforts, attention, and investments to ensure environmental sustainability in their products and services. To enhance the efforts for environmental sustainability, it is necessary to identify the most important drivers that support companies to initiate innovation activities toward green concepts (Song and Yu, 2018; Yahya et al., 2022).

Nowadays, the implementation of greener innovation among companies has become much more important to both the decision-makers and researchers. Greener innovation includes such types of innovation activities that are involved in the management of energy conservation, pollution prevention, waste recycling, green product "design" and lastly corporate environmental management (Lin et al., 2014). According to Chen et al. (2006), greener innovation can be classified as greener product innovation, greener process innovation, and greener management innovation. On the one hand, greener product innovation can be defined as the development of products, which are designed and

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developed considering environmental concerns. On the other hand, greener process innovation can be defined as the process, which is modified in a way that follows strict environmental regulations during the production of environmental-friendly products (Gohoungodji et al., 2020). In the case of greener management innovation, companies should adopt content and technologies that support green initiatives (Harrington et al., 2014; Begum et al., 2022).

In general, the implementation of greener innovation in companies is a not simple initiative but a complex and difficult task that requires the involvement of many skilled stakeholders (Silva et al., 2018). Such complexity creates many challenges to the implementation of greener innovations in companies (Govindan et al., 2014; Stringham et al., 2015; Kushwaha and Sharma, 2016; Silva et al., 2018). Among all the existing challenges, one of the major challenges is the necessary knowledge and skills gaps to promote greener innovation. It is seen in the literature that there is limited research has been conducted on identifying the skills gaps to promote green innovation (Freel, 1999; de Oliveira et al., 2018; Pavlova, 2018; Jun et al., 2021; Arici and Uysal, 2022). Based on this research gap, the objective of this study is mainly to collect the essential skills gaps to promote green innovation in a region or country and prioritize the skills gaps. Moreover, the study's aim is also to foster initiative on how the identified skills gaps can be achieved through proper education and training. Furthermore, the study aims to contribute to the development of the proposed center of vocational excellence (CoVE) that supports reskilling and upskilling local workforces as necessary to adopt green innovation strategy in organizations.

To fulfill the specified objectives, it is essential to reform the existing educational institutions, especially vocational education and training (VET) institutions that provide practical support to the companies in their daily activities. It is, therefore, crucial to focus on the VET institutions, as it is from where skilled workforce for greener innovation can be supplied to the stakeholders. To enrich the capacities and competences within the VET institutions, it is necessary to update their curriculum and professional training to reskill and upskill the required workforces for green innovation. Based on the identified study objectives and organizational needs, this study is contributed to answering three research questions (RQs), which can be stated as follows:

RQ 1: What are the identified skills gaps as necessary to adopt greener innovation in successful enterprises?
RQ 2: What are the influences of vocational education and training (VET) institutions to promote greener innovation in the industrial segment?
RQ 3: How a center of vocational excellence (CoVE) could contribute to ensure greener industrial development?

The rest of the article is followed as: Section 2 outlines a literature review that contains descriptions related to greener policies, technologies, and skills requirements for greener innovation and identified research gaps. The study methodology is explained in Section 3, while overall study results are stated in Section 4. The managerial implications based on the study outcomes are stated in Section 5. The study is concluded with future research directions in Section 6.

2. Literature review

For organizations and communities, green innovation (GI) is considers an utmost importance and plays a crucial component of maintaining environmental management (Chen et al., 2012; Aguilera-Caracuel and Ortiz-de-Mandojana, 2013; Arenhardt et al., 2016). Recent years have seen an increase in research in this area (Takalo et al., 2021; Zhang et al., 2022). Furthermore, environmental deterioration is becoming a serious threat to human survival. GI is also considered as a means of achieving environmental conservation, economic development and can guide firms toward achieving sustainable competitive advantages (Díaz-García et al., 2015; Fliaster and Kolloch, 2017; Shahzad et al., 2022). Due to these advantages, GI is a topic of discussion among researchers and administrators of numerous enterprises (Gürlek and Tuna, 2018). "Green innovation", also known as "Eco-innovation", is a process that helps develop new products and technologies with the intention of lowering environmental risks including pollution and the detrimental effects of resource extraction (Castellacci and Lie, 2017; Peng et al., 2021).

To deploy GI for organizational success, it is necessary to adopt green practices in terms of innovation (Chou, 2014; Huang and Li, 2017); deploying corporate culture through employee knowledge, experience, and skill sharing; practicing a green corporate culture (Gürlek and Tuna, 2018; Chu et al., 2019) and having corporate collaboration for the implementation of innovation demonstrating commitment by all parties (Stanovcic et al., 2015; Roy and Khastagir, 2016). Senior managers in entrepreneurs who are more committed to environmental conservation will be more creative in their implementation of green innovations (Suasana and Ekawati, 2018; Huang et al., 2019). Researchers' perspectives on innovation management gradually changed as environmental challenges became more serious; as a result, substantial attention is now paid to the value of technological innovations from an ecological point of view (Takalo et al., 2021). In such circumstances, establishing environmental management through the adoption of laws and regulations can reduce adverse environmental effects (Ben Arfi et al., 2018; El-Kassar, A.N. and Singh, S.K., 2019).

To ensure successful environmental management, it is necessary to include green management, marketing, production, and innovation (Brundtland, 1987; Chen and Hung, 2014; Dai et al., 2017; Li et al., 2019). Moreover, it is essential to categorize the potential factors that affecting the implementation of GI. From literature survey, these factors can be identified and categorized as social impacts and perceived behavioral control (Chen and Hung, 2014; Chou, 2014; Huang and Li, 2017); knowledge management in GI (Arfi et al., 2018; Abbas and Sağsan, 2019); increased organizational capacity; and human capital (El-Kassar, A.N. and Singh, S.K., 2019; Peng et al., 2021). Furthermore, Albort-Morant et al. (2018) have highlighted the significance of environmental innovation among other innovations in their investigations. This innovation is promoted on a larger scale than other types of innovations through collaboration and knowledge sharing among employees, formulation of an active environmental strategy in organizations, research and development and collaboration with innovation providers (Díaz-García et al., 2015; Kunapatarawong and Martínez-Ros, 2016).

2.1. Essential skills requirements and contribution of VET institutions for green innovation

Concerning essential skills needed, the United Nations Industrial Development Organization (UNIDO) identified four groups of skills that are highly relevant for a green future such as engineering and technical skills; science skills; operation management skills; monitoring skills (Arthur, 2021). Similarly, the World Economic Forum pinpoints six categories to promote green practices in organizations such as science skills; architectural and planning skills; green engineering and tech skills; agricultural skills; environmental justice skills; systems skills (Masterson, 2021). Furthermore, there are some critical soft skills described by UNIDO as "skills for the future", which are empathy, creativity, adaptability, resilience, and design thinking (Arthur, 2021). Although the aforementioned categorizations are given to the readers for an understanding of the relevant skills, they have remained rather broad and not very specific for a region or a country. Additionally, these categorizations of necessary skills gap may not be relevant in certain geographical regions, as each region has different needs and not all of them are equally developed. Having said that, there is the need for a study to be carried out and targeted to specific regions and according to their own needs, to create a tailor-made upskills and reskills strategy to enhance the green innovation for the regional development and welfare.

Green innovation has increasingly become a crucial topic in policy-makers' agendas thus urging more sustainable practices among industry and society (Mariadoss et al., 2011; Fraj et al., 2013; Dong et al., 2014; Eikelboom et al., 2018; Li et al., 2019). A clear example is the European Union, taking green innovation as a major topic for strategic policies to promote a greener mindset. The European Commission has adopted several plans and initiatives during the past few decades. For instance, in 1990, eco-businesses were initially fostered reaching a point where they became a very dynamic sector in the European Union (European Commission, 2007). In 2011, the Eco-Innovation Action Plan was released being key to encourage sustainable production and consumption (European Commission, 2011). In 2019, the European Green Deal (European Commission, 2019) was adopted to turn greenhouse gas net emissions to zero by 2050 in the EU. Under the European Green Deal, three important initiatives can be found (New Circular Economy Action Plan, the Biodiversity Strategy for 2030, and the Zero Pollution Action Plan).

It is generally accepted that the VET system plays a critical role to foster green innovation. There is a direct relationship between the VET and a skilled workforce that upholds the organizational capacity and the economy as a whole to support green innovation. The main contribution of the VET system to green innovation is to provide the required education and training (Nelson and Phelps, 1966). There is a linkage between education, training, and green innovation that enhances the capacity of technical competencies of the workforce (Lundvall, 1998). The quality and quantity of green innovation depend on both the technical and generic competencies distributed along with the workforce. In the VET sector, the absorption of technical and generic competencies among the workforce enhances the technology diffusion, collaboration, and leadership among organizations, which ultimately promotes green innovation. The VET institutions are the essential pillar for economic growth that provide skilled workforces as necessary to contribute to closing skills gaps and reducing unemployment. Through VET systems, individual learners enable access to higher education routes, which are considered an integral part of lifelong learning indeed.

2.2. Status of skills gaps for adopting green innovation in the Vaasa region, Finland

Since this article refers to the Vaasa region in Finland, we will focus on Finland's overall Eco-Innovation scores. Finland has been among the three top-scoring countries in innovation in the world since 2012. But that is not a surprise, since according to Bahn-Walkowiak et al. (2020) the most eco-innovative countries strongly support the start-up ecosystem and have no problem investing in R&D, which is translated in academic publications and numerous patents. In the long run, green practices are fostered and green jobs are created. Finland is great at all of these green practices in general and the country has set a goal to become a carbon neutral country by 2035 and not 2050 as the EU mandates (Finnish Government, 2019).

In addition to Finland being a top performer in terms of eco-innovation, it closely follows the Smart Specialization Strategy (S3) framework. This S3 framework belongs to the Europe 2020 jobs and growth agenda and it is aimed to support necessary research and innovation activities with the ultimate goal of enhancing specific regions' economic development strategy based on each region's strengths (Virkkala et al., 2017). Although Finland has traditionally been an innovation leader that also closely follows the S3 framework for all its regions, there is currently a lack of data concerning specific skills and competencies needed to foster green innovation in certain regions (e.g. Vaasa region) and that are related to the betterment of the S3 priority areas. Fulfill the lack of necessary information related to skills gaps for green innovation, the European Union funded GREENOVET project was ideated. The aim of the GREENOVET project is to promote Vocational Education and Training (VET) Excellence in Green Innovation in Europe while seeking an innovative, inclusive and sustainable economy.

To full regional skills gaps, this GREENOVET project will establish Centers of Vocational Excellence (CoVEs) in 4 regions in Europe namely Styria in Austria, Leiria in Portugal, Skopje in North Macedonia, and Vaasa in Finland. The interesting aspect of this project is that the CoVEs will utilize resources, infrastructure, and mainly knowledge from key regional actors (e.g. industry cluster) and institutions (e.g. higher education institutions (HEIs), both lower and higher VET) to strengthen the regional skills ecosystems, thus improving the region's economic, social and environmental conditions. (European Commission, 2020).

3. Study methodology

The work discussed in this article was conducted as part of the GREENOVET - European VET Excellence Platform for Green Innovation project, financed by the European Commission through the Erasmus + program. This project aims to foster the development of Vocational Education and Training (VET) Excellence in Green Innovation across Europe enabling an innovative, inclusive and sustainable economy. This is an ongoing EU project that started in November 2020 and will be ended in October 2024. This project aims to facilitate green innovation by identifying the skills gaps to achieve it. The architectural artifacts of this study were derived following a systematic questionnaire survey method. All the necessary data was collected from stakeholders consisting of academic institutions and industrial communities in the Vaasa region, Finland during the period 2021. The basic objectives of this study were to identify the skills gaps and to investigate the status of VET institutions to foster green innovation within regional industries.

To full the identified research objectives, this study adopted both qualitative and quantitative approaches. In the case of the qualitative approach, necessary skills gaps were collected through various means such as workshops, semi-structured interviews (face-to-face and online meetings) and questionnaires surveys, available reports, and databases. To collect the required data, firstly, a list of potential regional stakeholders was defined and two workshops were organized. The stakeholders were selected based on their knowledge and expertise in terms of green innovation and both higher and lower vocational education and training institutions. One of the workshops was held on face-to-face, while the other one was online. There were 27 participants in the face-to-face workshop, whereas, the online workshop was attended by 31 participants coming from various companies, higher education institutions (HEIs), vocational education and training (VET) schools, and other government and non-government organizations working in the region of Vaasa. Participants in both workshops were divided into three groups as follows: a) small and medium-sized companies, b) large companies, c) HEI/VET providers and public authorities. The outcomes from both the workshop sessions were collected and used as inputs to this study.

Secondly, the qualitative data were collected through a series of semi-structured questionnaires survey (see the Apendix 1) with the regional stakeholders consisting of small and medium-sized companies, large companies, HEI/VET providers, and public authorities. The invitation to answer the semi-structured questionnaire survey was sent via e-mail to 380 people within the HEIs, VET schools, and the Ostrobothnia S3-related industries in the Vaasa region. In terms of organization type (Enterprise or HEI/VET), some respondents identified their organizations within different sectors, thus yielding a total number of 115 complete and useful survey responses collected for these specific questionnaires survey, which can be seen in Fig. 1. From these responses, 70.43% came from enterprises, and the remaining 29.57% came from HEI/VET providers and VET-related public authorities. The ideal share of responses according to organization type was expected to be 70% enterprises and 30% HEI/VET, hence meeting the planned scenario. A total share of 39.13% of the responses came from the Ostrobothnia S3 key focus areas for strategic development. The response rate was 30.26%, which was accepted for generalizing this kind of questionnaire survey (Cochran, 1977; Hair et al., 2007; Sousa et al., 2017; Gunawan

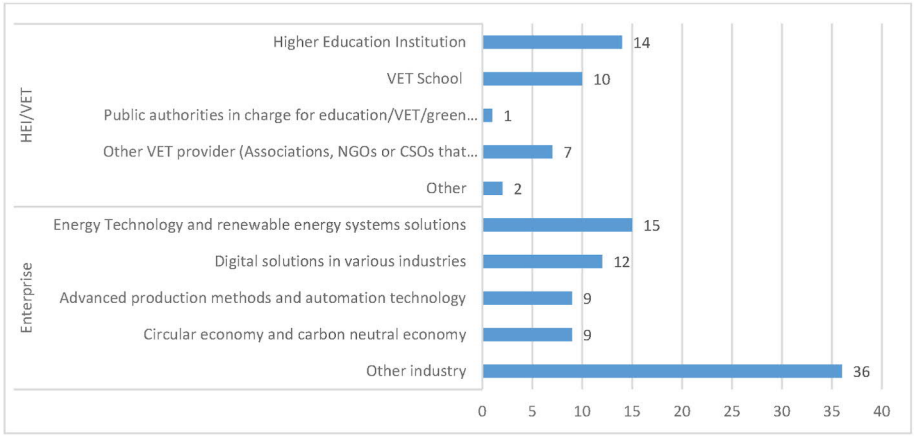

Fig. 1. Number of responses from a respective industry/sector.

et al., 2021).

From the survey responses, it was noticed that there were 14 responses from micro organizations (<10 employees), 27 from small (10–49 employees), 25 from medium (50–249 employees), and 34 from large (>250 employees). The distribution of responses was categorized according to organization size and can be seen in Fig. 2. The size of the organizations is classified based on the suggestion from OECD (2022).

For these semi-structured questionnaires survey, each of the interviewees was asked to suggest the top fifteen missing technical occupations he/she believes are highly significant for green innovation in the region, and linked them to the five most critical generic skills. Each interviewee gave his/her opinions on both types of missing technical and generic skills, with a given score from 0 (not needed) to 6 (most needed). The top fifteen needed technical skills were collected through the interviews, while the top fifteen the generic skills were chosen from already existing 54 generic skills sets under the European Competence Frameworks: Lifecomp (Sala et al., 2020), Digcomp (Carretero Gomez et al., 2017), Entrecomp (Bacigalupo et al., 2016) and Lifelong Learning competences), that are widely accepted in the EU. The main outcomes from these semi-structured interviews were the 15 most needed technical skills/occupations and the 15 most important generic skills, which are as presented in Table 1 and Table 2, respectively.

The collected qualitative data were analyzed using Excel software. This software helps to quantify the number of respondents and their responses and to visualize the collected data over various tables and figures. These tables and figures were very much useful ways to highlight all the responses to the corresponding stakeholders. The collected responses were presented to the respective stakeholders who participated in the interview survey to adopt necessary strategies (e.g.

Table 1
Identified technical skills/occupations as necessary to foster green innovation.

Priority level	Technical skills/occupations
1	Expert in green innovation
2	Sustainable product designer/developer/manager
3	Multidisciplinary expert for green innovations and digital competencies
4	Designer with a green mindset
5	Smart/advanced solutions developer
6	Expert in calculating a carbon footprint
7	Process automation in managing the waste
8	Sustainable monitoring expert
9	Circular economy expert
10	Sustainable forestry consultant
11	Cybersecurity expert
12	Big data/anomalies analysis (applied mathematics) in energy technology
13	Project manager with expertise in waste management
14	Practitioners for maintenance of smart buildings
15	Manufacturers with a green mindset and knowledge of green technologies

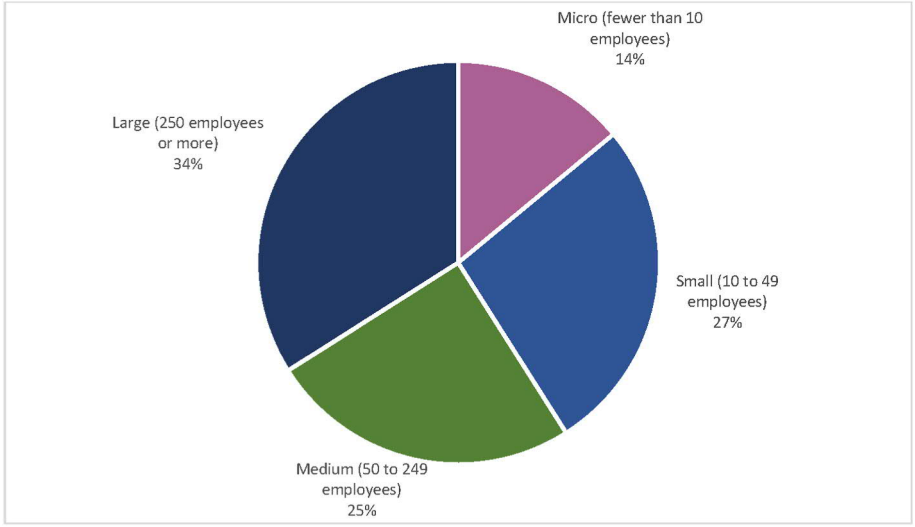

Fig. 2. Size of organizations participating in the survey.

Table 2
Identified generic skills as necessary to foster green innovation.

Priority level	Generic skills
1	Ethical and sustainable thinking
2	Spotting opportunities
3	Creativity
4	Vision
5	Collaboration
6	Growth mindset
7	Valuing ideas
8	Mobilizing others
9	Working with others
10	Protecting the environment
11	Taking the initiative
12	Learning through experience
13	Flexibility
14	Critical thinking
15	Entrepreneurship competence

education and practical training) to promote green innovation by upskilling and reskilling the potential workforces in the specific region.

4. Results analysis

Based on the study findings, this study proposes a framework to foster green innovation, which is depicted in Fig. 3. From Fig. 3, it is noticed that there are several enabling factors to support adopting green innovation in organizations. For instance, to initiate green innovation identification of both technical and generic skills is mandatorily followed by maintaining a sustainable eco-system concerning three pillars such as economic, social, and environmental perspectives. In addition, proper education and training are necessary through higher educational institutions (HEI), lower and higher VET, and companies to upskill and reskill the required workforces to promote green innovation. Moreover, up-to-date technology and favorable policymaking are crucial elements in motivating and maintaining sustainable industries for green initiatives. Nevertheless, it is not only a matter for organizations and businesses to be greener and cleaner but it is also beneficial to respect our costly environment.

The study results were analyzed concerning the identified research objectives. From this study, the first research objective to identify the essential technical and generic skills gaps to promote green innovation are collected, which are highlighted in Fig. 4 and Fig. 5 respectively. It can be observed from Fig. 4 that out of fifteen identified technical skills/occupations, the three highest-ranked skills are "Smart/advanced digital solutions" (score 4.86), "Sustainable products and services designer" (score 4.84), and "Green innovation expert" (score 4.80) respectively. Moreover, the lowest-ranked three technical skills are also seen as "Sustainable monitoring" (score 3.66), "Waste management expert" (score 3.79), and "Process automation for waste management" (score 3.87) respectively.

Similarly, Fig. 5 depict the top three generic skills scores out of identified most important fifteen skills as chosen by the interview respondents for green innovation, which are "Collaboration" (score 5.21), "Spotting opportunities" (score 5.09), and "Working with others" (score 5.03). Moreover, the least needed three generic skills for green innovation are also identified as "Mobilizing resources" (score 4.37), "Protecting the environment" (score 4.71), and "Flexibility" (score 4.71) respectively.

This study addresses the second research objective by proposing a CoVE in the Vaasa region that supports fulfilling the necessary skills gaps to foster green innovation. This centre will help to promote required skills gaps in the region by providing necessary education and training. Table 3 and Table 4 highlight how both technical and generic skills/occupations can be achieved through CoVE in Vaasa region according to the participants in the questionnaires survey respectively. The rows and columns of Table 3 represent the identified seven ways of addressing the technical skills by the proposed CoVE and each of the fifteen identified technical skills/occupations respectively. The color-codes used in both Tables 3 and 4 represent the suggested methods to address the technical and generic skills of the CoVE respectively. The dark green color in both Tables 3 and 4 means that the proposed method to address the specific skill/occupation is the highest-voted by the respondents, while light green color is the second most-voted, dark red color is the least-voted, and pink color is the second least-voted. For instance, from Table 3, it is seen that the first and second ways for addressing technical skills/occupations by the CoVE such as "Extending the existing educational program (s) with new contents", and "Creating a new educational program that will lead to the formal qualification (Policy measures for educational improvements)" to promote first and second technical skills/occupations such as "Green innovations" and "Designing and developing sustainable products and services" are supported by the 35.37% and 16.87% of interview participants respectively.

In a similar manner to Table 3, Table 4 displays the identified generic skills based on interview respondents. As an example, it is seen from Table 4 that the first and second ways for addressing technical skills/occupations by the CoVE such as "Extending the existing educational program (s) with new contents", and "Creating new educational programme that will lead to the formal qualification (Policy measures for educational improvements)" to promote first and second generic skills such as "Ethical and sustainable thinking" and "spotting opportunities" are supported by the 43.59% and 5.06% of interview participants respectively u.

The third study objective was addressed by investigating the potential benefits of the proposed CoVE. Based on the respondents from the questionnaires survey, all the prospective benefits from the CoVE are

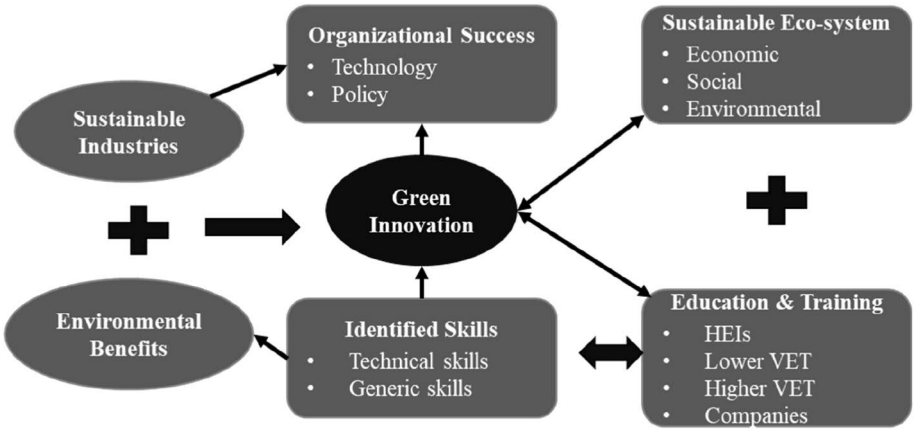

Fig. 3. Proposed framework for green innovation.

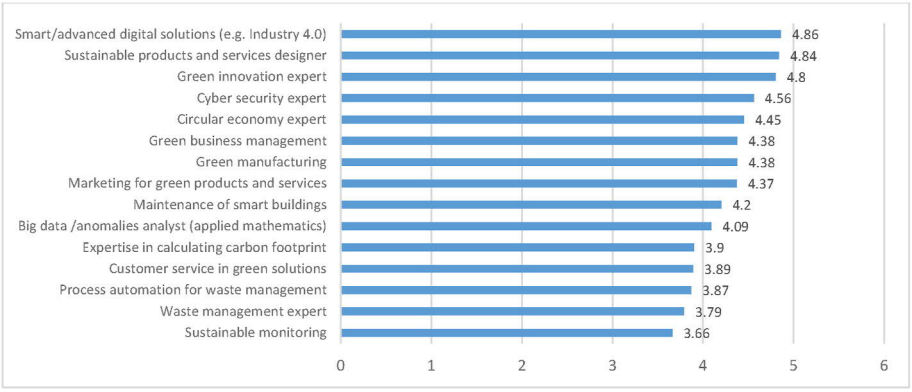

Fig. 4. Identified technical skills/occupations relevant to green innovation, ranked from highest to lowest. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

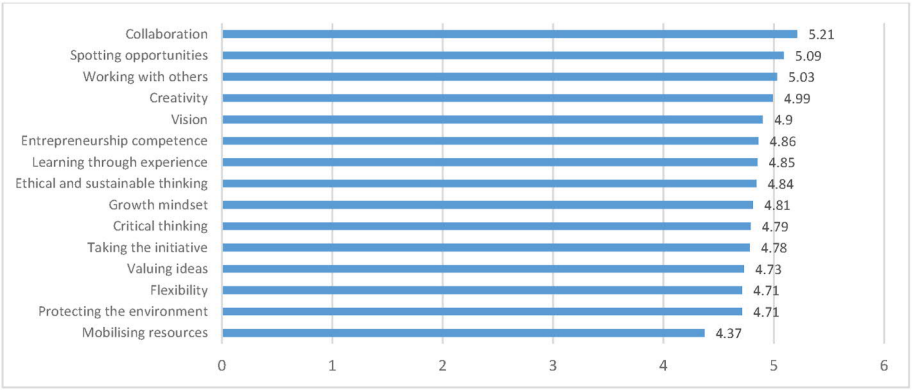

Fig. 5. Identified generic skills scores relevant to green innovation, ranked from highest to lowest. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

Table 3
Heatmap: Ways for addressing each technical skill/occupation by the CoVE.

Technical occupations / Ways for addresing by the CoVE	Green innovations	Designing and developing sustainable products and services	Smart/advanced digital solutions (e.g. Industry 4.0)	Calculating carbon footprint	Process automation in for waste management	Sustainable monitoring	Circular economy	Customer service in green solutions	Cyber security	Big data /anomalies analyst (applied mathematics)	Waste management	Maintenance of smart buildings	Green manufacturing	Green business management	Marketing for green products and services
1. Extending the existing educational programme(s) with new contents (Policy measures for educational improvements)	35.37%	37.35%	38.10%	40.79%	35.90%	37.50%	38.96%	28.57%	49.35%	38.16%	31.43%	34.62%	34.67%	28.21%	33.33%
2. Creating new educational programme that will lead to the formal qualification (Policy measures for educational improvements)	6.10%	16.87%	11.90%	3.95%	2.56%	4.69%	6.49%	4.29%	15.58%	26.32%	1.43%	11.54%	8.00%	12.82%	6.41%
3. Creating new training course that will lead to the informal/non-formal qualification (Policy measures for educational improvements)	3.66%	6.02%	4.76%	3.95%	1.28%	10.94%	1.30%	7.14%	7.79%	11.84%	4.29%	6.41%	2.67%	14.10%	7.69%
4. Capacity building/ in-house training not leading to a qualification	15.85%	10.84%	15.48%	18.42%	24.36%	15.63%	14.29%	27.14%	10.39%	2.63%	20.00%	11.54%	13.33%	11.54%	19.23%
5. Capacity buildings/Trainings for VET (Vocational Education and Training) providers (teachers, trainers, educators ...)	13.41%	8.43%	8.33%	21.05%	10.26%	9.38%	16.88%	11.43%	9.09%	6.58%	15.71%	10.26%	14.67%	6.41%	7.69%
6. Projects (Internships/ student projects) between VET providers and national companies that practice the missing technical skill (learning	12.20%	7.23%	9.52%	5.26%	11.54%	7.81%	11.69%	10.00%	2.60%	7.89%	15.71%	11.54%	6.67%	14.10%	12.82%
7. Projects (Internships/ student projects) between VET providers and international companies that practice the missing technical	13.41%	12.05%	11.90%	5.26%	14.10%	14.06%	10.39%	11.43%	5.19%	6.58%	10.00%	12.82%	20.00%	11.54%	12.82%
8. Other	0.00%	1.20%	0.00%	1.32%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.43%	1.28%	0.00%	1.28%	0.00%

accumulated according to their priority levels as seen in Fig. 6. It is seen from Fig. 6 that "Cooperation with industry" is considered the highest benefit from the CoVE with the score of 19.94%, while "Trainings" is the second highest benefit from the CoVE with the score of 17.98% and so on. From Fig. 6, it is also noticed that the r, respondents would not be very much interested in the CoVE offerings on "Job vacancies announcements" a scoring of 4.21%, "Preselection of potential employees (VET trainees)" a scoring of 8.15%, and "Support for project applications

Table 4
Heatmap: Ways for addressing each generic skill by the CoVE.

Ways for addresing by the CoVE \ Generic skills	Ethical and sustainable thinking	Spotting opportunities	Creativity	Vision	Collaboration	Growth mindset	Valuing ideas	Mobilising resources	Working with others	Protecting the environment	Taking the initiative	Learning through experience	Flexibility	Critical thinking	Entrepreneurship competence
1. Extending the existing educational programme(s) with new contents (Policy measures for educational improvements)	43.59%	26.58%	26.92%	17.33%	16.67%	28.17%	28.00%	18.84%	21.25%	48.00%	27.14%	13.16%	22.86%	34.67%	33.77%
2. Creating new educational programme that will lead to the formal qualification (Policy measures for educational improvements)	3.85%	5.06%	7.69%	2.67%	2.56%	5.63%	4.00%	4.35%	2.50%	4.00%	1.43%	1.32%	1.43%	2.67%	5.19%
3. Creating new training course that will lead to the informal/non-formal qualification (Policy measures for educational improvements)	5.13%	5.06%	3.85%	8.00%	1.28%	4.23%	6.67%	5.80%	3.75%	6.67%	2.86%	1.32%	0.00%	4.00%	9.09%
4. Capacity building/ in-house training not leading to a qualification	23.08%	22.78%	16.67%	28.00%	25.64%	26.76%	21.33%	31.88%	23.75%	16.00%	20.00%	28.95%	27.14%	20.00%	18.18%
5. Capacity buildings/Trainings for VET (Vocational Education and Training) providers (teachers, trainers, educators ...)	10.26%	13.92%	8.97%	8.00%	6.41%	12.68%	16.00%	10.14%	6.25%	12.00%	17.14%	9.21%	12.86%	12.00%	7.79%
6. Projects (Internships/ student projects) between VET providers and national companies that practice the missing technical skill (learning	2.56%	10.13%	20.51%	16.00%	21.79%	7.04%	10.67%	5.80%	22.50%	5.33%	17.14%	19.74%	18.57%	9.33%	14.29%
7. Projects (Internships/ student projects) between VET providers and international companies that practice the missing technical	7.69%	11.39%	8.97%	12.00%	20.51%	8.45%	10.67%	11.59%	15.00%	4.00%	8.57%	21.05%	11.43%	10.67%	7.79%
8. Other	3.85%	5.06%	6.41%	8.00%	5.13%	7.04%	2.67%	11.59%	5.00%	4.00%	5.71%	5.26%	5.71%	6.67%	3.90%

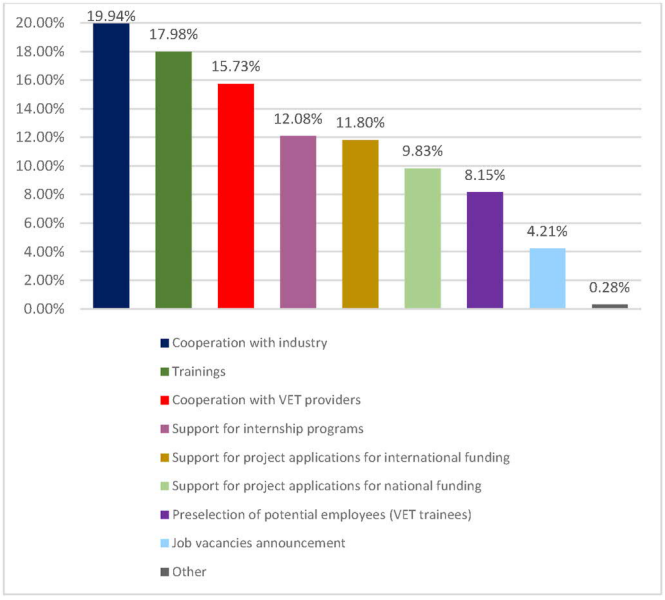

Fig. 6. Potential benefit of the CoVE services, ranked from highest to lowest.

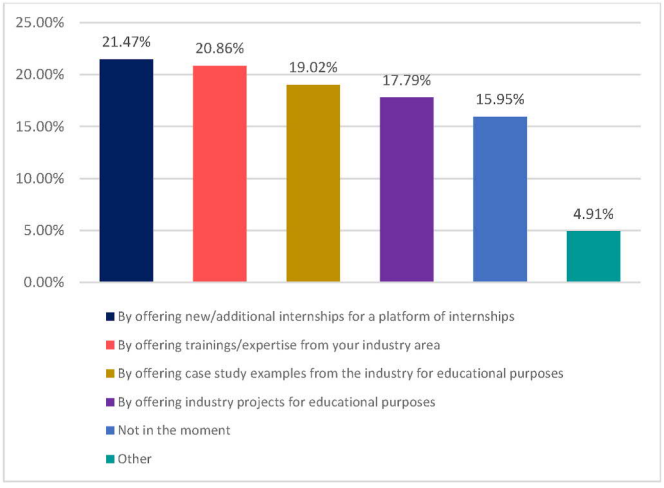

Fig. 7. Different ways of potential support for the CoVE, ranked from highest to lowest.

for national funding" a scoring of 9.83%.

In addition, to know the potential benefits of the proposed CoVE, the respondents were also asked how various stakeholders in the region will provide necessary support to execute various functionality in the CoVE. The responses from the participants are accommodated in Fig. 7 accordingly. From Fig. 7, it is seen that regional stakeholders are most interested in supporting the CoVE "By offering new/additional internships for a platform of internships" with a score of 21.47%, while other supports are provided as "By offering trainings/expertise from your own industry area" with a score of 20.86%, "By offering case study examples from the industry for educational purposes with a score 19.02%, and so on.

There are several studies have been conducted in Europe to foster green innovation in general but very limited research has been done to identify necessary skills gaps. For instance, Kelliher and Reinl (2015) presented the study results from Green innovation and future technologies (GIFT) project initiated by EU INTERREG project aiming at up-skilling SME businesses to foster a sustainable green economy. Cecere and Mazzanti (2017) studied the green skills, competences and jobs in European SMEs with respect to reconcile sustainability and development of firms as a reaction from the markets and the policy-makers. Harrington et al. (2016) studied green innovation with respect to adopting capacity building and learning network within SMEs. Giorgio and Patricia (2019) studied the skills shortages and skill mismatch to corporate investment in Europe. They identified that the skills gaps and mismatches come at economic and social cost. Based on the stated studies in European level, it is seen that the presented study will be an added value to identify and fulfil the required skills gaps to foster green innovation in Europe.

5. Theoretical and practical implications

This study highlights several useful pieces of information concerning the managerial perspective to adopt a green innovation strategy in an organization. This perspective can be discussed based on the three

identified research questions. To address the first research question, it is noticed that in adopting green practices whether it is an industry or an organizational establishment, first of all, there is a necessity to identify the required skills. This study is taken a methodological approach to identify the skills gaps to adopt a green innovation strategy in the Vaasa region, Finland, which can be generalized in other parts of the world. The methodological approach might be varying from one region to another or one country to another but the basic principle might be the same. Based on the presented study, the top most critical fifteen technical and fifteen generic skills required to foster innovation are identified. These skills requirements might vary from one region to region and one country to another based on the region's or country's needs.

The second research question was addressed based on the theoretical contribution of VET institutions to promote green innovation in a country or a region. It is purposefully studied with many examples, which were mainly based on the previous study on how VET institutions contribute to ensuring environmental sustainability through supporting green innovation practices. Additionally, the perspectives of green innovation from VETs' point of view are also elaborated by the interview participants. The respondents, who participated in the questionnaire survey expressed their opinions and offered valuable guidelines, and ranked them intending to suggest how regional VET providers can substantially cooperate and coordinate along with other stakeholders to foster green innovation in general.

To address the third and final research question, this study proposed the overall framework of the CoVE and its need to promote green innovation. Based on the questionnaire survey, the respondents highlighted the potential benefits of CoVE, which will be useful to provide the required education and training to upskill and reskill the workforce towards green innovation practices. Moreover, the benefits from the CoVE were also ranked based on the opinions of the respondents, which were very much useful for necessary planning activities to achieve those potential benefits.

Moreover, there are other insights from this study that can be discussed concerning managerial perspectives. It is noticed from this study that in addition to HEIs and VETs providers, there needs to be integrated with other social forces to promote green innovation such as industrial sectors, business sectors, government and non-government organizations, etc. Moreover, it is also critical and necessary to change the mindset of local inhabitants or citizens through various dissemination activities to promote green awareness and green culture within social segments through seminars, symposiums, workshops, etc. Furthermore, there needs to take different initiatives to motivate and build environmental awareness among the citizens and also make them concerned about the detrimental effect of environmental degradation that affects global sustainability.

6. Conclusions

To promote green innovation, it is essential to understand the nature of skills gaps. Identification of such skills gaps helps organizations to be green with all of their everyday activities. To fulfil such skills gaps, there needs to be a proper education and training environment, from which it is possible to deliver a workforce with a higher skills-set. This kind of learning environment can be fostered though HEIs and VET institutions. The functionality of a VET institution is to develop a skilled workforce as necessary to run an organization successfully. This form of institution both in higher VET and lower VET needs to be equipped with resourceful faculties to ensure the supply of a skilled workforce.

In today's needs, it is essential to set up a center of excellence (CoVE) that support reforming VET institutions. This CoVE platform can contribute to fulfilling current and future high-quality skills gaps for industries and fostering green innovation eco-systems. It also boosts the status of VET institutions by acting as a hub to introduce green and digital innovations. This platform entails new roles and missions for VET establishments that lead to introducing entrepreneurial and other key competencies for lifelong learning. Through the CoVE, VET institutions and networks should be able to design and deliver new curricula, which can enable VET providers to become more attractive, responsive, inclusive, and relevant (Arribas, 2020). To foster successful CoVE, it is necessary to conceptualize the partnerships between the VET providers, industries, governments, and other stakeholders. Such collaboration contributes to fostering the usage of required knowledge and skills as required for sustainable economic development and promoting the "greening" of skills.

This study contributes to identifying the current skills gaps and the necessary skills to promote green innovation in the Vaasa region, Finland, which is also a part of a European GREENOVET project. The study outcomes are elaborated within the scope of this article. From this study, 15 technical skills and 15 general skills are identified, which are essential to enable green innovation to protect the costly environment in the organization. These identified skills can be verified from region to region and country to country, which is dependent on the region's or country's target to ensure green innovation. After identifying the skill set, the CoVE can be able to design and develop the necessary educational program consisting of various courses and training. This CoVE can contribute to fostering green innovation by providing a set of proper education and training programs.

To conduct this study, there were several limitations which needs to addressed in the future studies. For instance, the sample was limited which can be extended to get a better generalized outcome. In addition, the study was confined in a specific region, which can be widen to several regions of a country to get a generalized view of the status of green innovation in a country. Moreover, the study was limited to specific institutions/organizations in the Vaasa region, which can be explored to other institutions/organizations to get better picture of green innovation in the region. All such limitations can be considered for further study on identifying skills gaps in promoting green innovation.

It is believed that the conducted study will contribute to identifying skills required for green innovation in any region or country globally. The stated methodology will contribute to guiding necessary procedural steps to conduct similar studies for the betterment of environmental protection. In the future, this study will be used to develop a framework to establish a CoVE that promotes green and sustainable innovation.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.cesys.2022.100100.

Appendix 1: Questionnaires used for the interview survey

1) How the cooperation among HEI (Higher Education Institute), VET and companies can be foster effectively and efficiently?
2) How do you think to initiate green innovation mindset among HEI, VET and companies?
3) What are your recommendations to motivate companies for green innovation?

4) What are your opinions to make the regional CoVE sustainable?
5) How do we increase visibility and attractiveness of VET among potential students and staff in the region?
6) What are the new skills companies' needs from HEI and VET providers?
7) How do you foster employment for students in the region?
8) What are your expectations from the GREENOVET project?
9) How can you contribute to make the GREENOVET project successful?
10) What are your specific recommendations for the regional development?

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